
MARROW ED8

Orthopaedics

Comprehensive Question Bank

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Basics of fracture and its management

Question 1:

Which of the following is a pathognomonic sign of a long bone fracture?

- a) Pain on movement
- b) Swelling
- c) Deformity
- d) Abnormal mobility

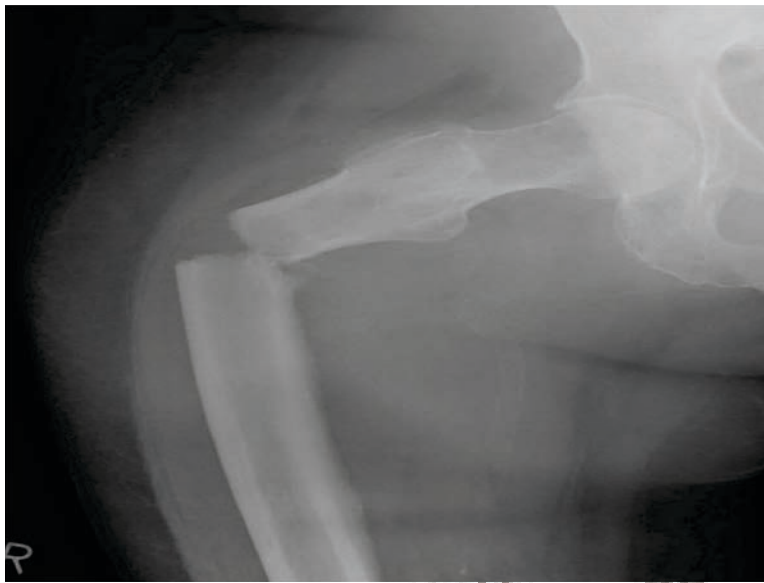
Question 2:

Match the following type of fractures with their associated mechanism of force.

- a) 1-a, 2-d, 3-c, 4-b
- b) 1-c, 2-a, 3-d, 4-b
- c) 1-b, 2-c, 3-a, 4-d
- d) 1-b, 2-a, 3-d, 4-c

Question 3:

An elderly woman was brought to the OPD after she slipped and fell from her chair. She is a known case of breast cancer with distant metastasis. The X-ray of the patient is given below. Which of the following statements is false regarding this type of fracture?



- a) It occurs in abnormal bones
- b) Mirels' score is used to assess the risk of fracture
- c) FDG-PET or CT is the gold standard in evaluating bony metastasis
- d) Pain occurs only after the fracture

Question 4:

All of the following conditions can cause a pathological fracture, except:

- a) Gaucher's disease
- b) Osteogenesis imperfecta
- c) Hyperparathyroidism
- d) Fabry's disease

Question 5:

You are working as a medical officer in the Indian army. An army recruit presents to you with complaints of pain in the right foot. He joined his training 6 months back. His X-ray is given below. What is the most likely diagnosis?



- a) Pathological fracture
- b) March fracture
- c) Runner's fracture
- d) Green stick fracture

Question 6:

In which of the following conditions does the bone heal by increased callus formation?

- a) Necrosis of bone ends
- b) Rigid fracture fixation
- c) Compression plating
- d) Flexible fracture fixation

Question 7:

A teenager is brought to the casualty after sustaining a wrist injury during a sports meet. His X-ray is given below. The orthopedic surgeon tries to reduce the fracture fragments by using traction on soft tissues around the bones. What is this technique known as?



- a) Callotaxis
- b) Ligamentotaxis
- c) Distraction osteogenesis
- d) Arthrodesis

Question 8:

Hanging cast is used to treat which of the following?

- a) Olecranon fracture
- b) Malgaigne's fracture
- c) Humerus shaft fracture
- d) Colle's fracture

Question 9:

A cast was applied to a patient with a wrist injury as shown below. What is this cast known as?



- a) Colles cast
- b) Scaphoid cast
- c) Bachelor cast
- d) Turn-buckle cast

Question 10:

Which of the following statements are true about open fractures?

- a) 1 and 2
- b) 1 and 4
- c) 2 and 4
- d) 2 and 3

Question 11:

A 40-year-old man presents with a fracture of the right tibia following an RTA. On examination, the wound is highly contaminated and appears as shown below. His distal pulses are felt well. According to the Gustilo-Anderson classification, this injury would be classified as type:



- a) II
- b) IIIA
- c) IIIB
- d) IIIC

Question 12:

You are the intern on duty and you receive patients who have been in a road traffic accident. For which of the following patients will you urgently call the orthopaedic resident on call?

- a) Patient with recurrent shoulder dislocation
- b) Patient with a fractured arm with capillary refill time of less than 3 seconds in his fingers
- c) Patient with a fractures arm with a 10 cm long incision over the arm
- d) Patient with a fractured arm with capillary refill time of 5 seconds in his fingers

Question 13:

An industrial worker was rushed to casualty after he accidentally got his leg stuck in a machine. On examination, he was found to have an open fracture as shown below. He was urgently taken up for wound debridement and was considered for primary closure. It can be performed in all of the following conditions, except:



- a) If injury to debridement interval \leq 12 hours
- b) Capillary refilling time of 2 seconds
- c) Impaired nerve supply
- d) Wound margin can be closed without tension

Question 14:

In which of the following fractures is surgical management necessary for optimum functional results?

- a) Clavicle fracture
- b) Distal radius fracture
- c) Fibula fracture
- d) Monteggia fracture

Question 15:

All of the following are common indications for the procedure shown below, except:



- a) Burns over the fracture site
- b) Type 1 open fracture
- c) Type 3 open fracture
- d) Limb lengthening

Question 16:

A 25-year-old patient underwent external fixation after sustaining a femur fracture. On follow-up, he was noted to have developed a pin-tract infection. He did not respond to antibiotics. On performing radiograph, what kind of sequestrum are you most likely to see in this patient?

- a) Button-hole sequestrum
- b) Black
- c) Tubular
- d) Ring

Question 17:

A 20-year-old patient presents to the OPD with complaints of limping. He gives a history of fracture a few months back. On examination, his left leg is shorter than his right leg. He undergoes the following procedure. Identify the incorrect statement regarding this procedure.



- a) Distraction is done at a rate of 1 mm per day.
- b) It is based on the principle of callotaxis.
- c) It is contraindicated in the presence of osteomyelitis.
- d) It is used to perform arthrodesis.

Question 18:

A patient undergoes bone grafting after losing a bone segment due to an open fracture. Which of the following is the best material that can be used to fill the defect?

- a) Freeze dried allograft
- b) rhBMP-7
- c) Calcium phosphate
- d) Autologous bone graft

Question 19:

A polytrauma patient with femur fracture and massive hemorrhage presents to the emergency department after a road traffic accident. Which of the following is not an immediate treatment consideration in this patient?

- a) Administration of IV crystalloids
- b) Administration of tranexamic acid
- c) Check coagulation with thromboelastography

d) Internal fixation of femur fracture

Answer Key

Question No.	Correct Option
1	d
2	b
3	d
4	d
5	b
6	d
7	b
8	c
9	b
10	b
11	c
12	d
13	c
14	d
15	b
16	d
17	c
18	d
19	d

Detailed Explanations

Solution to Question 1:

Abnormal mobility in a long bone is a pathognomonic sign of fracture.

A fracture is a break in the structural continuity of the bone. Generally, movements occur in the limb only at the joints. If one is able to elicit mobility at locations other than the joints (say in the middle of the arm), it is a definite sign of a fracture. Crepitus may be felt while doing this. Other features of a fracture include:

- Pain

- Bruising
- Swelling
- Deformity

These can be due to a soft-tissue injury or dislocation as well.

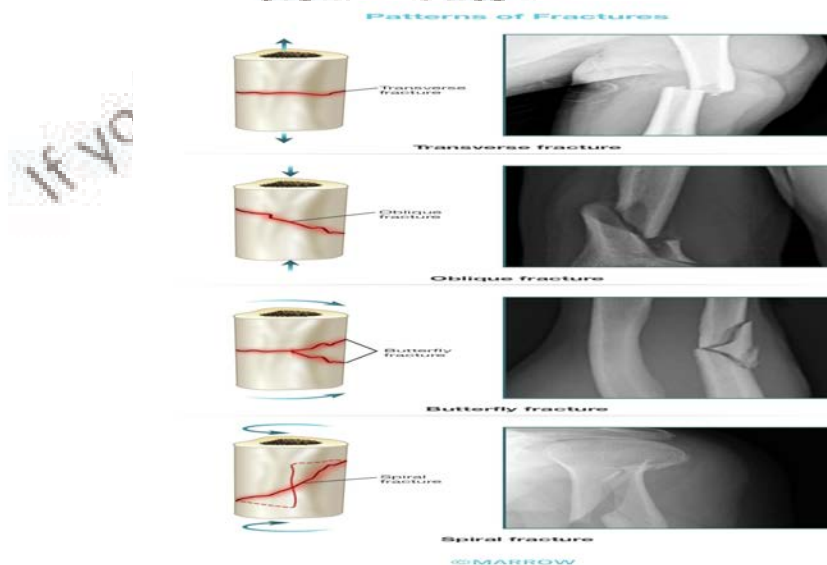
Clinically, eliciting abnormal movement or crepitus inflicts more pain. Hence it is no longer recommended.

Solution to Question 2:

The correct match is:

Most fractures occur due to a combination of forces, but the dominant mechanism of force is revealed by the type of fracture.

Type of fracture	Mechanism of force
Transverse fracture	Tension
Oblique fracture	Compression
Butterfly fragment	Bending
Spiral fracture	Twisting



Based on the continuity of the periosteum, fractures can be complete or incomplete.

In complete fractures, the bone is split into two or more fragments and continuity of periosteum is disrupted. It can be:

- Impacted fracture - The fracture fragments are jammed together and the fracture line is not visible
- Comminuted fracture - There is a fracture of more than two fragments
- Segmental fracture - A separated fragment is seen in the middle
- Avulsion fracture - Breaking of a piece of bone attached to a strong muscle. e.g. olecranon and patella fracture

In incomplete fractures, the bone is incompletely split and the periosteum remains in continuity. They include:

- Greenstick fractures: The outer cortex breaks and the inner cortex bends causing the bone to buckle like the snapping of a green twig. It is seen in the pediatric population.
- Compression fractures: Cancellous bone crumple due to force. This is typically seen in vertebral bodies, calcaneum, and the tibial plateau.

Solution to Question 3:

The given clinical scenario with a history of trivial trauma, breast cancer, and the X-ray findings are suggestive of a pathological fracture due to bone metastasis. Pain in the case of a pathological fracture usually precedes the fracture.

Fractures occur due to:

- Trauma
- Repetitive stress (stress or fatigue fracture)
- Abnormal weakening of the bone (pathological fracture)

Pathological fractures are fractures that occur in a weakened bone that has structurally changed due to some condition. They occur either spontaneously or due to minor trauma. The features suggestive of a pathological fracture include:

- Pain at the site before the fracture
- Multiple recent fractures
- Elderly patient
- History of primary malignancy
- Unusual fracture pattern (Banana fracture - transverse fracture through an abnormal area of bone, similar to breaking a segment from a banana)

Pathological fracture
(Banana fracture pattern)



FDG-PET or CT is the gold standard in evaluating bony metastases. The risk of fracture in metastatic bone lesions is assessed using Mirels' score.

A Mirels's score ≥ 8 warrants a prophylactic fixation. Management of pathological fracture is based on the causative lesion and survival of the patient.

Mirel's criteria			
Score	1	2	3
Site	Upper limb	Lower limb	Peri-trochanteric
Pain	Mild	Moderate	Functional
Lesion	Blastic	Mixed	Lytic
Size	$<1/3$	$1/3$ to $2/3$	$>2/3$

Solution to Question 4:

Fabry's disease does not cause pathological fractures. It presents with angiokeratomas and acroparasthesias.

Pathological fractures are fractures that occur in a weakened bone that has structurally changed due to some condition. They occur either spontaneously or due to minor trauma.

In Gaucher's disease, there is a deficiency of glucocerebrosidase. This leads to an accumulation of lipid-laden macrophages in the bone tissue, weakening the bone and causing fractures.

Osteogenesis imperfecta is an autosomal dominant disorder that occurs most commonly due to mutation in the COL1A and COL2A genes. This results in the abnormal formation of type 1 collagen. Since type 1 collagen is mainly present in the bone, the patient presents with repeated

fractures with no or minimal trauma.

Hyperparathyroidism can cause severe bone resorption leading to bone pains and pathological fracture.

Overall, osteoporosis is the most common reason for pathological fractures. Below the age of 20, the common causes of pathological fracture are benign bone tumors and cysts.

Solution to Question 5:

The given clinical scenario and the X-ray showing a fracture of the 2nd metatarsal are suggestive of a March fracture. It is a type of stress fracture.

Stress fractures (or fatigue fractures) occur in a normal bone that is subjected to chronic repetitive stress. This initiates a bone remodeling process. When resorption occurs faster than replacement, the bone becomes liable to fracture. Such fractures are typically seen in athletes, dancers, or military personnel who have a strenuous exercise regimen.

Common sites for stress fractures include:

- Metatarsals (especially the second, march fracture)
- Calcaneum
- Navicular
- Distal shaft of the fibula (runner's fracture)
- Tibial shaft
- Patella
- Femoral neck

MRI is the investigation of choice to diagnose stress fractures. It can visualize lower-grade stress injuries before X-ray changes appear. A bone scan is the investigation of choice when multiple sites have stress fractures.

Most stress fractures are managed using an elastic bandage and avoidance of painful activity until the lesion heals. Stress fracture of the femoral neck should be managed by internal fixation as a prophylactic measure.

The image below shows a stress fracture:



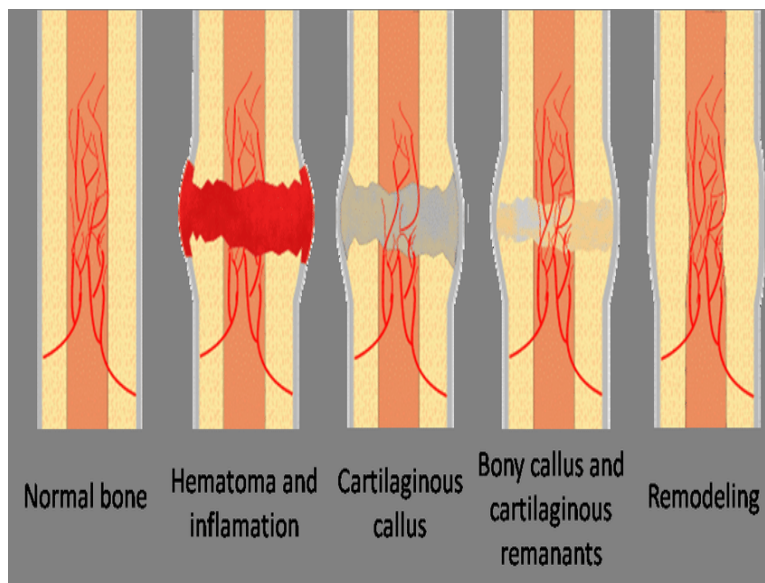
Solution to Question 6:

Increased callus formation is seen with flexibly fixed fractures.

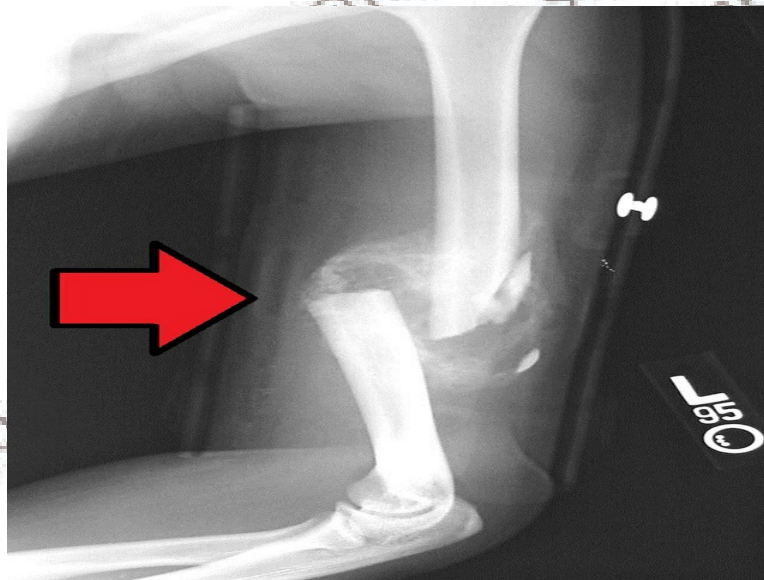
Fracture heals through direct union (primary bone healing) or callus formation (secondary bone healing).

- Direct union: This occurs when the fracture site is absolutely stable. This is seen in a fracture held by a metal plate with absolute stability and in cases of impacted fracture in cancellous bones. There is no stimulus for callus formation. Osteoblastic new bone formation occurs directly between the fracture fragments.
- Callus formation: This occurs when the fracture is not fixed rigidly. The healing proceeds through 5 stages:
 - Hematoma formation
 - Inflammation
 - Soft callus formation
 - Hard callus formation
 - Remodeling

Healing by callus ensures mechanical strength as the movement and stress make the callus grow stronger.



The image below shows callus formation:



Solution to Question 7:

The technique which uses traction on the soft tissue around the bones to reduce the fracture fragments is known as ligamentotaxis. The given X-ray shows a fracture of the radial styloid process (Chauffeur's fracture or Hutchinson fracture).

Reduction of the fracture is done to ensure normal alignment and adequate apposition of the bone fragments. There are two methods of reduction:

- **Closed reduction:** The fracture is reduced under appropriate anesthesia and muscle relaxation. Closed reduction of fracture relies on indirect fragment alignment utilizing the pull of the soft tissue envelope (ligaments and capsules), which is known as ligamentotaxis.

- Open reduction: Operative reduction of the fracture under direct vision.

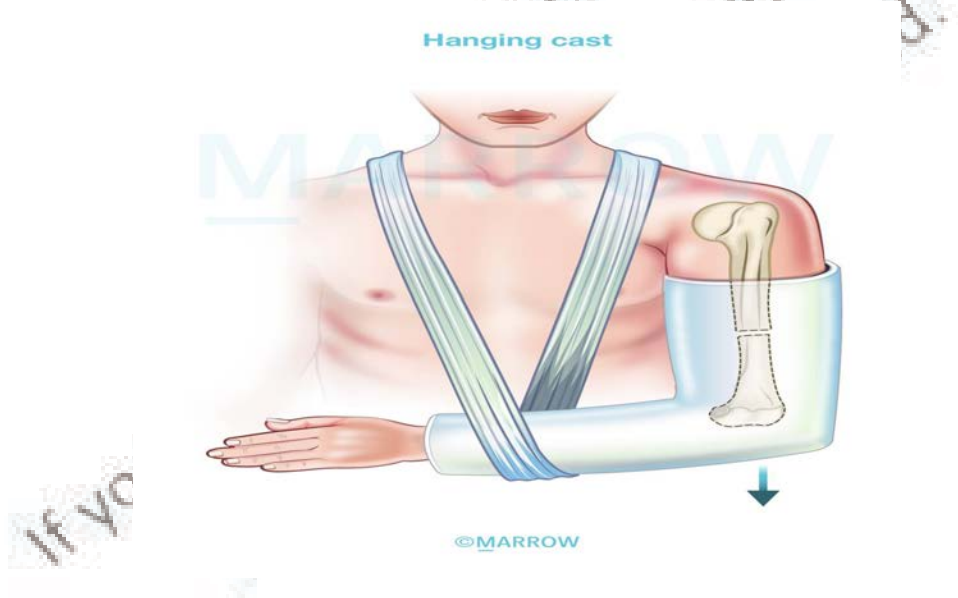
Option A and C: Callotaxis is callus distraction or distraction osteogenesis. It is used for limb lengthening or filling of large segmental defects in the bone.

Option D: Arthrodesis (artificial ankylosis or syndesis) is the artificial induction of joint ossification between two bones by surgery.

Solution to Question 8:

A hanging cast is used to treat the fractured shaft of the humerus.

Humerus shaft fracture heals readily with just the external cast as it is usually enough to bring the fragments into alignment. The arm is placed over the lower chest with the elbow at 90°. A collar and cuff support can be used to maintain the position. The weight of the arm provides continuous traction to the humerus (traction by gravity).



After the fracture is reduced, it is important to hold the reduction with some restriction of movements to promote soft-tissue healing and to allow free movement of the unaffected parts. The methods of holding reduction include:

- Continuous traction (traction by gravity, skin traction, or skeletal traction)
- Cast splintage
- Functional bracing
- Internal fixation
- External fixation

Solution to Question 9:

The cast applied to a patient in the glass holding position is known as the scaphoid cast. It is used to treat scaphoid fractures.

To apply a scaphoid cast, the wrist is held in slight dorsiflexion and the thumb is in abduction and slight flexion as if the glass is being held between the index finger and thumb. It extends from just below the elbow to just proximal to the metacarpal necks of the digits. On the thumb, the cast extends just proximal to the interphalangeal joint.

Scaphoid fracture presents with pain and swelling over the radial aspect of the wrist. A fall on an outstretched hand could result in such a fracture. The fracture can be confirmed (when an x-ray does not show a fracture) if there is pain elicited in the anatomical snuff box on the radial border of the wrist.

An oblique x-ray of the wrist should be able to show a scaphoid fracture.

Solution to Question 10:

Open fractures are usually associated with multiple other injuries and compartment syndrome can occur as a complication of open fractures.

Open fractures are characterized by a break in the overlying skin and soft tissues. Hence, the fracture fragment is exposed to the external environment. It is usually associated with multiple other injuries.

The most common sites involved in open fractures include

- Phalanges (Fingers and toes)
- Tibial diaphysis
- Distal radius
- Ankle

Open fractures are more prone to develop an infection, as it's exposed to the external environment. The presence of an open fracture does not prevent the development of compartment syndrome.

Major components of management of all open fractures are:

- Antibiotic prophylaxis - It should be given as early as possible
- Early debridement of the wound and fracture - This includes the following steps:
 - Excision of the wound margins
 - Extension of the wound if required
 - Delivery of the fracture outside the wound for proper examination
 - Removal of the devitalized tissue
 - Cleansing of the wound to remove all the foreign materials
- Nerves and tendons are usually left alone, but if the wound is clean, a repair can be considered
- Wound cover:

- In Gustilo Type I and II fractures wound cover can be done at the time of debridement (Early wound cover)
- Delayed wound cover is usually practiced in Type III fractures
- Fracture stabilization - The method of stabilization depends on the degree of contamination, amount of soft tissue damage, and time from the injury to operation.
- External fixation is used as a temporary measure if there is a delay in wound cover
- If definitive wound cover can be achieved at the time of debridement and there is no significant contamination, then an open fracture can be managed as same as a closed injury

Solution to Question 11:

This open fracture will be classified as Type IIIB on Gustilo-Anderson's classification due to the extensive wound (>10 cm), high contamination, very severe loss of soft tissue cover, and intact vascularity.

A fracture where the skin and soft tissues are breached is known as an open fracture (or a compound fracture). Gustilo and Anderson's classification is the most commonly followed classification for open fractures.

Open fractures with an arterial injury that requires repair will be classified as IIIC, irrespective of the size of the soft-tissue wound.

Solution to Question 12:

Capillary refill time of more than 3 seconds indicates inadequate limb perfusion. It is a surgical emergency and could be due to either vascular injury by direct trauma or compartment syndrome. Hence an orthopedic intervention will be needed urgently.

All other patients will also need an orthopedic intervention, however, the blood flow should be restored at the earliest.

Solution to Question 13:

When there is impaired nerve supply, primary closure of open fracture is not recommended.

Primary closure of open fracture is the closure of the wound by direct skin suturing during the index procedure (first debridement). In general, primary closure of wounds of Gustilo type I and II fractures can be done at the time of debridement.

In Gustilo type IIIA fractures, some surgeons delay closure until a second-look procedure is performed. In most cases of Gustilo type IIIB and IIIC injuries, a delayed closure is practiced.

Important criteria for primary closure:

- The patient's general condition should be stable

- Injury to debridement interval is < 12 hours
- All necrotic material must have been removed
- Stable fixation can be achieved either by internal or external fixation
- Normal circulation
- Intact nerve supply
- The wound skin margins can be closed without tension
- There should be no multisystem injuries

Solution to Question 14:

Surgical management is necessary for optimum functional results in Monteggia fracture (fracture of the ulnar shaft with concomitant dislocation of the radial head).

While the other listed injuries may necessitate surgery in certain situations, conservative treatment for Monteggia fracture yields poor results.

Fractures in which surgical treatment will be needed to obtain an optimal result include:

- Displaced intraarticular fractures
- Unstable fractures after failed conservative management
- Major avulsion fractures after failed conservative management
- Displaced pathologic fractures
- Fractures in which conservative treatment is known to provide poor functional results, such as femoral neck fractures, Galeazzi fracture-dislocations, and Monteggia fracture-dislocations
- Displaced physal injuries with high-risk for growth arrest (Salter-Harris types III and IV)
- Nonunions, especially malreduced ones, after failed conservative or operative management

Solution to Question 15:

The image shows external fixation using an external fixator. Type 1 open fracture is not a common indication for external fixation.

External fixation is holding the fracture using transfixing screws that pass through the bone above and below the fracture and are connected to each other by rigid bars or an external frame. This provides rigid fixation of the bones in cases where other methods of immobilization are inappropriate.

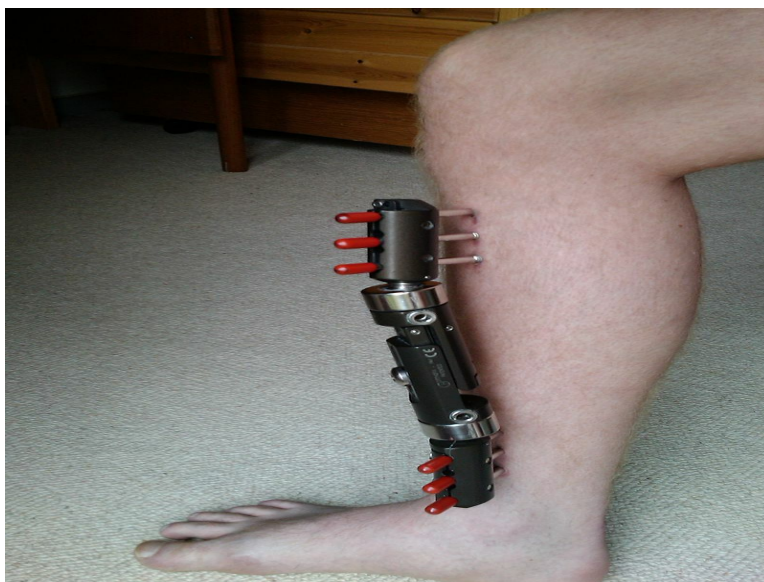
External fixation is especially applicable for the tibia and pelvis. It is also used for fractures of the femur, humerus, and distal radius.

Common indications for external fixation:

- Severe type II and III open fractures

- Fractures associated with severe burns (as burn tissue predisposes to infection and can result in osteomyelitis)
- Fractures requiring grafts
- Fractures requiring distraction
- Limb lengthening (Ilizarov Procedure)
- Arthrodesis
- Infected fractures or nonunions
- Correction of malunions

The image given below shows an external fixator applied to the right tibia:



Solution to Question 16:

The given clinical scenario with a history of external fixation is suggestive of a pin site infection. It appears as a ring sequestrum in an X-ray.

Sequestrum is a fragment of dead bone lying within a cavity formed by necrosis. Various types of sequestra and their causes are given in the following table:

The image below shows a ring sequestrum formed at the site of a pin used in the diaphysis of the tibia:

Type of Sequestrum	Cause
Tubular or diaphyseal sequestrum	Acute pyogenic osteomyelitis
Ring sequestrum	Amputation stump and at Steinmann pins
Ivory sequestrum	Syphilis

Type of Sequestrum	Cause
Fine sandy sequestrum	Viral osteomyelitis
Coarse sandysequestrum	Body of vertebra (cavity oftuberculosis)
Flake or Feathery sequestrum	Tuberculosis of rib (cavity of tuberculosis)
Kissing sequestrum	Peridiscal tuberculosis of vertebra
Button-hole sequestrum	Radiation
Blacksequestrum	Actinomycosis



Solution to Question 17:

The given image shows distraction osteogenesis using the Ilizarov apparatus. Osteomyelitis is not a contraindication for this procedure.

Distraction osteogenesis (distraction histogenesis) is the mechanical induction of new bone that occurs between bony surfaces that are gradually pulled apart. This is described as the tension stress effect.

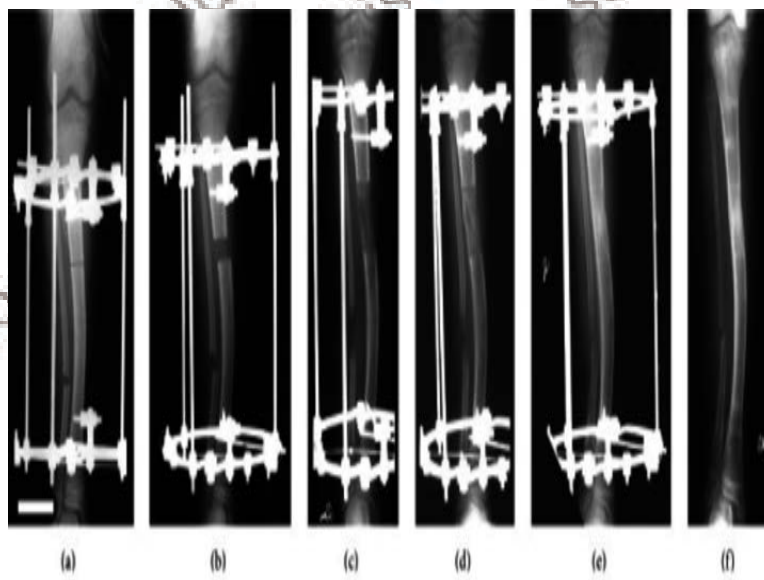
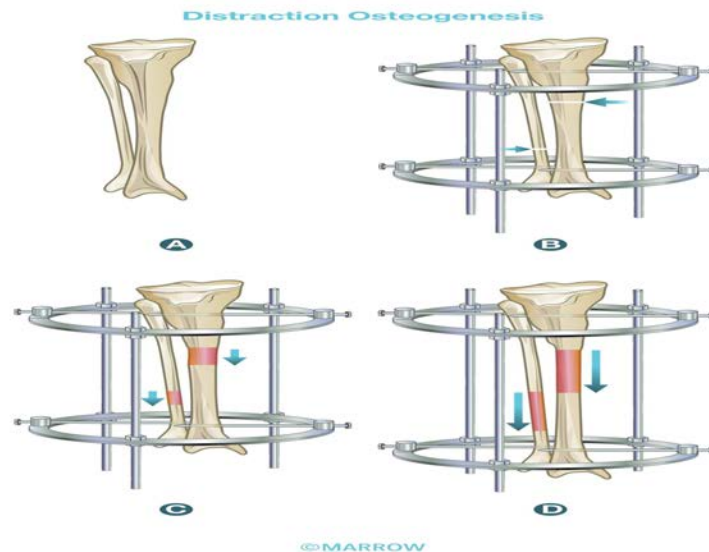
The most important application of the tension-stress principle is known as callus distraction (or callotaxis). A careful fracture of the bone is performed, followed by a short wait. The young callus formed is gradually distracted using a circular or unilateral external fixator. This is used in limb lengthening or for the filling of large segmental defects in the bone.

Distraction or compression is carried out at the rate of 1 mm per day. This is done in four sittings - 0.25 mm, four times a day. It is also used in the following scenarios:

- Non-union
- Deformity correction

- Osteomyelitis - as it offers the possibility of liberal excision of bone
- Arthrodesis - crushing articular surfaces can stimulate union between opposing bones

An illustration of distraction osteogenesis using the Ilizarov apparatus and the radiograph depicts the procedure is given below:



Solution to Question 18:

The autologous bone graft is the gold standard material for filling bone defects.

Bone grafts are used to fill the defects in bones caused due to a fracture or malignancy. Bone grafts work by various methods:

- Osteoinduction is the recruitment and differentiation of pluripotent mesenchymal stem cells into bone-forming osteoprogenitor cells

- Osteoconduction is the creation of the scaffold to support the ingrowth of blood vessels, perivascular tissue, and osteoprogenitor cells
- Osteogenesis is the process of bone formation after the terminal differentiation of osteogenic progenitor cells into mature osteoblasts

Solution to Question 19:

The internal fixation of a femur fracture is not an immediate concern in a patient with polytrauma and hemodynamic instability secondary to severe blood loss. Instead, splinting is preferred until the patient has been stabilized.

Damage Control Orthopaedics (DCO) in unstable/borderline polytrauma patients involves 3 components:

- Stage 1: Resuscitative procedures for rapid hemorrhage control
- Stage 2: Restoration of normal physiologic parameters
- Stage 3: Definitive surgical management

The first stage is early temporary stabilization of unstable fractures and the control of the bleeding. In femur fracture, the most suited approach is temporary stabilization using an external fixator.

The second stage involves resuscitation and stabilization of the patients in the ICU.

Finally, the third stage involves delayed definitive fracture management after the patient's condition becomes suitable. In femur fracture, the definitive procedure is intramedullary nailing which is performed after the patient becomes stable.

Complications of fracture

Question 1:

A 7-year-old boy is brought to casualty following a fall on an outstretched hand. He has swelling and pain on his left elbow. X-ray done is given below. Which of the following vessels is most likely to be injured?



- a) Axillary artery
- b) Radial artery
- c) Brachial artery
- d) Ulnar artery

Question 2:

Which of the following combination of skeletal trauma - nerve injury is wrongly matched?

- a) Wrist injury- Anterior interosseous nerve
- b) Fracture humerus- Radial nerve
- c) Monteggia fracture- Posterior interosseous nerve
- d) Knee dislocation- Common Peroneal nerve

Question 3:

Which is the most common fracture associated with acute compartment syndrome in adult patients?

- a) Femur fracture
- b) Forearm fracture
- c) Tibial shaft fracture
- d) Humerus fracture

Question 4:

The earliest symptom of acute compartment syndrome is _____

- a) Pain
- b) Pallor
- c) Paresthesia
- d) Paralysis

Question 5:

A construction worker got entrapped in a collapsed building. He sustained severe injury over his legs. Which of the following feature is unlikely to be seen?

- a) Metabolic acidosis
- b) Hypokalemia
- c) Acute tubular necrosis
- d) Coagulopathy

Question 6:

Which of the following statements regarding reperfusion injury is false?

- a) It may follow fasciotomy in compartment syndrome
- b) It is only a localised inflammatory response
- c) It can cause muscle damage
- d) It can trigger systemic coagulopathy

Question 7:

A patient came to the casualty after a RTA with fracture of femur. On 3rd day of admission, he developed sudden breathlessness. Which of the following is the most common cause?

- a) Hypovolemic shock
- b) Pulmonary hypertension
- c) Post trauma MI
- d) Fat embolism

Question 8:

Which of the following is the earliest muscle to be involved in Volkmann's ischemic contracture of the forearm?

- a) Flexor digitorum superficialis
- b) Flexor digitorum profundus
- c) Extensor carpi radialis brevis
- d) Flexor Carpi Radialis

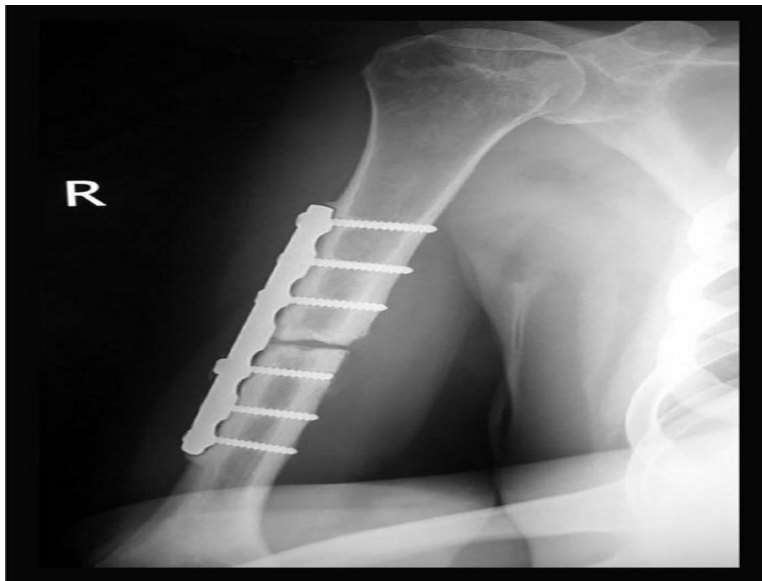
Question 9:

An 80-year-old man developed right-sided calf muscle pain and swelling. He was bedridden following a right inter-trochanteric fracture. What is the most likely diagnosis?

- a) Chronic osteomyelitis
- b) Compartment syndrome
- c) Deep vein thrombosis
- d) Arterial claudication

Question 10:

A patient was treated with open reduction and internal fixation for humerus fracture 9 months ago. His recent X-ray is given below. Which of the following is not a risk factor for this condition?



- a) Smoking
- b) Diabetes mellitus
- c) Bone loss
- d) Anatomical reduction

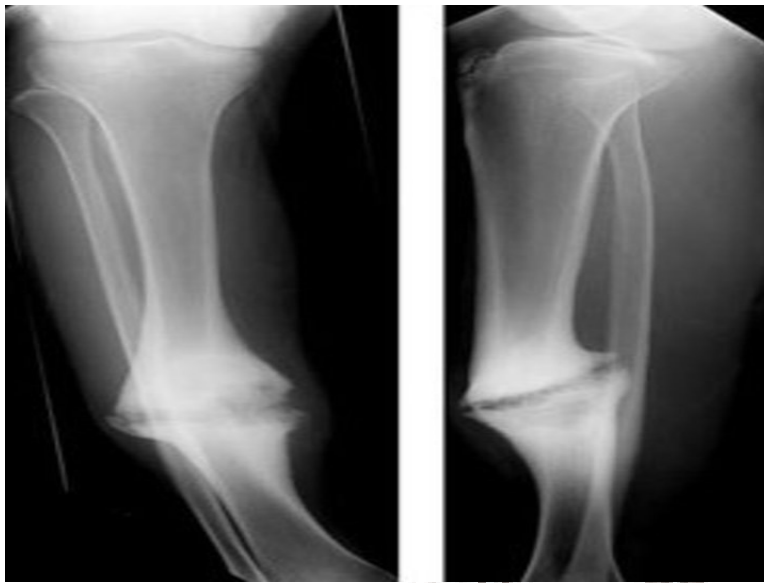
Question 11:

Which of the following fractures is most prone to non-union?

- a) Proximal scaphoid
- b) Inter-trochanteric
- c) Distal radius
- d) Olecranon fracture

Question 12:

An X-ray of a patient with a history of tibial fracture 9-months back is given below. Which type of non-union is he suffering from?



- a) Hypertrophic
- b) Oligotrophic
- c) Atrophic
- d) Pseudoarthrosis

Question 13:

A patient presented with non-union of tibial fracture. The orthopedician suggested treatment by providing stability using a cast or brace. Which of the following type of nonunion does the patient most likely has?

- a) Hypertrophic
- b) Atrophic
- c) Oligotrophic
- d) Pseudoarthrosis

Question 14:

What is the most appropriate treatment for atrophic non-union?

- a) Application of cast
- b) External fixation
- c) Stabilization and bone grafting
- d) Internal fixation

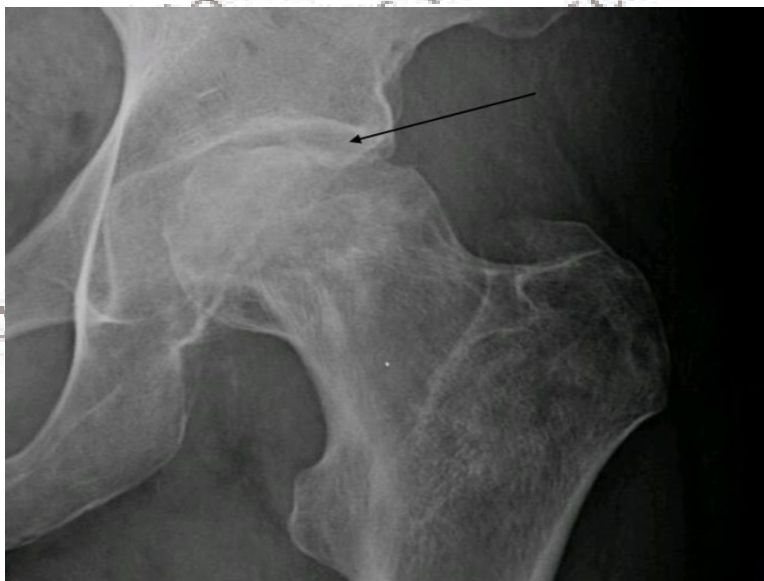
Question 15:

Which of the following is not a common strategy used in the treatment of patients with infected non-unions?

- a) Ilizarov technique
- b) PMMA antibiotic beads
- c) Internal fixation
- d) Parenteral antibiotics

Question 16:

A 55-year-old woman presents with painful restriction of movements of her left hip. She had a history of a fall a few months back which she ignored. A recent radiograph is given below. What is the most probable diagnosis?



- a) Osteoarthritis
- b) Slipped capital femoral epiphysis
- c) Fibrous ankylosis
- d) Avascular necrosis

Question 17:

A 20-year-old man presents with pain and swelling of elbow. He had a past history of fracture of radial head which was surgically treated. X-ray done is given below. Which of the following is true about this condition?



- a) Caused due to immobilisation
- b) Initial management is by surgery
- c) It is a malignant condition
- d) Indomethacin prevents recurrence

Question 18:

Which of the following substances is used for bone formation in a patient with non-union?

- a) PMMA
- b) BMP
- c) Ca PO₄
- d) CaSO₄

Answer Key

Question No.	Correct Option
1	c

2	a
3	c
4	a
5	b
6	b
7	d
8	b
9	c
10	d
11	a
12	a
13	a
14	c
15	c
16	d
17	d
18	b

Detailed Explanations

Solution to Question 1:

The given clinical scenario and X-ray is suggestive of supracondylar fracture of the humerus in which brachial artery is most commonly injured.

When there is vascular injury, the patient may complain of paraesthesia or numbness distal to the injury. On examination, the injured limb will be pale or slightly cyanosed, cold, and the pulse will be weak or absent.

If a vascular injury is suspected, an angiogram or duplex scan is done immediately. If the test detects vascular injury, emergency treatment must be initiated without much delay.

Solution to Question 2:

Wrist injury is associated with damage to the median nerve, not the anterior interosseous nerve.

Nerve injuries can be associated with closed fractures or open fractures:

- Closed fractures are less commonly related to nerve injury and spontaneous recovery within 4 months is observed in 90% cases. The nerve is explored if recovery is delayed beyond the expected time, or when nerve conduction studies do not demonstrate any evidence of recovery.

- Open fractures are more likely to cause the nerve to be completely severed. The nerve is explored and repaired at the time of debridement or during wound closure.

Solution to Question 3:

The most common fracture causing acute compartment syndrome in adult patients is tibial diaphyseal fractures.

Fractures are the most common cause for acute compartment syndrome. The top 3 fracture sites associated with acute compartment syndrome include:

- Tibial diaphysis (shaft)
- Distal radius
- Forearm bones diaphysis

Soft tissue injury is the second most common cause of acute compartment syndrome.

Solution to Question 4:

The earliest symptom of acute compartment syndrome is pain.

Acute compartment syndrome is a surgical emergency caused by increased pressure within a fascial compartment, leading to tissue ischemia. It is characterized by rapid progression of pain and swelling in an extremity, commonly precipitated by traumatic injury.

The classic features of ischemia in acute compartment syndrome include the 5 P's:

- Pain - It is the first symptom of acute compartment syndrome. Ischemic muscle is highly sensitive to touch. On passive stretching of the muscles, severe pain can be elicited.
- Paresthesia - It is the first sign of nerve ischemia.
- Pallor - It may not be seen always. The skin outside the compartment may be normally perfused, as only the intra-compartmental perfusion may be affected.
- Paralysis - Paralysis of muscle groups affected in that compartment is a late sign.
- Pulselessness - Usually, the peripheral pulses and capillary return are intact in the early stages, unless there is a major arterial injury. If pulses are absent, arteriography is indicated.

The diagnosis can be confirmed by measuring the intra-compartmental pressure using a split catheter introduced into the compartment. The difference between diastolic pressure and compartment pressure is known as differential pressure (ΔP). A differential pressure (ΔP) of less than 30 mm Hg (4.00 kilopascals) is an indication for immediate compartment decompression by performing a fasciotomy.

Solution to Question 5:

The given clinical scenario is suggestive of crush syndrome. In this condition hyperkalemia is seen, not hypokalemia.

Crush syndrome can result when a limb is compressed for a prolonged period. For e.g. getting crushed or entrapped in a vehicle or rubble and after extended use of a pneumatic antishock garment. This results in hypoperfusion and myonecrosis in the crushed limb. When the limb is released from the compression, toxic metabolites get released to cause reperfusion injury.

Crush syndrome can result in a systemic reaction due to tissue necrosis. Free myoglobin can lead to acute tubular necrosis and renal failure. Myonecrosis can lead to metabolic acidosis with hyperkalemia and hypocalcaemia. The procoagulants escaped into the systemic circulation can produce systemic coagulopathy.

Management of crush syndrome:

- Encouraging high urine flow, along with alkalization of urine with sodium bicarbonate to prevent precipitation of myoglobin in the renal tubules
- Renal hemofiltration if there is oliguria or renal failure
- If compartment syndrome is confirmed, then fasciotomy is performed
- Radical excision of necrosed muscle to avoid sepsis
- Aggressive management of the open wound

Solution to Question 6:

Reperfusion injury is not always local; it can also result in a systemic inflammatory response.

Reperfusion injury is the term used for a group of complications that follow the re-establishment of blood flow to ischemic tissues. It can also occur after fasciotomy and following restoration of blood flow to muscles in acute compartment syndrome.

Reperfusion results in an inflammatory response in the ischemic tissue, which is probably triggered by muscle breakdown products. These activate the intrinsic clotting system resulting in microvascular thrombosis. When a large amount of muscle is ischemic, there can be a systemic inflammatory response and systemic coagulopathy. The mediators released into systemic circulation damage the vascular endothelium, leading to increased permeability, transcapillary fluid leakage, worsening of intra-compartmental pressure, and eventually multiple organ failure.

Solution to Question 7:

History of sudden onset breathlessness on the 3rd day of admission after femur fracture should raise suspicion of fat embolism.

Fat embolism is the presence of fat globules in vital organs and peripheral circulation after a fracture of the long bone or other major trauma. Its pathogenesis can be related to 2 factors: the release of free fatty acids by the action of lipases on the neutral fats and the actual obstruction of small pulmonary vessels by fat globules.

Clinical features:

- Early signs are fever and tachycardia
- Presenting features are of 2 types -
- Cerebral type - drowsiness, restlessness, disorientation
- Pulmonary type - tachypnoea, tachycardia
- Classical triad -
- Respiratory distress
- Neurological abnormalities
- Petechial hemorrhages
- Pathognomonic signs are petechiae on the trunk, axillae, conjunctival folds, and retina.

Treatment of fat embolism is mainly supportive as given below:

- Respiratory support with oxygen
- Heparinization increases lipoprotein lipase activity
- Intravenous low molecular weight dextran
- Corticosteroids to avoid pneumonitis
- Prompt stabilization of long-bone fractures

Solution to Question 8:

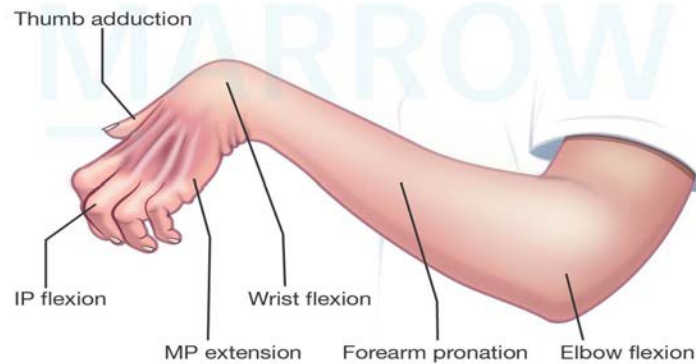
The earliest muscle to be involved in Volkmann's ischemic contracture is the flexor digitorum profundus.

Ischemic contracture of muscles affected by arterial injury or compartment syndrome is known as Volkmann's ischaemic contracture. In the forearm, it is most commonly seen following supracondylar humeral fractures.

The classical clinical picture of established Volkmann contracture includes:

- Elbow flexion
- Forearm pronation
- Wrist flexion
- Thumb adduction
- Metacarpophalangeal joint extension
- Finger flexion

Volkmann's ischemic contracture

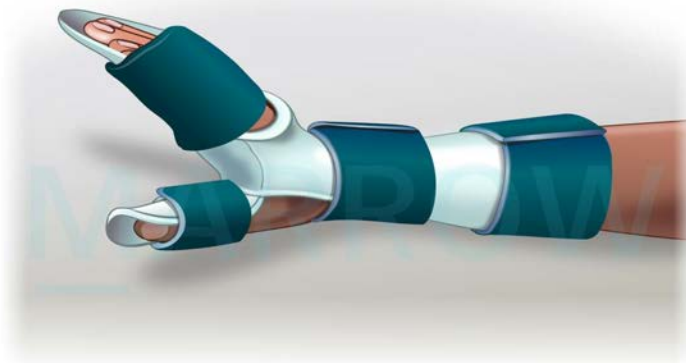


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Treatment

- Mild deformities - passive stretching of the contracted muscles with a turn-buckle splint (Volkmann's splint)
- Moderate deformities - soft tissue sliding procedures (Maxpage operation)
- Severe deformities - early excision of all necrotic muscles, combined with complete median and ulnar neurolysis. This is followed by a secondary procedure of tendon transfers to restore function. If motor activity is not present in these tendons, a free innervated Gracilis muscle transfer may be considered.

Volkmann splint



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Solution to Question 9:

The given clinical scenario is suggestive of deep vein thrombosis. It occurs due to immobilization and venous stasis.

It most commonly occurs in the calf veins and less often in the proximal veins of the thigh and pelvis. It is caused due to Virchow's triad:

- Hemodynamic changes (stasis or turbulence)
- Hypercoagulability
- Endothelial injury/dysfunction

It is usually asymptomatic. Some patients may present with pain in the calf or thigh. There may be an increase in temperature and pulse rate. Calf swelling and tenderness may be noted. Increased pain on passive dorsiflexion of the foot (Homan's test), although frequently used is now regarded as an unreliable sign.

Solution to Question 10:

The given clinical scenario and X-ray are suggestive of non-union. The anatomical reduction provides stability and decreases the probability of non-union.

Nonunion is when a fracture has failed to heal within the expected time and is unlikely to heal without a new intervention. The US Federal Drug Administration (USFDA) defines non-union as failure to achieve union by 9 months since the injury, and for which there have been no signs of healing for 3 months. Improper immobilization is the most common cause of non-union.

Delayed union is when a fracture has failed to heal within the expected time but has the potential to heal without further intervention.

Risk factors for non-union include the following:

- Host related factors -
 - Advanced age
 - Malnutrition
 - Smoking
 - Endocrine diseases (diabetes)
 - Immunosuppression
 - Osteoporosis
 - Vascular diseases
 - Taking medications that delay bone healing
- Fracture related factors -
 - High energy fractures
 - Greater degree of soft tissue injury
 - Bone loss
 - Periosteal stripping

- Devascularization
- Infection/contamination
- Treatment related factors -
- Lack of good stabilization
- Following improper technique such as poor casting
- Rigid fixation with bone gaps
- NSAIDs (implicated in some studies)

Solution to Question 11:

Among the given fractures, proximal scaphoid fractures are most prone to non-union.

Since the nutrient artery enters the scaphoid near its distal end, proximal fractures are associated with avascular necrosis and non-union. The more proximal the fracture in the scaphoid, the higher the chances of avascular necrosis and non-union.

Certain bones have a relatively limited or watershed blood supply that can potentially get interrupted by fracture. These include:

- Head of the femur: after fracture of the neck or posterior dislocation of the hip.
- Proximal scaphoid: due to fracture through the waist of the scaphoid.
- Lunate: following a dislocation.
- Body of talus: after fracture of its neck.

Fractures in these sites have a higher risk for non-union or development of osteonecrosis.

Other options:

Option B: Inter-trochanteric fractures involve either the greater or lesser trochanters or both, more common in the elderly following a history of a fall. Malunion is the most frequent complication. The vast metaphyseal region has an abundant blood supply, contributing to a higher union rate and fewer chances of avascular necrosis.

Option C: Distal radius fractures occur by fall on an outstretched hand and they include Colles' fracture (most common), Smith's fracture, Barton's fracture, and Chauffer's fracture. The complications include joint stiffness, malunion (more common), carpal tunnel syndrome, subluxation of the inferior radio-ulnar joint, Sudeck's dystrophy, and rupture of the extensor pollicis longus tendon. Avascular necrosis or non-union is rare.

Option D: Olecranon fracture results from a direct injury as in a fall onto the point of the elbow. Complications include non-union, elbow stiffness, and osteoarthritis.

Scaphoid Fracture



Solution to Question 12:

The given X-ray shows hypertrophic non-union of the tibia.

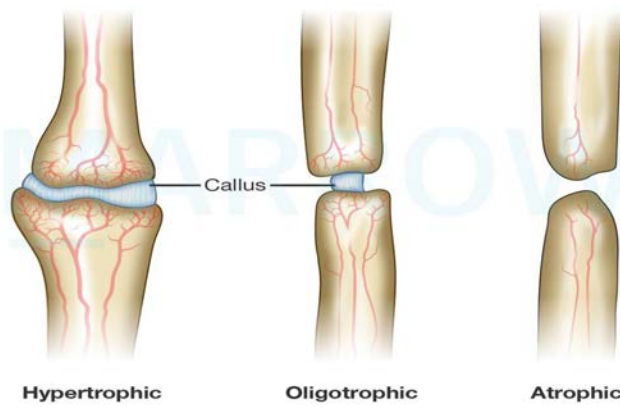
Although the enlarged fracture ends suggest active osteogenesis, the gap is not bridged because of inadequate stability. Such non-unions have adequate vascularity and display abundant callus.

Based on the biologic potential for fracture healing, non-union can be of the following types:

- **Atrophic:** Poor healing response with no callus formation due to little or no active bone-forming cells at the fracture site. The blood supply is typically poor. On radiography, there is an absence of bone reaction.
- **Oligotrophic:** There is minimal callus formation, often due to inadequate approximation of fracture surfaces. On radiography, there is minimal bone healing reaction.
- **Hypertrophic:** These fractures have an adequate healing response and good vascularity. There is a lack of adequate stability for the union to occur. On radiography, there is usually abundant callus formation with an intervening dark area of fibrocartilage-lacking mineral. It can occur after initial nonoperative management or in some cases after initial operative management where there was inadequate stabilization.

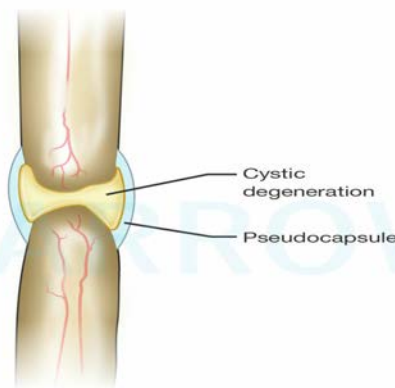
Pseudoarthrosis has features of hypertrophic nonunion, but due to excessive and chronic motility, there is the formation of a pseudo-capsule containing fluid similar to an actual synovial joint.

Types of non-union



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Pseudoarthrosis



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Solution to Question 13:

Stabilization using casts and braces are used in the treatment of hypertrophic nonunion.

Management of nonunion:

- Hypertrophic nonunion: Stabilization to allow chondrocyte-mediated mineralization of the fibrocartilage between fracture ends. With stabilization, healing usually occurs by 8 weeks.
- Oligotrophic nonunion: Correcting the issues related to bone contact through mechanical compression or bone grafting to close the defects. In some cases, a combination of biologic and mechanical methods is used.
- Atrophic nonunion: Autogenous bone graft or BMP to provide biologic stimulus at the fracture site. The other procedure done is debridement or excision of the non-vital bone ends.

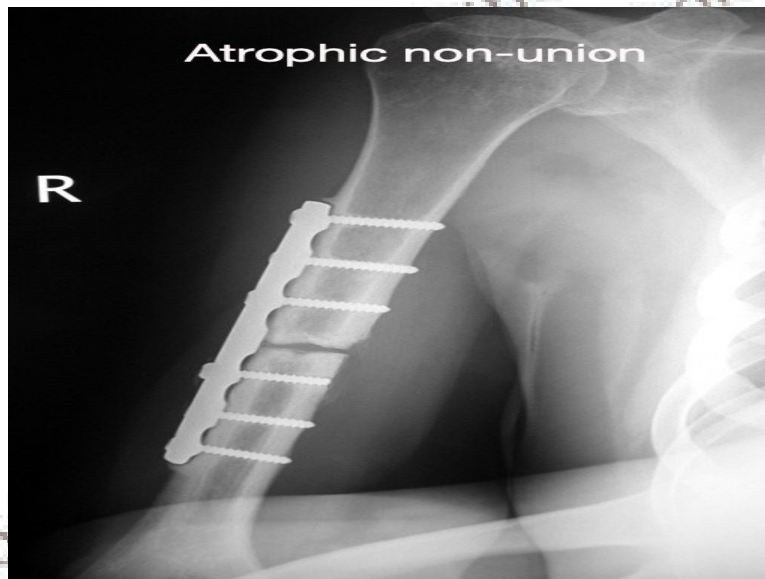
- Pseudoarthrosis: Debridement of the pseudoarthrosis, opening of the medullary canal and providing more stability usually with compression at the nonunion site. In some cases, biologic stimulation may be helpful to promote healing.

Solution to Question 14:

Atrophic nonunions require bone grafting and stabilization in order to heal.

Autogenous bone graft remains the standard graft substance used in the repair of atrophic nonunions. Bone grafts are also used in some cases of oligotrophic nonunions and pseudoarthroses. The anterior iliac crest is the most common site from which grafts are obtained followed by the fibula.

The below X-ray image shows atrophic nonunion of humeral shaft 18 months after ORIF.



Solution to Question 15:

Internal fixation is not a common strategy used in the treatment of infected non-unions.

This is because metal implants promote adherence of microbes and cause biofilm formation. They also adversely affect phagocytosis and control of infection. The diagnostic gold standard for detecting infection in fracture nonunion sites is deep tissue or bone culture.

Strategies used in the management of infected non-unions include:

- Removal of internal implants if the infection is problematic or when bone grafting is required. Implants are retained if the infection can be controlled and union can be achieved without grafting procedures.
- Management of the infectious process by debridement of the infected nonviable bone and surrounding nonviable soft tissues, parenteral antibiotics, and bone stabilization.

- Local antibiotic delivery may be performed, especially when there is dead space due to debridement. Antibiotic-impregnated synthetic materials are used, such as polymethylmethacrylate (PMMA) cement beads.
- Cancellous autograft with antibiotics (vancomycin and gentamycin).
- Stabilization with an Ilizarov fixator.

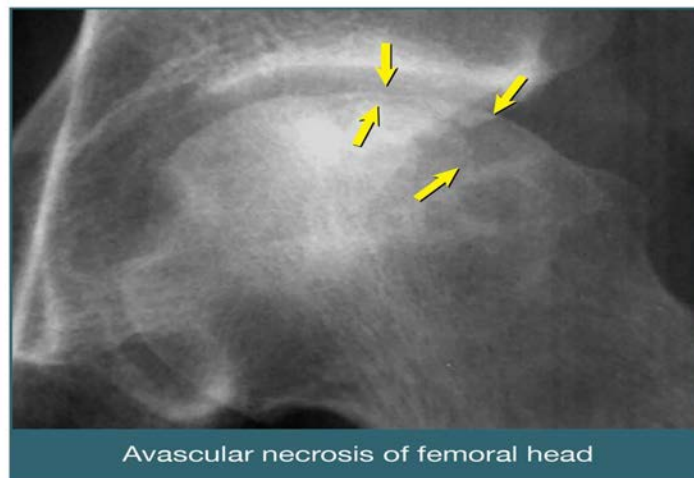
Solution to Question 16:

The given clinical scenario and x-ray showing flattening of the femoral head is suggestive of avascular necrosis. It is most commonly seen after a fracture neck of femur.

The patient complains of pain and walks with a limp. The condition is treated by a total hip replacement. If untreated, osteoarthritis of the hip develops.

The image below shows the crescent sign, which is caused by the necrotic and repair processes that occur during avascular necrosis.

Crescent sign



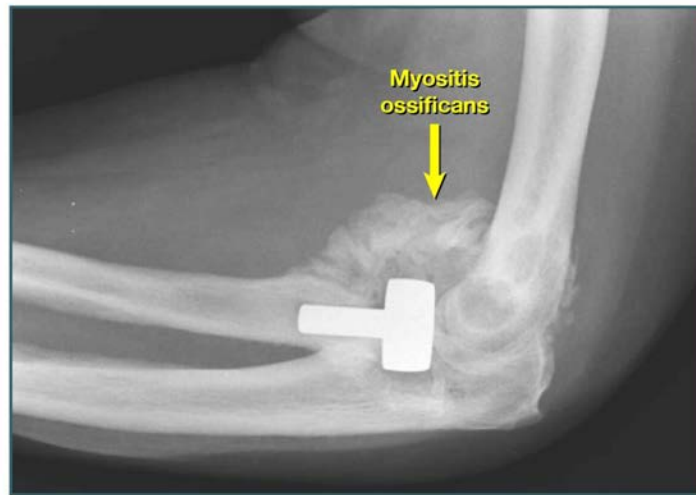
Solution to Question 17:

The given clinical scenario and X-ray is suggestive of myositis ossificans which is a complication of fracture. Recurrence of this condition can be prevented by indomethacin and radiotherapy.

Myositis ossificans is defined as ectopic benign pathological bone formation. It is most commonly seen after dislocation of elbow or a blow to brachialis, deltoid or quadriceps. The patient presents with gross restriction of range of movements and should be advised not to massage the site as it promotes ossification.

Treatment involves joint rest in the position of function until the pain subsides, followed by gentle movements. After a few months if the pain and restriction still persist then the bony mass is excised.

The X-ray given below shows myositis ossificans.



Solution to Question 18:

Among the given options, bone morphogenic protein (BMP) is the substance used for bone formation in a patient with non-union.

BMP is a bone-stimulating protein used as a bone graft in the treatment of non-union and open tibial fractures.

Bone grafts can be:

- Osteoinductive: They stimulate osteogenesis through the differentiation of mesenchymal cells into osteoprogenitor cells. BMPs are osteoinductive.
- Osteoconductive: They provide linkage across defects and a scaffold upon which new bone can form. Calcium phosphate (Option C), calcium hydroxyapatite, and calcium sulfate (Option D) are osteoconductive.

Polymethylmethacrylate (PMMA), also known as bone cement, holds bone and metal implants together by forming an interlocking network between the irregularities.

Regional conditions of neck

Question 1:

What is the most common cause for congenital torticollis?

- a) CMV infection
- b) Neurogenic
- c) Fibrosis
- d) Tumors

Question 2:

Which of the following features would you least expect to see in a patient with Klippel-Feil syndrome?

- a) Short neck
- b) Low posterior hairline
- c) Limited neck movements
- d) Elevated scapula

Question 3:

What is the most common skeletal anomaly associated with Klippel-Feil syndrome?

- a) High scapula
- b) Vertebra plana
- c) Scoliosis
- d) Pseudoarthrosis

Question 4:

A 6-year-old boy presented with the following findings. What is the likely diagnosis?



- a) Milwaukee shoulder
- b) Sprengel deformity
- c) Long thoracic nerve injury
- d) Klippel-Feil syndrome

Question 5:

Which of the following is not associated with Sprengel deformity?

- a) Diastematomyelia
- b) Klippel-Feil syndrome
- c) Dextrocardia
- d) Congenital scoliosis

Question 6:

Which of the following best describes basilar impression?

- a) Presence of os odontoideum
- b) Fusion of cervical vertebrae at birth
- c) Softening of the skull bones
- d) Indentation of skull floor by cervical spine

Question 7:

Which of the following is not a cause for thoracic outlet syndrome?

- a) Cleidocranial dysostosis
- b) Malunion of fracture clavicle
- c) Cervico-thoracic scoliosis
- d) Pancoast tumor

Question 8:

Which of the following is a manifestation of neural compression in patients with thoracic outlet syndrome?

- a) Weakness of the shoulder
- b) Weakness in flexion of the arm
- c) Paresthesias along the lateral border of the arm
- d) Paresthesias along the medial border of the arm

Question 9:

A 28-year-old archer presents with complaints of weakness of the shoulder and tingling sensation in his fingers while in the full draw position. You suspect thoracic outlet syndrome. All of the following are provocative tests for this condition, except:

- a) Adson's test
- b) Wright's test
- c) Jobe's test
- d) Roos's test

Question 10:

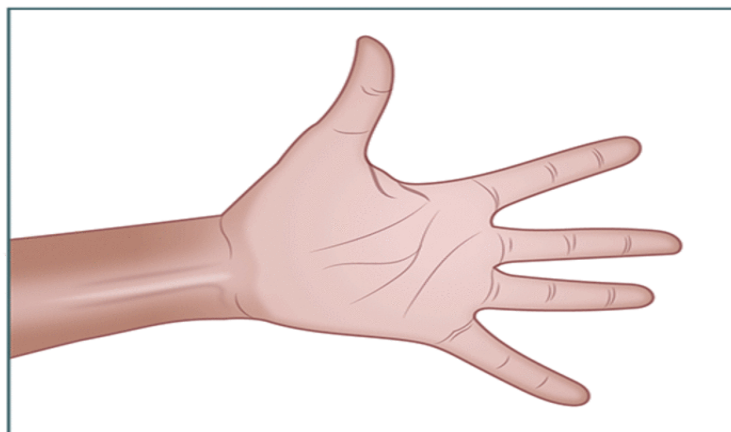
A 30-year-old man presents with numbness of both hands. He was asked to perform the test demonstrated below. What is this test?



- a) Adson's test
- b) Pemberton test
- c) Roos test
- d) Wright test

Question 11:

The test performed in the following video is



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- a) Allen's test
- b) Roos test

- c) Adson's test
- d) Wright test

Question 12:

A 45-year-old woman presented with progressively worsening pain in her left shoulder for 6 months. The pain radiates to the left upper arm. It increases after carrying weights and reduces with rest. Occasionally, there was tingling paresthesia in the left arm. Clinical examination was unremarkable except for a positive Adson's test on left side. The X-ray of the cervical spine is shown. What is your diagnosis?



- a) Tumour of upper lobe lung
- b) Malunion of fracture clavicle
- c) Cervical rib
- d) Abnormal first rib

Question 13:

A 40-year-old patient came to the OPD with a history of recurrent neck pain and stiffness over the last year. A cervical X-ray was done and is shown below. Which of the following is not an operative treatment for this condition?



- a) Anterior discectomy and fusion
- b) Foraminotomy
- c) Posterior decompression
- d) Intervertebral disc replacement

Question 14:

A patient presented with pain and tingling sensation in the arms. CT showed the following finding. Which of the following is false regarding this condition?



- a) Mostly seen in cervical spine

- b) Mostly seen in younger age group
- c) Associated with fluorosis
- d) Can cause spinal stenosis

Answer Key

Question No.	Correct Option
1	c
2	d
3	c
4	b
5	c
6	d
7	a
8	d
9	c
10	c
11	a
12	c
13	c
14	b

Detailed Explanations

Solution to Question 1:

The most common cause for congenital torticollis is fibrosis of one of the sternocleidomastoid muscles.

Solution to Question 2:

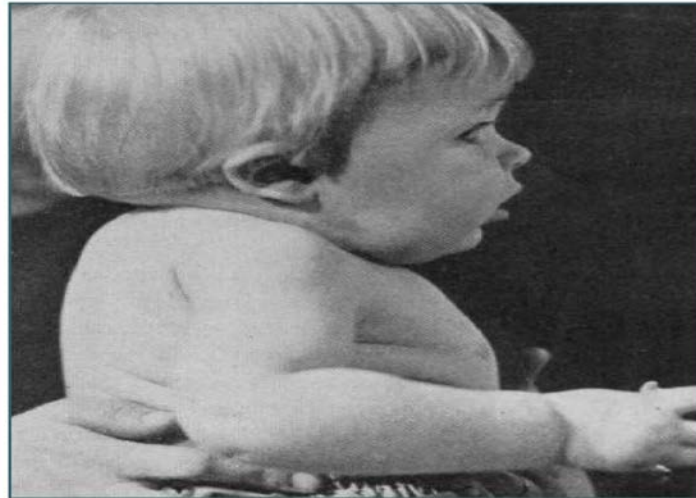
Elevated scapula is not a part of the clinical triad of Klippel-Feil syndrome. However, it is associated with Sprengel deformity, which occurs in approximately 30% of cases.

The classic clinical triad seen in this condition includes:

- Short neck
- Low posterior hairline
- Limited range of neck motion

Klippel-Feil syndrome is a developmental disorder caused by a failure of normal segmentation of the cervical somites during the 3rd to 8th week of embryogenesis. This results in a congenital fusion of at least 2 cervical vertebrae, sometimes a block of cervical vertebrae, and rarely the entire cervical spine.

Klippel Feil syndrome



X-rays may show the fusion of two or more cervical vertebrae. The vertebrae are also widened and flattened (wasp-waist appearance).

The below radiograph from a Klippel-Feil syndrome patient shows the fusion of C6, C7, and T1 vertebrae:

Klippel-Feil syndrome



Solution to Question 3:

Most common skeletal anomaly associated with Klippel-Feil syndrome is scoliosis.

Klippel-Feil syndrome is often associated with other skeletal and extraskeletal anomalies:

- Skeletal anomalies: scoliosis & Sprenkel deformity & cervical ribs
- Extraskeletal anomalies: renal abnormalities & deafness & congenital heart disease

Ventricular septal defect is the most common cardiovascular anomaly associated with this syndrome.

Synkinesis (mirror movements) is involuntary paired movements of hands and arms seen in around 20% of children with Klippel-Feil syndrome. The child cannot move one hand without a similar reciprocal movement in the opposite hand.

Solution to Question 4:

The image shows an upward elevation of the scapula relative to the thoracic cage characteristically seen in Sprengel deformity.

Sprengel deformity is a congenital upward elevation of the scapula. It is due to the failure of the scapula to descend completely in embryonic life.

The affected scapula is smaller, shaped differently, abnormally high, and somewhat prominent. Shoulder movements are usually painless. Abduction and elevation of shoulders may be limited due to fixation of the scapula.

The Cavendish classification is used to grade the severity of Sprengel deformity.

If the deformity is mild, no treatment is required. In severe deformity, surgery may be indicated. These procedures include:

- Green procedure
- Woodward procedure
- Mears procedure

Solution to Question 5:

Dextrocardia is not associated with Sprengel deformity.

Sprengel deformity is the congenital elevation of the scapula. It is characterized by an elevated shoulder on the affected side, with an abnormally high, smaller, and prominent scapula. The neck appears shorter, and there may be kyphosis or scoliosis of the upper thoracic spine. While shoulder movements are painless, abduction and elevation may be limited due to scapular fixation.

Abnormalities associated with Sprengel deformity include:

- Klippel-Feil Syndrome

- Kyphosis or Scoliosis
- Cervical rib
- Omovertebral bar (a bony bridge between the scapula and the cervical spine)
- Spina bifida
- Diastematomyelia (congenitally split spinal cord)
- Torticollis
- Renal abnormalities

The image below shows Sprengel deformity:



Solution to Question 6:

Basilar impression (basilar invagination) is a deformity in which there is an indentation of the skull floor by the upper cervical spine.

Basilar invagination is invagination (infolding) of the base of the skull that occurs when the top of the C2 vertebra migrates upward. It can cause narrowing of the foramen magnum (the opening in the skull where the spinal cord passes through to the brain). It also may press on the lower brainstem.

Basilar impression can be primary (congenital) or secondary (acquired).

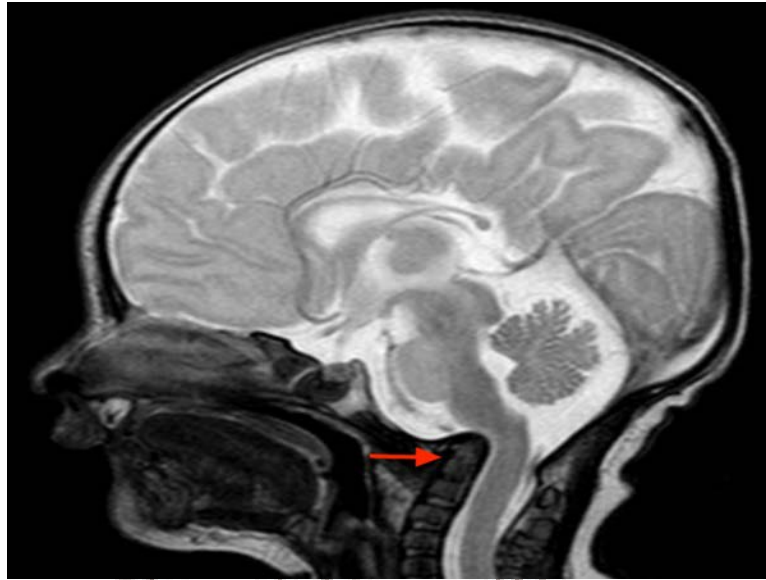
- Primary: Congenital defect in bone development at the craniocervical junction. The tip of the odontoid bone is more cranial than normal.
- Secondary: Acquired deformity due to systemic diseases that affect bony structures at the base of the skull.

Neurologic symptoms are seen due to pressure on the brainstem such as weakness and paresthesia in the limbs. There can be symptoms related to compression of cranial nerves (trigeminal, vagus, glossopharyngeal, hypoglossal) and the vertebral artery.

Craniometric parameters used for diagnosis include McRae's line, Chamberlain's line, and McGregor's line.

Treatment is by surgical decompression and stabilization with a posterior occipito-cervical arthrodesis. Odontoidectomy is done if compression is due to aberrant odontoid.

The below image shows basilar invagination in an infant with indentation of the medulla oblongata by the odontoid process.



Solution to Question 7:

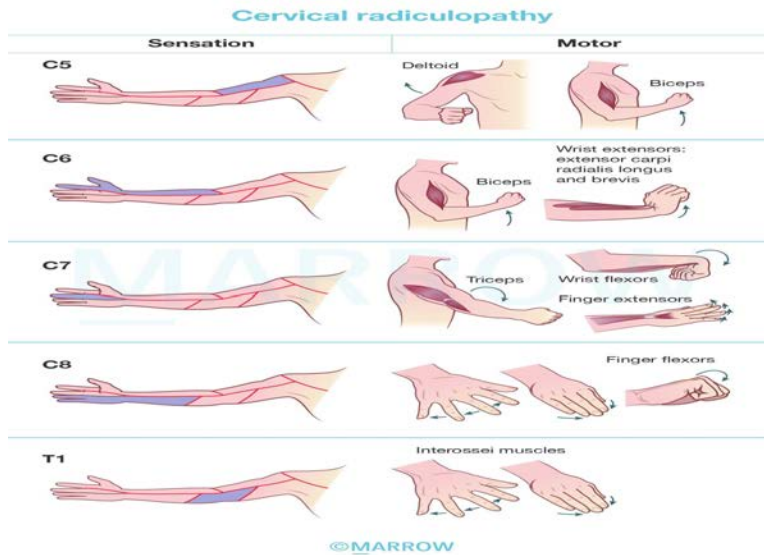
Cleidocranial dysostosis does not cause thoracic outlet syndrome.

Tumor arising from the upper lobe of the lung (eg: Pancoast tumor), cervicothoracic scoliosis, and malunion or nonunion of fracture clavicle are causes of thoracic outlet syndrome.

Solution to Question 8:

Patients with thoracic outlet syndrome typically complain of pain and paresthesias along the medial aspect of the arm, forearm and medial two fingers.

This corresponds to the most common roots compressed in a thoracic outlet syndrome which are C8 and T1.



Solution to Question 9:

Jobe's test is not a provocative test for thoracic outlet syndrome. Jobe's test is performed to evaluate for shoulder impingement syndrome.

The provocative tests for thoracic outlet syndrome include Adson's test, Wright's test, and Roos's test.

Solution to Question 10:

The test performed in the image is Roos test. It is also referred to as the elevated arm stress test (EAST). It is a provocative test for the diagnosis of thoracic outlet syndrome.

For this test, the patient abducts the shoulders to 90 degrees and flexes the elbow to 90 degrees. The patient is made to open and close the hand repeatedly for three minutes. The test is positive if the patient is unable to complete the test or experiences cramping, pain, numbness, on the affected side.

Solution to Question 11:

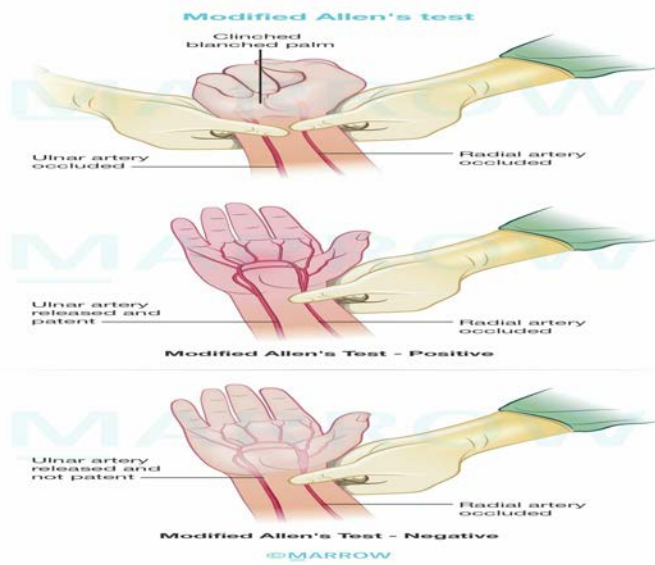
The test performed in the given video is Allen's test.

Allen's test is mainly used to test the adequacy of ulnar collateral blood flow to the hand, which is usually done prior to radial artery cannulation.

Procedure:

- The radial and ulnar arteries are occluded as the patient makes a tight fist so as to exsanguinate the palm.

- Then the patient is asked to open the hand and the occlusion over the ulnar artery is released.



Interpretation:

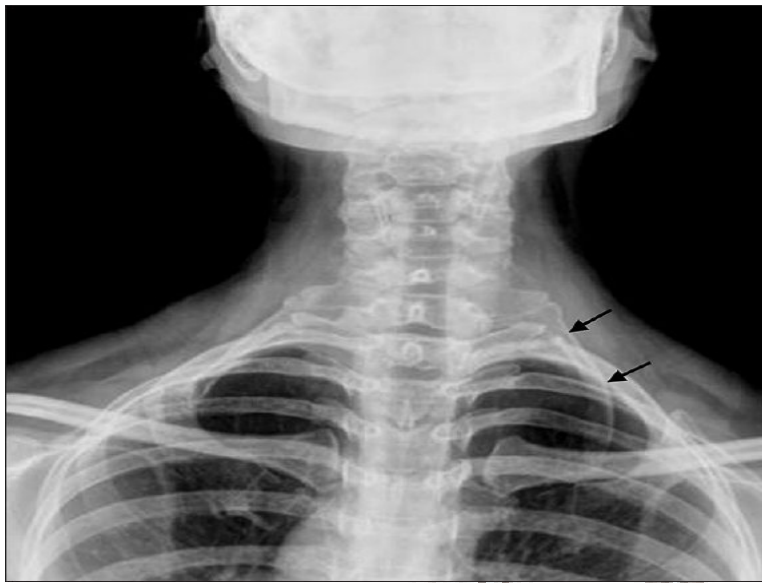
- As occlusion of the ulnar artery is released, the color of the open palm is observed. Normally, the color will return to the palm within 5 – 6 seconds.
- If the palm remains pale for more than 6-10 seconds, it indicates reduced ulnar collateral flow.
- The modified Allen's test considers a threshold of 5 to 15 seconds.

Clinical significance:

- In recent years, studies have shown that, although the Allen test is often used to identify patients at increased risk for ischemic complications from radial artery cannulation, the predictive value of this test is poor.
- It is also used for identifying patients acceptable for radial artery harvest or use for coronary angiography.

Solution to Question 12:

The given X-ray shows a cervical rib on the left side.



The cervical rib is an additional rib that arises from the 7th cervical vertebra. It may be a complete rib or incomplete and present for a short distance with the anterior part having a fibrous band. It is usually unilateral and more common on the right side.

In most individuals with cervical rib, there are no symptoms. It is incidentally detected on radiographs. In a small proportion of individuals with cervical rib, it can cause symptoms of thoracic outlet obstruction due to pressure on the neurovascular structures. These symptoms manifest after the age of 30 years as the shoulders start to sag with increasing age.

The absence of a rib on the x-ray does not rule out the possibility of a cervical rib. CT and MRI are more sensitive.

Solution to Question 13:

The clinical features and the X-ray image showing degenerative changes and bony spurring at C5-6, the most possible diagnosis is cervical spondylosis. Among the operations listed, posterior decompression is not a treatment option for cervical spondylosis.

Cervical spondylosis is a disorder arising due to chronic intervertebral disc degeneration in the cervical region. Changes are most common in lower cervical segments such as C5/6 and C6/7. The most common clinical feature is pain and stiffness of the neck. The X-ray may show osteophytes and degenerative changes.

Treatment:

- Conservative treatment with analgesics, physiotherapy and the cervical collar is the mainstay
- Operative treatments performed include:
 - Anterior discectomy and fusion
 - Foraminotomy
 - Intervertebral disc replacement

- Laminoplasty

Cervical spondylosis



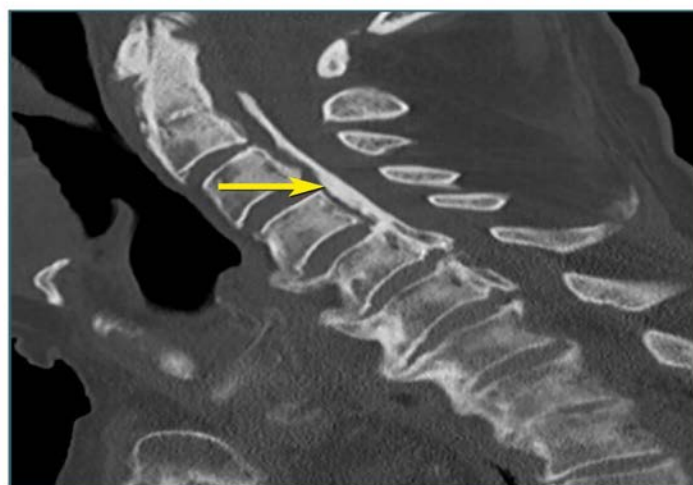
Solution to Question 14:

The CT scan shows an ossified posterior longitudinal ligament, which is usually seen after the age of 50 years.

It is associated with various bone-forming conditions such as diffuse idiopathic skeletal hyperostosis (DISH) and fluorosis. It is most commonly seen in the cervical spine. It can result in spinal stenosis and cervical myelopathy causing pain and weakness in the limbs. X-ray shows dense ossification along the back of the vertebral bodies in the mid-cervical spine.

Treatment is needed if the symptoms are progressive. Posterior decompression is the operation of choice.

Ossified posterior longitudinal ligament



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If you purchased this from someone else,
you may have been scammed.

Injuries of clavicle, shoulder and arm

Question 1:

Which part of the clavicle is most commonly fractured?

- a) Medial third
- b) Middle third
- c) Lateral third
- d) Medial half

Question 2:

A biker fell on his shoulder due to an accident. Chest X-ray revealed a fracture of the middle third of the clavicle with the lateral fragment displaced inferiorly. What is the reason for this displacement?

- a) Pull of the sternocleidomastoid muscle
- b) Pull of the teres minor muscle
- c) Pull of gravity on the arm
- d) Pull of the pectoralis muscle

Question 3:

Which of the following statements is false regarding clavicular shaft fracture?

- a) The most commonly fractured bone is clavicle
- b) Non-union is the most common complication
- c) Neurological deficit is rarely seen
- d) Displaced fractures are treated with intramedullary nails

Question 4:

In which of the following conditions is a Velpeau bandage not used?

- a) Humerus shaft fracture
- b) Posterior shoulder dislocation

- c) Glenoid fossa fractures
- d) Acromioclavicular dislocation

Question 5:

Which is the most important ligament for maintaining shoulder joint stability?

- a) Superior glenohumeral ligament
- b) Middle glenohumeral ligament
- c) Inferior glenohumeral ligament
- d) Coracoacromial ligament

Question 6:

A young cricketer presented with severe pain and deformity of the shoulder following bowling practice. The AP-view radiograph of the affected shoulder is given below. Which of the following statements is false regarding this condition?



- a) Bankart lesion may occur as a complication
- b) Recurrence is associated with Hill-Sachs lesion
- c) Radial nerve is most commonly injured
- d) It can also be caused by a fall on the hand

Question 7:

Which of the following best describes the bony Bankart lesion?

- a) Avulsion fracture of the glenoid rim
- b) Stripping of the antero-inferior glenoid labrum
- c) Rupture of inferior glenohumeral ligament complex
- d) Avulsion of posterior capsular periosteum

Question 8:

An elderly man presented with pain and inability to move his shoulder after a fall. On examination, loss of normal contour of the shoulder was noted. Which of the following tests cannot be used to diagnose the likely condition?

- a) Gerber test
- b) Bryant test
- c) Callaway test
- d) Dugas test

Question 9:

A patient is diagnosed with anterior shoulder dislocation after a fall. You are about to reduce the dislocation using Kocher's maneuver. What is the order of steps you will follow to do this?

- a) Traction, external rotation, abduction, medial rotation
- b) Traction, extension, adduction, medial rotation
- c) Traction, abduction, medial rotation, extension
- d) Traction, external rotation, adduction, medial rotation

Question 10:

Which of the following muscles is tightened during Putti-Platt's operation?

- a) Supraspinatus
- b) Subscapularis
- c) Infraspinatus
- d) Teres minor

Question 11:

A patient who had just undergone electro-convulsive therapy presented to the casualty with pain over the shoulder. The arm was held in internal rotation and could not be rotated back to the normal position. What is the most likely diagnosis?

- a) Superior dislocation of the shoulder
- b) Posterior dislocation of shoulder
- c) Anterior dislocation of shoulder
- d) Inferior dislocation of shoulder

Question 12:

A patient who suffered an epileptic attack at home presented with pain over the left shoulder. An AP view X-ray of the shoulder was done as given below. Which sign is seen here?



- a) Comolli's sign
- b) Light bulb sign
- c) Destot's sign
- d) Oliver's sign

Question 13:

On which aspect of the humeral head is reverse Hill-Sachs lesion seen?

- a) Posterolateral
- b) Anteromedial
- c) Posteromedial
- d) Anterolateral

Question 14:

A 22-year old man presented with pain and abduction deformity of the right shoulder after falling on the abducted arm. His AP-view shoulder radiograph is given below. What is the diagnosis?



- a) Anterior dislocation
- b) Posterior dislocation
- c) Inferior dislocation
- d) Superior dislocation

Question 15:

The most common sequela of traumatic dislocation of the shoulder in young adults is_____.

- a) Subscapular tendinitis
- b) Rotator cuff injury
- c) Recurrent dislocation of shoulder
- d) Frozen shoulder

Question 16:

A 56-year-old woman presented with pain and decreased movement of the right arm after a fall. On examination, there was swelling and tenderness over the right shoulder region. However, the normal contour of the shoulder is maintained. What is the most likely diagnosis?

- a) Acromio-clavicular dislocation
- b) Fracture of the clavicle
- c) Shoulder dislocation
- d) Proximal humerus fracture

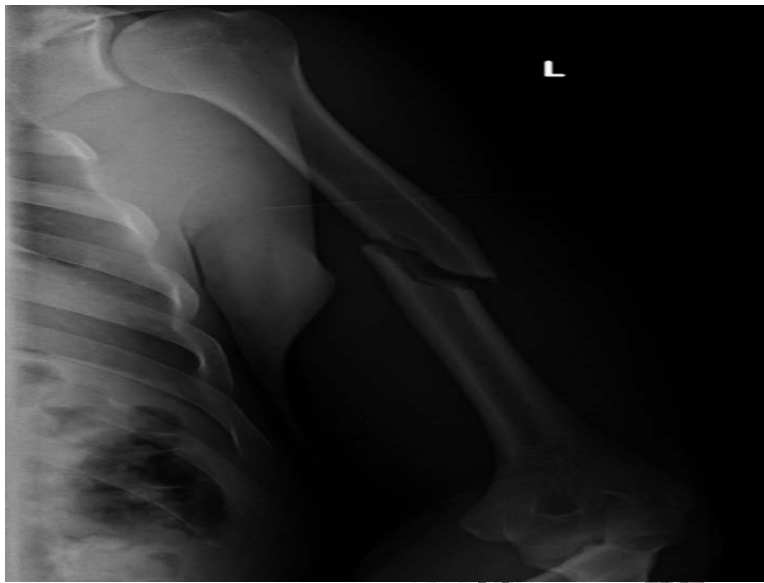
Question 17:

What is the most commonly used classification system for proximal humerus fractures?

- a) Neer's classification
- b) Garden's classification
- c) Gartland's classification
- d) Bado's classification

Question 18:

A construction worker presented with pain and swelling of his left arm after falling on his side from a height. An upper arm X-ray was done which is given below. Which nerve is most likely to be injured in this condition?



- a) Axillary nerve
- b) Ulnar nerve
- c) Radial nerve
- d) Median nerve

Question 19:

A baseball player presented with right upper arm pain. He started experiencing pain after he threw a ball and felt a pop. An upper arm X-ray was done and is given below. What is this fracture known as?



- a) Holdsworth fracture

- b) Clay shoveller's fracture
- c) Lisfranc fracture
- d) Holstein-Lewis fracture

Answer Key

Question No.	Correct Option
1	b
2	c
3	b
4	c
5	c
6	c
7	a
8	a
9	d
10	b
11	b
12	b
13	b
14	c
15	c
16	d
17	a
18	c
19	d

Detailed Explanations

Solution to Question 1:

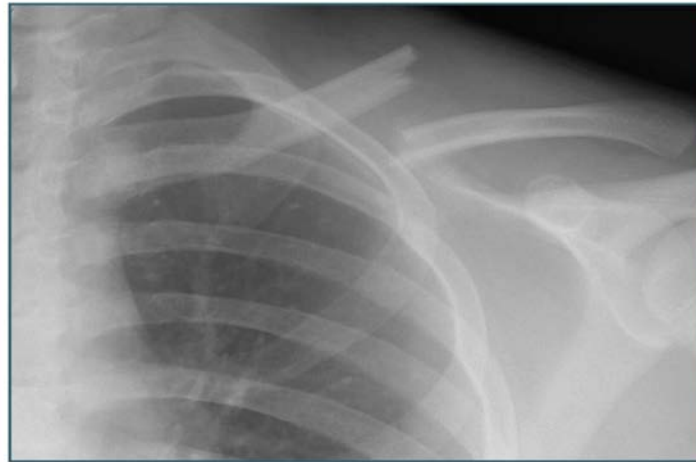
The middle third of the clavicle is most commonly fractured.

The middle third of the clavicle is narrowest and has the least amount of surrounding soft tissue structures. Therefore, 80% of fractures are seen in this area.

Within the middle-third of the clavicle, the junction of the medial 3/5th and the lateral 2/5th has been described to be the weakest point. Lateral third fractures are the second most common type of clavicular fractures.

Fall on the shoulder (direct impact) and fall on the outstretched hand are the most common causes of clavicle fracture.

Fracture clavicle



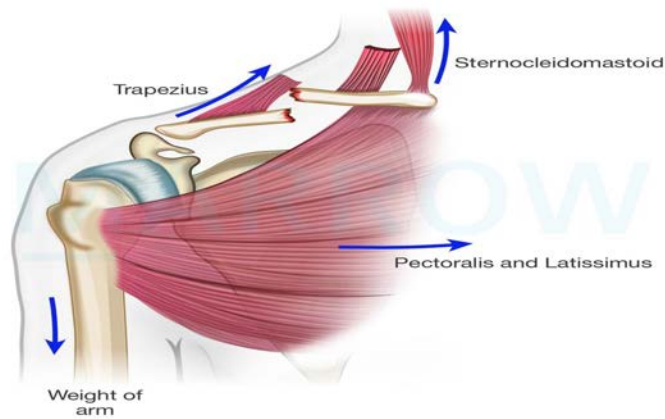
Solution to Question 2:

The lateral fragment in a clavicle fracture is displaced inferiorly due to the force of gravity acting on the ipsilateral arm.

The medial fragment is held up by the action of the sternocleidomastoid muscle.

(Note: Both Pectoralis muscle and the weight of arm are responsible, but since the weight of arm is superior to the muscle bulk and even as per standard reference we would go with the rational explanation.)

Displacing forces in fracture clavicle



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Solution to Question 3:

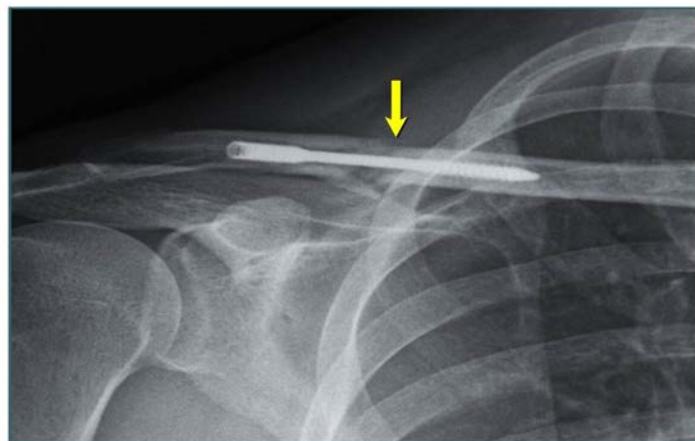
Non-union is a relatively rare complication in clavicle shaft fracture. Malunion is the most common complication in clavicle fractures

The most common bone to be fractured is the clavicle. It is also the most common bone to be fractured during birth. Neurological deficit is rare in clavicular shaft fractures.

Undisplaced fractures are treated with a sling or figure of eight bandages for 2-3 weeks. This is followed by mobilization of the limb as the pain subsides.

Displaced fractures are treated with internal fixation either by contoured locking plates or intramedullary nails.

Intramedullary fixation of clavicular fracture



Solution to Question 4:

Velpeau bandage is not used in glenoid fossa fractures as they require surgical fixation because they are intra-articular.

Velpeau bandaging is done by keeping the patient's elbow flexed and the forearm placed against the chest. A sling is then applied to support the weight of the arm. Several layers of restrictive bandages are then applied around the arm and the torso.

Velpeau bandage is commonly used for:

- Acromioclavicular dislocations
- Humeral shaft fractures
- After open reduction of posterior shoulder dislocation

Acromioclavicular joint injuries are usually seen with direct injury to the lateral shoulder. They are also seen after fall on an outstretched arm with the elbow locked in extension.

They are classified into six types using the Rockwood classification. Type 1-3 is managed conservatively using the Velpeau bandage. Type 4-6 is treated by open reduction and internal fixation.

Velpeau bandage - Injuries of clavicle





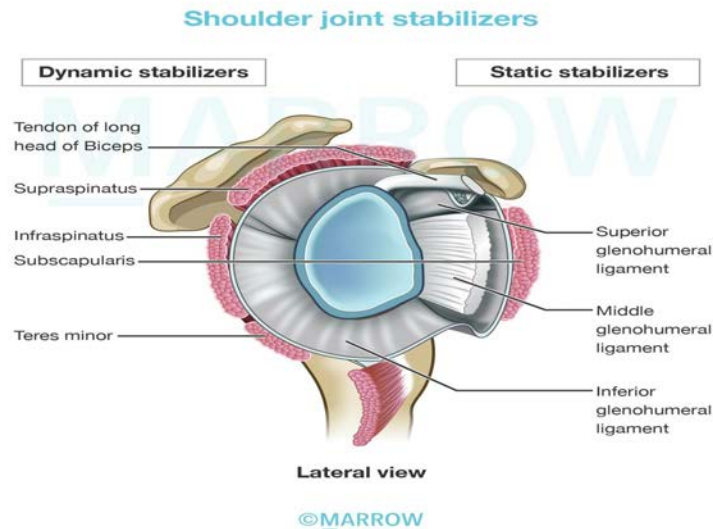
Solution to Question 5:

The inferior glenohumeral ligament is the most important in maintaining shoulder joint stability. It is the main stabilizer when the shoulder is abducted and in extreme ranges of motion.

The shoulder joint is anatomically unstable. Only 25% of the humeral head articulates with the glenoid.

The joint is reinforced by:

- Static stabilizers (3 capsular thickenings or ligaments):
 - Superior glenohumeral ligament (SGHL)
 - Middle glenohumeral ligament (MGHL)
 - Inferior glenohumeral ligament (IGHL)
- Dynamic stabilizers (rotator cuff muscles):
 - Supraspinatus
 - Infraspinatus
 - Teres minor
 - Subscapularis
 - The long head of biceps



Solution to Question 6:

This radiograph shows anterior dislocation of the shoulder. The nerve commonly injured in anterior dislocation is the axillary nerve, not the radial nerve.

The radiograph shows the disturbed articulation between the humeral head and glenoid fossa. The humeral head is seen below and medial to the glenoid socket. This suggests anterior dislocation of the shoulder joint.

Common cause for anterior dislocation:

- Young adults - athletic injuries
- Elderly - falls

Bankart lesion is a tear in the anteroinferior part of the glenoid labrum caused by the head of the humerus during anterior dislocation.

Hill-Sachs lesion is a compression fracture on the posterolateral aspect of the humeral head. It is caused by the pressure of the anterior glenoid rim on the humeral head in recurrent dislocations.

Hill Sach lesion



Solution to Question 7:

The bony bankart lesion is a small, avulsion fracture of the glenoid rim.

During an anterior shoulder dislocation, the head of the humerus can tear the anteroinferior part of the glenoid labrum. This is known as Bankart lesion. In some cases, a small fragment of bone from the glenoid rim can also get avulsed. This is known as a bony Bankart lesion.

Avulsion of posterior capsular periosteum is seen in reverse Bankart lesion.

Bony Bankart lesions



Solution to Question 8:

The above clinical scenario is suggestive of anterior shoulder dislocation. It cannot be diagnosed with the help of Gerber's test. This test is used to diagnose impingement between the rotator cuff and the coracoid process.

Four tests can be used to diagnose anterior dislocation of the shoulder:

- Bryant's test
- Dugas test
- Hamilton ruler test
- Callaway test

Solution to Question 9:

The correct order of steps in Kocher's manoeuvre is traction ° external rotation ° adduction ° medial rotation (TEAM). This is used for the reduction of anterior shoulder dislocation.

Other maneuvers used in anterior dislocation of the shoulder include:

- Stimson's gravity method
- Hippocratic method (traction counter-traction)

Solution to Question 10:

Putti-Platt's operation for shoulder instability involves overlapping and tightening of the subscapularis tendon and capsule. It is not commonly done anymore.

Surgeries done for shoulder instability include:

- Bankart's operation (most common): The glenoid labrum and the capsule are re-attached to the front of the glenoid rim.
- Laterjet-Bristow's operation: The coracoid process is osteotomized and transplanted along with its muscle attachments to the anterior rim of the glenoid.
- Neer's capsular shift: The shoulder joint capsule is detached from the neck of the humerus and shifted inferior to the neck.

Solution to Question 11:

The history and clinical features are suggestive of posterior dislocation of shoulder.

Posterior dislocation of the shoulder usually occurs with an indirect force causing marked internal rotation and adduction. This condition can be seen after a convulsion, or an electric shock. It can also occur after a fall on the flexed and adducted arm, or after a direct blow to the front of the shoulder.

The classical attitude of the arm is internal rotation and locked in that position. The examiner will be unable to externally rotate the arm back to normal position.

Solution to Question 12:

The light bulb sign can be seen on the given AP radiograph of the left shoulder. It is seen in cases of posterior dislocation of the shoulder.

In posterior dislocation of the shoulder, the humerus rotates internally. This causes changes to the normal radiographic contour of the head of the humerus. The humerus appears similar to a lightbulb in AP views.

Posterior dislocation of shoulder - Light bulb sign



Other radiological signs described in posterior dislocation of the shoulder in the AP view are as follows:

- The rim sign: Widening of the glenohumeral joint space $>$ 6 mm
- The vacant glenoid sign: The glenoid fossa looks empty as the humeral head has moved away from it
- The trough sign: A vertical line is seen on the anteromedial part of humeral head due to the impression fracture by the glenoid labrum

Option A: Comolli's sign is seen in scapular fracture.

Option C: Destot's sign is seen in pelvic fracture.

Option D: Oliver's sign is seen in aortic aneurysm.

Solution to Question 13:

The reverse Hill-Sachs lesion is seen on the anteromedial aspect of the humeral head.

It is also known as McLaughlin lesion. it refers to an impaction fracture of the anteromedial aspect of the humeral head.

It is seen following a posterior dislocation of the humerus. This occurs due to the impact of the glenoid rim on the humeral head.

Solution to Question 14:

In the above clinical scenario, the history and radiograph suggest an inferior dislocation of the shoulder, which is also known as luxatio erecta.

Inferior dislocation is rare and occurs when the arm is forcefully pulled up when in full abduction (hyper-abduction force). The head of the humerus gets forced out of the inferior part of the capsule and comes to lie below the glenoid.

The patient will present with the arm locked in abduction. On examination, the humeral head may be felt in or below the axilla.

The X-ray below shows disturbed articulation between the humeral head and glenoid. The humeral head is seen below the glenoid. The humerus shaft is in the abducted position. This is characteristic of luxatio erecta.



Solution to Question 15:

The most common sequela of traumatic shoulder dislocation in young adults is recurrent dislocations of the shoulder joint.

Traumatic shoulder dislocation is associated with tear of the glenoid labrum (Bankart lesion). This results in loss of attachment of the inferior glenohumeral ligament, which is the primary static stabilizer of the shoulder.

In addition, there is a loss of concavity due to damage to the labrum. Therefore, the shoulder joint becomes unstable. This predisposes the person to repeated shoulder dislocations. Shoulder instability/recurrent dislocation is an indication for surgical intervention.

Solution to Question 16:

In the above clinical scenario, the history and examination findings suggest a fracture of the proximal humerus. It is most commonly seen in osteoporotic, postmenopausal women.

The most common mechanism of injury in fracture of the proximal humerus is falling on the outstretched hand. The patient usually presents with localized shoulder pain and limitation of movement in the affected arm.

Clinical features:

- Soft tissue swelling and ecchymosis
- Bony tenderness over the upper part of the humerus
- Normal contour of the shoulder is retained (maybe lost in severe fractures and fracture-dislocations)
- Axillary nerve is the most common nerve to be injured in proximal humerus fractures

Management:

- Undisplaced proximal humerus fractures are treated using an arm pouch or sling.
- Displaced and unstable fractures are treated by open reduction and internal fixation.

Fracture surgical neck of humerus



Solution to Question 17:

The most commonly used classification system for proximal humeral fractures is Neer's classification.

Neer classification is based on the displacement of 4 major anatomical components of the proximal humerus:

- Humeral head
- Lesser tuberosity
- Greater tuberosity
- Proximal humeral shaft

Displacement is defined as the separation of any part by more than 1 cm or angulation of more than 45 degrees.

Based on the number of parts displaced, these fractures are classified into 4 major groups. It is divided into one-part fracture, two-part fractures, three-part fractures, and four-part fractures.

Solution to Question 18:

In the above clinical scenario, the history and radiograph suggest a closed fracture of the shaft of the humerus. The radial nerve is commonly damaged in this condition.

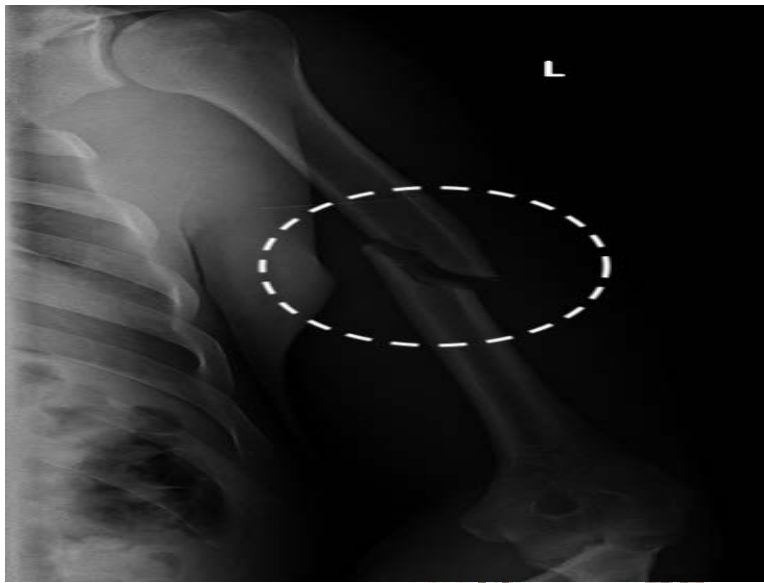
It manifests as an inability to dorsiflex the wrist and digits (wrist drop and finger drop).

Numbness occurs on the dorsoradial aspect of the hand and the dorsal aspect of the radial 3 1/2 digits.

Management of humerus shaft fractures:

- Conservative management using a hanging cast or U-slab for 2-3 weeks followed by functional bracing
- Surgical fixation by compression plating, interlocking intramedullary nail, semi-flexible pins, or an external fixator is indicated in:
 - Open fractures
 - Pathological fractures
 - Unstable humeral and forearm fractures (floating elbow)
 - Radial nerve palsy

The below X-ray shows shaft of humerus fracture.



Solution to Question 19:

The radiograph shows a displaced spiral fracture of the humerus at the junction of the middle-third and distal-third. This is known as Holstein-Lewis fracture.

There is a high risk of entrapment of the radial nerve in the bone fragments of this fracture. Hence this fracture is associated with radial nerve injury (wrist drop).

Holstein Lewis fracture



Injuries of elbow and forearm

Question 1:

On examining a patient with an injury around the elbow, you notice that the three-point bony relationship is maintained. This finding can be seen in which of the following conditions?

- a) Supracondylar fracture of humerus
- b) Dislocation of elbow
- c) Medial condyle fracture
- d) Intercondylar fracture of humerus

Question 2:

A boy is rushed to the ER by his coach after he sustains a fall during a football match. On examination, there is tenderness and swelling over his left elbow. An X-ray revealed a supracondylar fracture of the humerus. Which of the following is false regarding this injury?

- a) Anterior displacement is more common
- b) Undisplaced fractures are associated with fat pad sign
- c) Displaced fracture with intact posterior cortex is Gartland's type II
- d) Undisplaced fractures are immobilized at 90 degrees

Question 3:

An X-ray done for a child with a history of a fall showed the following finding. Which of the following complications is least likely to be seen in this child?



- a) Injury to the brachial artery
- b) Myositis ossificans
- c) Inability to do OK sign with fingers
- d) Cubitus valgus deformity

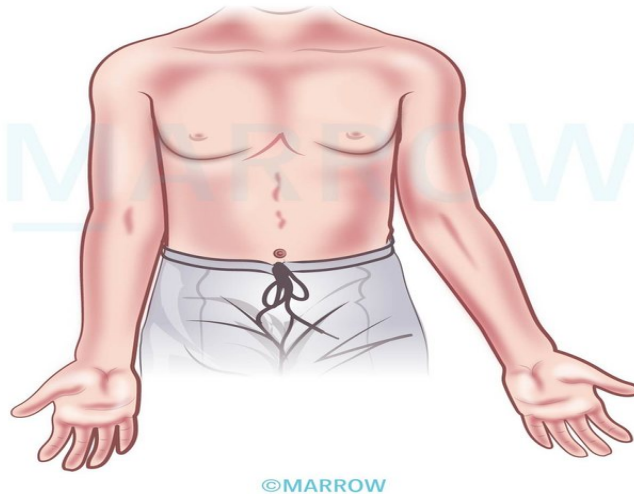
Question 4:

Which of the following injuries is most likely to be seen in a child with a fall on his hand with the elbow extended and forced into varus?

- a) Fracture medial epicondyle of humerus
- b) Fracture lateral condyle of humerus
- c) Fracture neck of radius
- d) Ulnar collateral ligament injury

Question 5:

A patient presented to the PHC with a deformity as shown in the image below. He fractured his left elbow a few months back which he left untreated. Which of the following features is most likely to be associated with this deformity?



- a) Loss of thumb opposition
- b) Anesthesia over tip of the little finger
- c) Anesthesia over the thumb
- d) Wrist drop

Question 6:

A maid is playing with a child by spinning him while holding his hands. A few hours later, the child starts crying, does not use his arm, and does not let anybody touch him. What is the possible diagnosis?

- a) Pulled elbow
- b) Olecranon fracture
- c) Fracture head of radius
- d) Elbow dislocation

Question 7:

Which of the following is false regarding a child presenting with a pulled elbow?

- a) The forearm lies in pronation
- b) The reduction is done under analgesia
- c) The elbow lies in flexion
- d) It is treated by extending and pronating the forearm

Question 8:

Which of the following is the most common type of elbow dislocation?

- a) Posterior dislocation
- b) Anterior dislocation
- c) Medial dislocation
- d) Lateral dislocation

Question 9:

Which of these is not a part of the terrible triad of the elbow?

- a) Posterior dislocation of the elbow
- b) Radial head fracture
- c) Fracture of coronoid process of ulna
- d) Fracture olecranon

Question 10:

A post-menopausal woman presents with a history of pain over the wrist after falling down the stairs. X-ray done is given below. What is the diagnosis?



- a) Smith's fracture

- b) Colles' fracture
- c) Galeazzi fracture
- d) Monteggia fracture

Question 11:

Rupture of which tendon is more likely to occur in patients with Colles fracture?

- a) Extensor pollicis longus
- b) Extensor pollicis brevis
- c) Abductor pollicis longus
- d) Extensor carpi ulnaris

Question 12:

An old lady slipped and fell at home. She was diagnosed with a Colles fracture and managed with a POP cast. What is the correct sequence of reduction?

- a) Traction, POP, palmar flexion, ulnar deviation
- b) Traction, palmar flexion, ulnar deviation, POP
- c) Traction, ulnar deviation, palmar flexion, POP
- d) Palmar flexion, ulnar deviation, traction, POP

Question 13:

The garden-spade deformity is seen in which of the following condition?

- a) Galeazzi fracture
- b) Smith's fracture
- c) Isolated Ulnar fracture
- d) Colles' fracture

Question 14:

A patient presents to the emergency department after he fell on his outstretched hand. An X-ray was performed and is given below. What is the diagnosis?



- a) Colle's fracture
- b) Rolando's fracture
- c) Galeazzi fracture
- d) Monteggia fracture

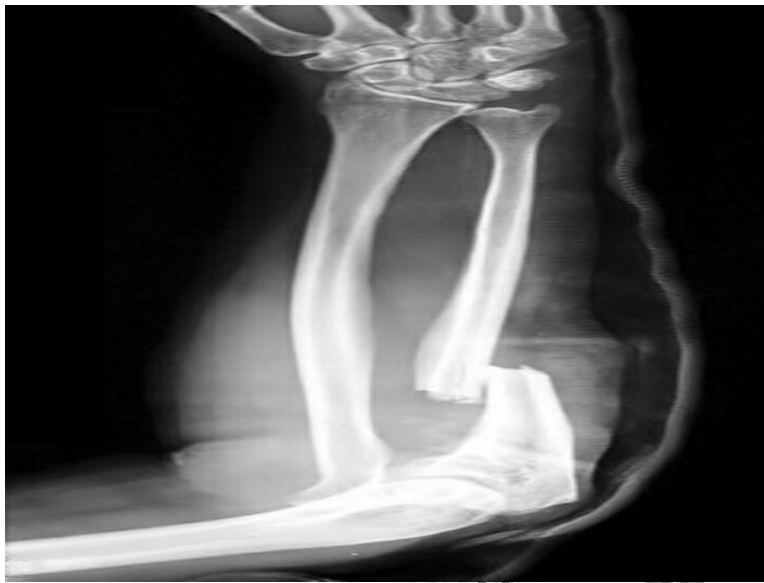
Question 15:

What is the preferred management in an adult with a Galeazzi fracture-dislocation?

- a) Closed reduction with above elbow cast
- b) Closed reduction with below elbow cast
- c) External fixation with Ilizarov method
- d) Internal fixation with compression plating

Question 16:

A child is brought to the casualty with pain and swelling of the forearm. Her mother gives a history of a fall while running in the playground. Radiograph image is given below. What is the likely diagnosis?



- a) Monteggia fracture
- b) Galeazzi fracture
- c) Barton fracture
- d) Night stick fracture

Question 17:

A basketball player presented to the casualty with severe pain in his wrist. He sustained a fall on his flexed wrist during a match. Examination revealed tenderness and painful dorsiflexion of his wrist. An X-ray of his wrist showed the following finding. What is the likely diagnosis?



- a) Smith's fracture

- b) Colles' fracture
- c) Reverse Barton's fracture
- d) Dorsal Barton's fracture

Question 18:

A person complains of severe pain after he fell backwards on his elbow. His X-ray is shown below. What is the preferred treatment in this condition?



- a) Above elbow slab
- b) Tension band wiring
- c) External fixation
- d) Excision of fractured fragment

Answer Key

Question No.	Correct Option
1	a
2	a
3	d
4	b
5	b

6	a
7	c
8	a
9	d
10	b
11	a
12	b
13	b
14	c
15	d
16	a
17	d
18	b

Detailed Explanations

Solution to Question 1:

The three-point bony relationship of the elbow is maintained in case of supracondylar fracture of the humerus. This is because the fracture occurs above the level of these bony landmarks.

Solution to Question 2:

Posterior displacement or extension type is more common in supracondylar fracture of the humerus.

It is the most common fracture following a fall on an outstretched hand. Most commonly seen in children between 5-8 years of age. On examination, an S-shaped deformity may be seen at the elbow. If the proximal fracture fragment is sharp and has penetrated the muscles and fascia, a dimple may be seen on the skin above the elbow (dimple sign).

Fractures are broadly classified into either extension or flexion types. Extension type fractures are further classified using Gartland's classification as:

- Type I - Undisplaced fractures
- Type II - Displaced fractures but with intact posterior cortex
- Type III - Displaced fractures, with no intact posterior cortex, and the fragment may be displaced either posteromedially or posterolaterally

Characteristic displacements (MID) include medial rotation/ medial tilt, impaction/ proximal shift, dorsal displacement/ dorsal tilt.

Supracondylar fracture of humerus



On radiology:

- Sail sign/ fat pad sign - an undisplaced fracture may show a triangular lucency like a sail of a yacht. This is due to the fat pad around the elbow being pushed forward by hematoma
- Fish-tail sign - due to rotation of the distal fragment, the anterior border of the proximal fragment looks like a sharp spike
- Baumann's angle / humeral-capitellar angle - can help in assessing the degree of medial angulation before reduction

Fat pad or sail sign



Treatment includes:

- Undisplaced fractures - immobilization at 90 degrees flexion in a cast for 3 weeks
- Comminuted or compound fractures - Dunlop's (skin) or Smith's (skeletal) traction
- Displaced fractures - closed reduction with percutaneous fixation

In open or severely displaced fractures or fractures with vascular damage, open reduction with K-wire fixation is indicated.

Solution to Question 3:

The given x-ray shows a supracondylar fracture of the humerus. Malunion leading to cubitus varus (gunstock deformity) is the most common complication following this fracture. Cubitus valgus is a very rare complication.

Cubitus varus is characterized by posterior displacement, horizontal rotation, and coronal tilt of the distal fragment. Correction methods include:

- Lateral closed-wedge osteotomy
- Medial open-wedge osteotomy (King's osteotomy)

The images below shows gunstock deformity.





Complications of supracondylar fracture of the humerus can occur early or late.

Early complications :

- Vascular injury - to the brachial artery resulting in
- Volkmann's ischemia
- Compartment syndrome
- Volkmann's ischemic contracture
- Nerve injury - to the anterior interosseus nerve & median & radial & ulnar nerve

Late complications :

- Gunstock deformity
- Elbow stiffness
- Heterotopic ossification (myositis ossificans)

Patients with anterior interosseous nerve injury are unable to perform the OK sign. This is due to weak flexor digitorum profundus and flexor pollicis longus muscles. The fingers get pinched, and instead of the tips, the volar surfaces of the thumb and index finger make contact.

Solution to Question 4:

Fracture of the lateral condyle of the humerus is most likely to be seen in a child with a fall on an outstretched hand in a varus position.

A large fragment of bone including the lateral condyle breaks off and is pulled away by the attached wrist extensors. The normal 3-point bony relationship at the elbow is lost. It is a Salter-Harris type IV injury as it crosses the growth plate and the epiphysis. It is an intra-articular fracture.

These fractures are managed surgically (fracture of necessity) with open reduction and internal fixation (ORIF) using either screws or K-wire.

Non-union is commonly seen in these fractures. If left untreated, the lateral growth plate fails to grow, while the medial one continues to grow, resulting in a cubitus valgus deformity.

Solution to Question 5:

The given image shows cubitus valgus deformity on the left side. It can lead to late-onset ulnar palsy (tardy ulnar nerve palsy) leading to anaesthesia at the tip of the little finger.

Cubitus valgus deformity is a late complication of non-union of fracture of lateral condyle of the humerus.

Solution to Question 6:

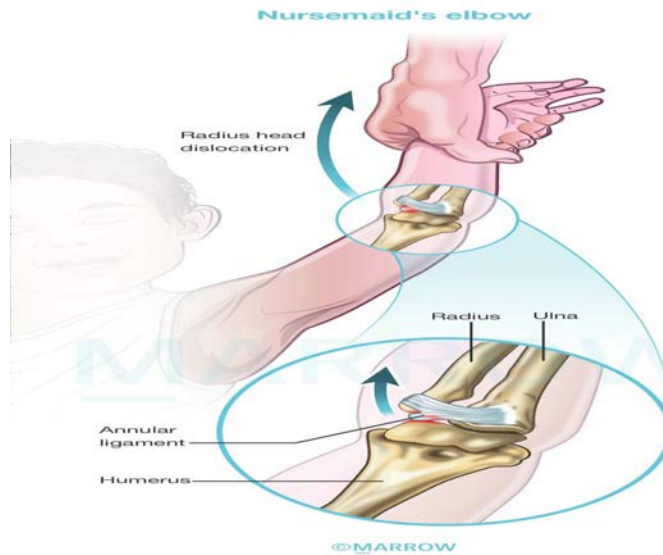
The given scenario of spinning the child by holding his hands, followed by features suggesting pain and inability to use the arm, points to a diagnosis of pulled elbow.

Pulled elbow or nursemaid's elbow refers to the dislocation of the radial head over the annular ligament, commonly seen in children under the age of 6 years. The mechanism of injury is through axial traction on the extended and pronated forearm. This happens when a child is pulled, lifted, or swung by the arm.

Following the dislocation, the child holds the arm relatively immobile, with the elbow extended and the forearm pronated, and resists supination.

The diagnosis is primarily clinical, though X-rays are usually obtained to exclude a fracture.

To treat the condition, simple analgesia is administered, and while the child's attention is diverted, the elbow is extended and pronated to relocate the radial head with a snap. This technique is preferred over the alternative method of supination and flexion, which tends to be more painful and less successful.



Solution to Question 7:

In the case of the pulled elbow, the elbow lies in extension and the forearm is pronated.

Characteristically, the child holds the elbow in extension with the forearm pronated (Option A) and resists supination.

The treatment is done under simple analgesia (Option B) and the procedure is attempted while diverting the child's attention.

There are two methods to treat this condition:

- Extension and pronation: In this technique, the elbow is extended and pronated (Option D) to relocate the radial head with a snap. This technique is reported to be more successful and less painful and, hence, is the preferred treatment.
- Supination and flexion: The elbow is supinated and flexed to relocate the radial head within the annular ligament.

Solution to Question 8:

Posterior dislocations are the commonest type of elbow dislocation.

Elbow joint is the most common joint to dislocate in children. They usually result from a fall on the outstretched hand with the elbow in extension. It may be associated with soft tissue injury involving the brachial artery, ulnar, median, and radial nerve.

These dislocations occur with a progression from lateral to the medial side, termed as Hori's circle. Complete dislocation is usually associated with disruption of the medial and lateral collateral ligaments and anterior capsule.

Patients present with severe pain at the elbow, and with the elbow in flexion. The three bony points relationship is disturbed. The triceps tendon becomes prominent (bowstringing of triceps). Reduction is done under anesthesia followed by immobilization in an above-elbow plaster slab for 3 weeks.

Solution to Question 9:

The terrible triad of the elbow does not include fracture of olecranon.

The terrible triad of the elbow or Hotchkiss triad includes:

- Posterior dislocation of the elbow
- Radial head fracture
- Fracture coronoid process of the ulna

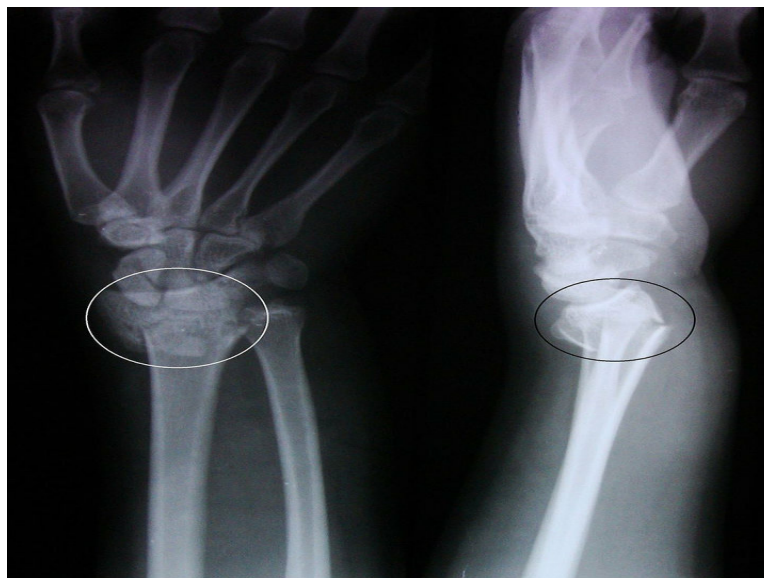
Note: Unhappy triad of the knee occurs due to a lateral blow to the knee causing injury to the anterior cruciate ligament, medial meniscus, and medial collateral ligament.

Solution to Question 10:

X-ray showing an extra-articular fracture at the distal end of the radius with dorsal angulation of the distal fragment is characteristic of Colles' fracture.

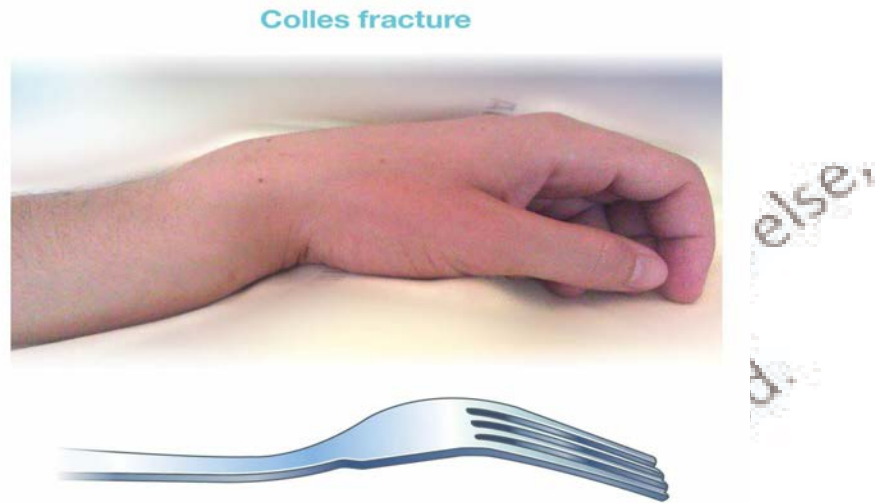
Displacements in Colles' fracture:

- Dorsal tilt/ shift
- Lateral tilt/ shift (Radial tilt/shift)
- Supination
- Impaction of fragments



The clinical feature includes dinner fork deformity with prominence on the back of the wrist and depression in the front. It is treated by a Colles' cast, which immobilizes the wrist in palmar flexion, pronation, and ulnar deviation.

The below image shows dinner fork deformity in Colles' fracture.



Solution to Question 11:

Rupture of the extensor pollicis longus tendon (EPL) occasionally occurs as a late complication of Colles' fracture.

This probably results from damage to the tendon by the sharp edges of the fracture fragments. It is followed by aseptic necrosis of a section of the tendon due to compression in the callus leading to attrition rupture.

Complications of Colles' fracture :

- Joint stiffness - Finger stiffness is the most common complication. Wrist, elbow, and shoulder are the other joints that can become stiff
- Malunion - is the second most common complication, and leads to dinner fork deformity
- Sudeck's osteodystrophy/ reflex sympathetic dystrophy
- Rupture of extensor pollicis longus tendon
- Carpal tunnel syndrome - causing median nerve compression
- Non-union - extremely rare

Solution to Question 12:

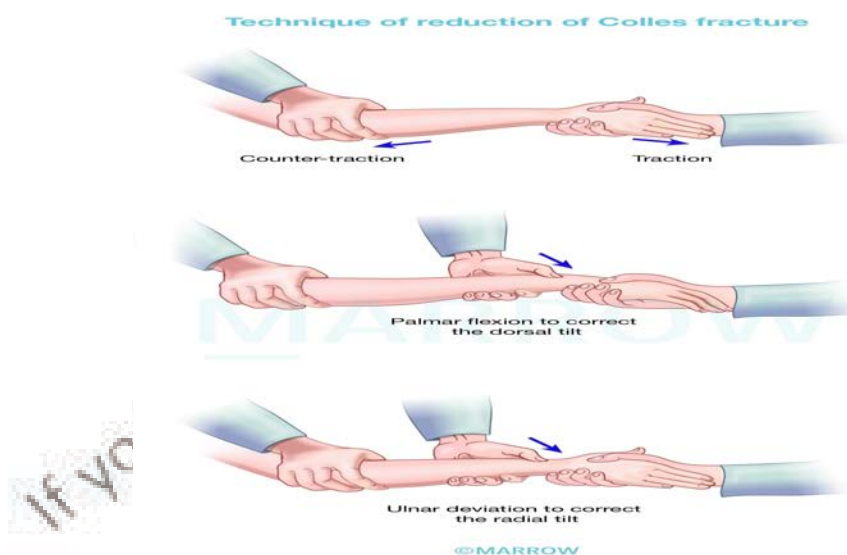
The correct order of reduction Colles' fracture is traction, palmar flexion, ulnar deviation, POP.

Management of Colles' fracture:

- Undisplaced fractures - Immobilization in a below-elbow plaster cast for 6 weeks
- Displaced fractures - Closed manipulative reduction and immobilization in Colles' cast
- Comminuted fractures in young adults - Surgical correction with percutaneous K-wire fixation, external fixators, or locking compression plates

The technique of reduction of Colles' fracture is as follows:

- Disimpaction of the fracture fragments by longitudinal traction against counter traction provided by the assistant
- The distal fragment is then pressed into palmar flexion followed by ulnar deviation
- The patient's hand is drawn into pronation, palmar flexion, and ulnar deviation
- A Colles' cast is then applied, extending from below the elbow to the metacarpal heads, with the wrist in palmar flexion and ulnar deviation

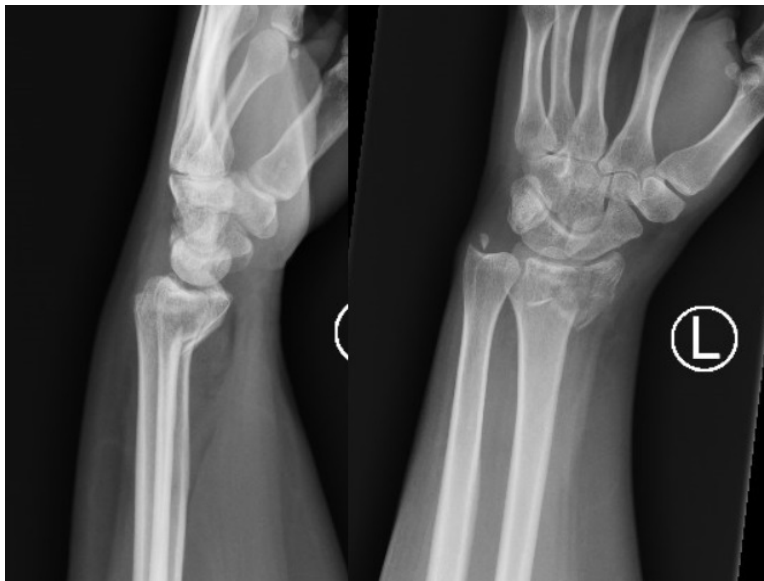


Solution to Question 13:

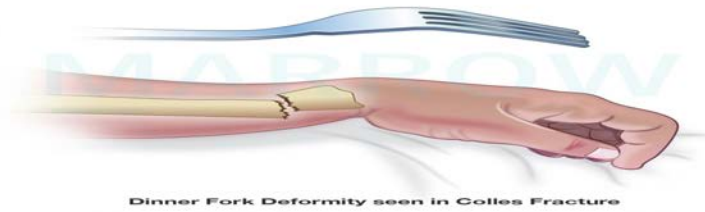
Garden spade deformity is seen in Smith's fracture.

Smith's fracture is the fracture of the distal one-third of the radius with palmar displacement. It is also called reverse Colles' fracture because it has displacements opposite to that of Colles' fracture i.e, pronation, palmar angulation, and ulnar deviation.

The images given below shows Smith's fracture with garden-spade deformity.



Smith's vs Colles Fracture



Dinner Fork Deformity seen in Colles Fracture



Garden Spade Deformity seen in Smith's Fracture

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Solution to Question 14:

The provided history of falling on an outstretched arm and the X-ray revealing an oblique fracture in the lower third of the radius with dislocation of the distal radio-ulnar joint point to the diagnosis of Galeazzi's fracture.

Galeazzi's fracture is the fracture of the lower third of the radius and the subluxation or dislocation of the distal radioulnar joint. This injury usually happens when one falls on an outstretched hand.

Patients present with pain, swelling, and deformity at the lower end of the radius. On examination, the disruption of the radio-ulnar joint can be elicited by pressing the lower end of the ulna. The ulna moves down and comes back like the key of a piano (piano-key sign).

The aim of treatment for this fracture is to preserve supination and pronation of the forearm. In children, closed reduction is usually enough to achieve perfect reduction. However, in adults, open reduction using a k-wire fixation or compression plating is usually required. It is also important to look for ulnar nerve damage.

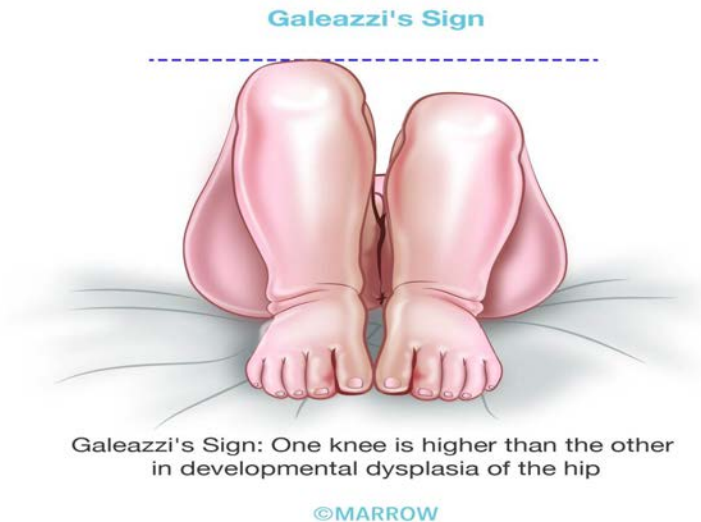
Galeazzi's fracture can cause complications such as malunion due to displacement of the fragment. This often results in deformity and limitation in supination and pronation.

Solution to Question 15:

Galeazzi fracture-dislocation in an adult is managed by internal fixation with compression plating of the radius. In children, closed reduction is usually successful.

Note: Galeazzi's sign is seen in developmental dysplasia of the hip where the infant's knees are flexed and approximated when lying down. One knee is higher than the other in developmental dysplasia.

The below image shows Galeazzi's sign.



Solution to Question 16:

The given X-ray shows a fracture in the proximal third of the ulna and there is a dislocation of the proximal radioulnar joint, which points to a diagnosis of Monteggia fracture-dislocation.

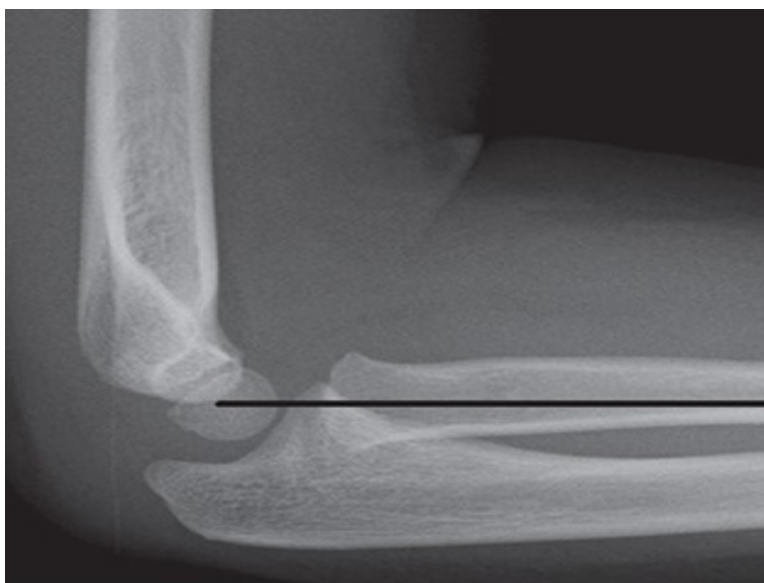
Dislocation of the head of the radius can be detected using McLaughlin's line (radiocapitellar line). A line drawn along the center of the shaft of the radius will cut the capitellum of the humerus in the center irrespective of the position of the elbow. In Monteggia fracture this relationship is disturbed.

The mechanism of injury in these fractures is usually a fall on the outstretched hand. Clinical features include:

- Deformity in the proximal forearm - due to ulnar fracture. The dislocation of the head of the radius may be masked by the swelling
- Pain and tenderness on the lateral side of the elbow - due to proximal radioulnar dislocation

Monteggia fracture is treated surgically (fracture of necessity). The ulnar fracture is reduced and bone restored to full length. It is then fixed with a plate and screws. The radial head usually reduces once the ulna is fixed.

The below image shows radiocapitellar line (McLaughlin's line) in a normal x-ray.



Solution to Question 17:

The radiograph reveals a distal radial fracture that extends into the intra-articular region. This is known as Barton's fracture. In this case, the dorsal segment is fractured, and therefore, this is a dorsal Barton's fracture.

Conservative treatment involves applying a short arm cast with the wrist in the neutral position. Surgical management is by open reduction and internal fixation with percutaneous pins or small plates and screws.

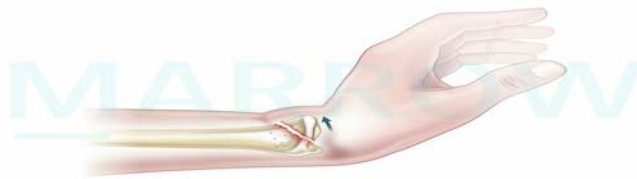
Reverse (volar) Barton's fracture is an articular fracture of the distal radius with dislocation in which the articular surface of the radius remains in contact with the carpus; however, the reverse type involves the volar portion rather than the dorsal aspect of the radius.

Conservative management is with a long-arm cast. Surgical fixation with K-wires, external fixators, and buttress plates are considered if the reduction is not properly retained. Ellis-T-shaped buttress plate fixation is preferred.

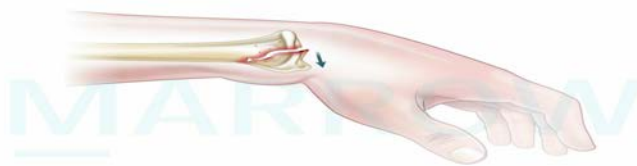
The below images shows reverse (volar) Barton's fracture.



Dorsal and reverse Barton's fracture



Dorsal Barton's fracture



Reverse Barton's fracture

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Solution to Question 18:

The given X-ray shows a displaced transverse fracture of the olecranon. Tension band wiring is one of the management methods in this case.

The Mayo classification divides olecranon fractures into three groups based on fracture displacement and elbow stability. Each group is further subdivided into comminuted or noncomminuted fractures.

- Type I - Undisplaced fractures
- Type II - Displaced but stable fractures
- Type III - Unstable fractures

Treatment includes:

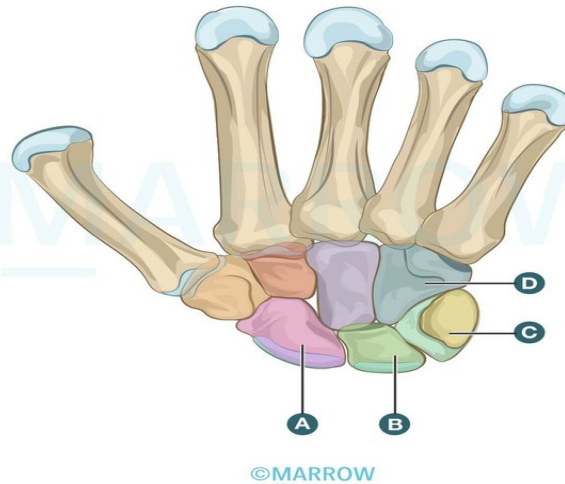
- Type I fractures - non-operative management
- Type II and III fractures - surgery
- Simple fractures without comminution or instability - tension band wiring, plate fixation, or an intramedullary rod
- Comminuted fractures and fractures with elbow instability - plate fixation
- Osteoporotic patients with significant comminution - excision of the olecranon and triceps advancement

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Injuries of hand

Question 1:

Identify the carpal bone that is most commonly fractured after fall on an outstretched hand.



- a) A
- b) C
- c) B
- d) D

Question 2:

A patient presented with swelling and tenderness over the anatomical snuffbox following an RTA. X-ray was performed which showed the following finding. Identify the false statement about this injury.



- a) Oblique x-ray view is preferred in recent fractures
- b) Malunion is a common complication
- c) Cast is applied in glass-holding position
- d) Herbert screw is used for internal fixation

Question 3:

Which of the following structures is most likely to undergo avascular necrosis in patients with scaphoid fracture?

- a) Waist of the scaphoid
- b) Distal fragment of the scaphoid
- c) Distal pole of the scaphoid
- d) Proximal fragment of the scaphoid

Question 4:

Which of the following is incorrect about perilunate dislocation?

- a) Lunate is dislocated anteriorly but the rest of the carpals remains in position
- b) Lunate remains in position but rest other dislocate dorsally
- c) Involves median nerve injury
- d) Tavernier's manoeuvre is used for closed reduction

Question 5:

Terry-Thomas sign is most likely to be seen in patients with which of the following injuries?

- a) Scaphoid fracture at the wrist
- b) Scapho-lunate instability
- c) Radio-carpal instability
- d) Distal radio-ulnar joint instability

Question 6:

A man came to the casualty with severe pain over his thumb. He gave a history of a fall during a football match. X-ray done is given below. What is the likely diagnosis?



- a) Bennett's fracture
- b) Rolando's fracture
- c) Boxer's fracture
- d) Chauffeur fracture

Question 7:

A Bennett fracture is difficult to maintain in a reduced state due to the pull of _____.

- a) Flexor pollicis longus
- b) Adductor pollicis brevis

- c) Extensor pollicis longus
- d) Abductor pollicis longus

Question 8:

A young man presents to the casualty with pain over his hand. He hesitantly mentions that he punched a wall in an anger outburst. A radiograph of his hand is shown below. Which of the following is false about this injury?



- a) MCP joints are kept in full flexion for safe immobilisation
- b) Strength of the grip is significantly affected
- c) It is an intra-articular fracture
- d) Cast is applied in James position

Question 9:

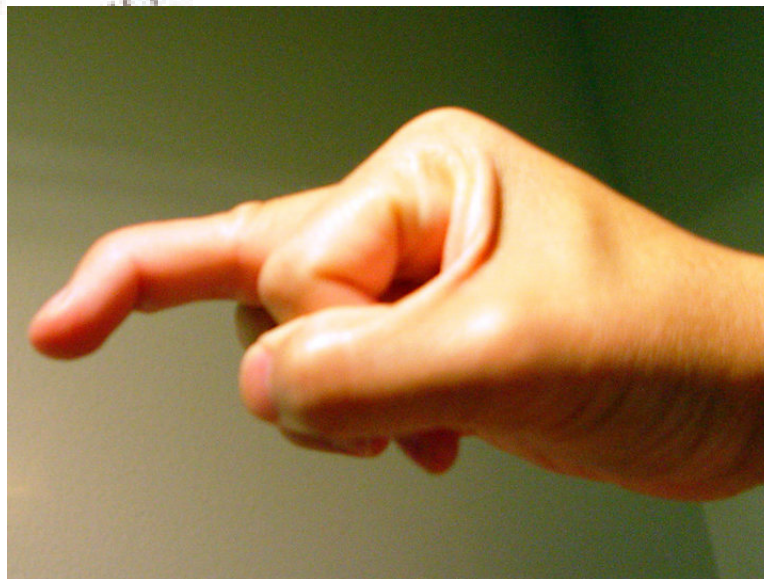
A radiograph of a patient with a history of injury to the hand is given below. What is the likely diagnosis?



- a) Barton's fracture
- b) Chauffeur's fracture
- c) Smith's fracture
- d) Rolando's fracture

Question 10:

A teenager sustained an injury to his middle finger while attempting to catch a basketball during a match. On examination, his finger appeared as shown below. Which of the following is false regarding this condition?



- a) The extensor tendon is disrupted at the distal interphalangeal joint

- b) Results from a forced extension of the fingertip
- c) Passive extension of the distal interphalangeal joint is preserved
- d) Dorsal hyperextension splints are used in the treatment

Question 11:

A footballer came to the casualty in severe pain over his index finger. He mentioned that the pain started after he pulled his opponent's jersey during the match. Avulsion of which tendon from the distal phalanx is most likely to occur in a patient with this condition?

- a) Extensor digitorum tendon
- b) Flexor digitorum superficialis tendon
- c) Flexor digitorum profundus tendon
- d) Extensor pollicis longus tendon

Question 12:

A middle-aged man presented to the clinic with a history of progressive wrist pain. Examination revealed stiffness of the wrist joint. A radiograph of his wrist is shown below. What is your provisional diagnosis?



- a) Sever disease
- b) Keinbock's disease
- c) Kohler's disease
- d) Osgood-Schlatter disease

Answer Key

Question No.	Correct Option
1	a
2	b
3	d
4	a
5	b
6	a
7	d
8	c
9	b
10	b
11	c
12	b

Detailed Explanations

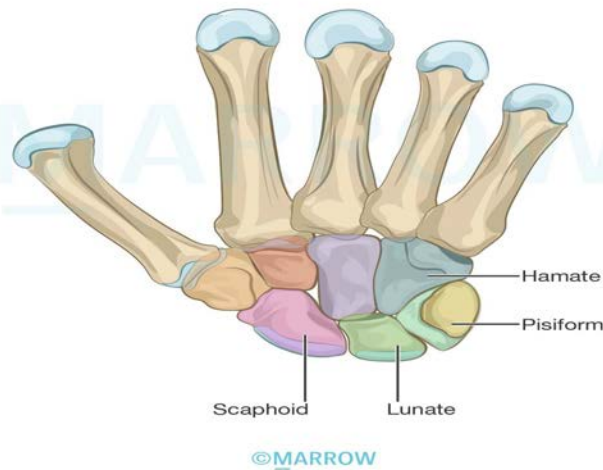
Solution to Question 1:

The scaphoid (labelled as A) is the most commonly fractured carpal bone after a fall on an outstretched hand.

It is more susceptible to fracture because it lies obliquely across the two rows of carpal bones. It also lies along the line of loading (i.e, in the line of weight transmission) between the forearm and thumb. A combination of forced carpal movement and compression, such as in a fall on the dorsiflexed (outstretched) hand, exerts severe stress on the scaphoid making it liable to fracture.

Due to its blood supply originating from the dorsal distal pole, the scaphoid's proximal pole possesses a poor blood flow, making it less prone to heal and resulting in non-union.

Carpal Bones



Solution to Question 2:

The given clinical presentation and the x-ray are suggestive of scaphoid fracture. Nonunion is a common complication of this condition, while malunion is rare.

Scaphoid fracture characteristically presents with tenderness in the anatomical snuffbox following a fall on an outstretched hand.

Recent fractures are less likely to be visible on AP view x-ray, hence oblique x-ray view is preferred. Common complications of scaphoid fracture include:

- Non-union and delayed union
- Avascular necrosis
- Wrist osteoarthritis

Treatment includes:

- Undisplaced fractures - immobilization in a scaphoid cast applied in a glass-holding position
- Displaced fractures - open reduction and internal fixation using Herbert's screw

The below image shows a Herbert screw.

Herbert screw



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Solution to Question 3:

The proximal fragment of the scaphoid undergoes avascular necrosis following a fracture.

This is because the blood supply of the scaphoid is from its distal end to the proximal end. A fracture disrupts the blood supply to the proximal part.

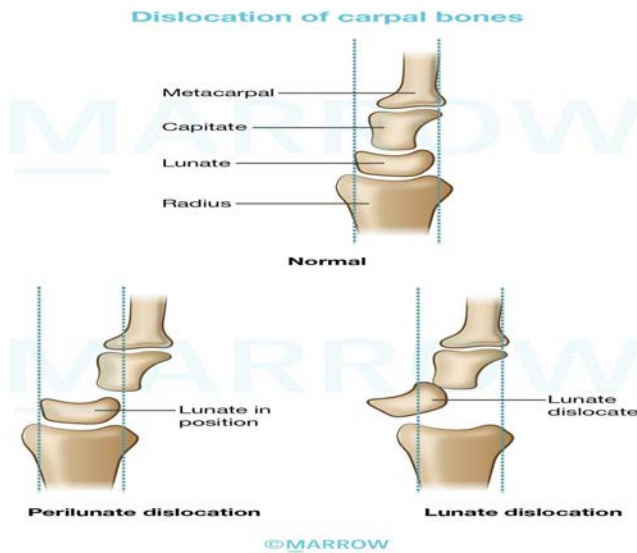
Solution to Question 4:

Among the given options, statement A is incorrect.

A fall on a dorsiflexed hand may tear the tough ligaments that normally bind the carpal bones, leading to dislocations. In peri-lunate dislocation, the lunate remains in position in the lunate fossa of the distal radius but the rest of the carpals dislocate dorsally. It is frequently associated with compression of the median nerve.

Prompt reduction reduces swelling and potential damage to the median nerve. The Tavernier maneuver is the most commonly used method of closed reduction. It involves locking the capitate into the distal concavity of the lunate. If the injury cannot be reduced using this method, urgent reduction in the theater should be performed.

In lunate dislocation, the lunate dislocates anteriorly while the rest of the carpal bones remain in place.



Solution to Question 5:

Terry–Thomas sign is most likely to be seen in patients with scapholunate instability.

It denotes the increased gap between the scaphoid and the lunate. A scapholunate gap of >3 mm is suggestive of instability. It results from tearing of the scapholunate ligament following a fall on an outstretched hand.

The given x-ray shows the Terry-Thomas sign. The sign is named after Terry Thomas, a British comedian with a visible gap between his two maxillary central incisors.



Solution to Question 6:

The given scenario and radiograph point to a diagnosis of Bennett's fracture.

Bennett's fracture is an oblique, simple intra-articular fracture of the base of the first metacarpal bone.

The given image shows Bennett's fracture.



Option B: Rolando's fracture is an intra-articular comminuted fracture of the base of the first metacarpal.

Option C: Boxer's fracture is the fracture of the fifth metacarpal neck.

Option D: Chauffeur fracture is a fracture of the radial styloid process.

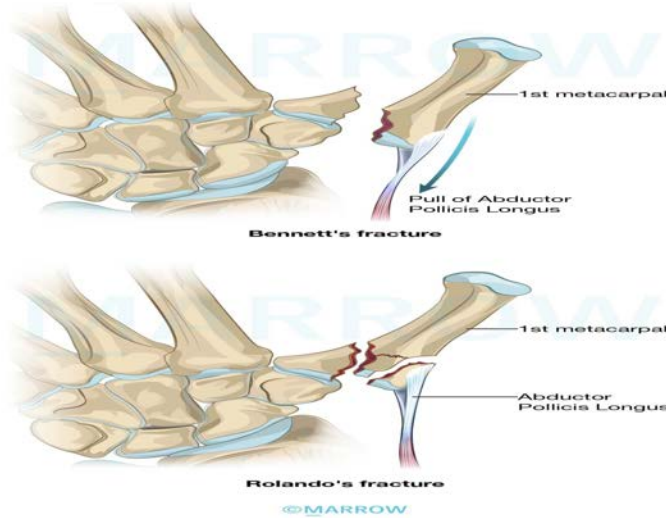
Solution to Question 7:

Bennett's fracture is difficult to maintain in a reduced state due to the pull of the abductor pollicis longus tendon on the shaft of the first metacarpal.

The small fractured fragment remains in contact with the trapezium but the rest of the metacarpal shaft is pulled proximally by the abductor pollicis longus tendon that is attached to its base.

In contrast, the comminuted fracture line of Rolando's fracture prevents the pull of the abductor pollicis longus tendon from being exerted on the metacarpal shaft.

Fractures at the base of first metacarpal

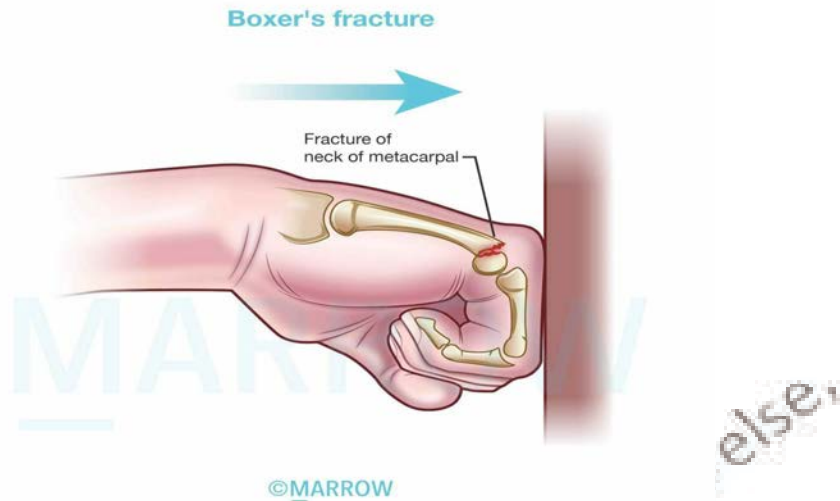


Solution to Question 8:

The given scenario and image showing an extra-articular fracture of the fifth metacarpal neck points to boxer's fracture. The strength of grip decreases in this fracture as the fourth and fifth fingers are responsible for the power grip of the hand.

Boxer's fracture is caused by striking an object with a closed fist, as seen in boxing, or occasionally by a direct injury.





The POP cast is applied in James' position/the position of safe immobilization for metacarpal fractures. Position of safe immobilization:

- Wrist slightly extended
- MCP joints in full flexion and the IP joints extended
- Thumb in abduction

This prevents stiffness and contractures as the ligaments are at their longest in this position.

Position of safe immobilization for metacarpal fractures (James' Position)



Wrist is slightly extended, MCP joints in full flexion, IP joints extended and thumb in abduction

Solution to Question 9:

The given radiograph showing a fracture of the radial styloid process points to a diagnosis of Chauffeur's fracture.

It is caused either by direct trauma to the wrist or traumatic radial deviation of the wrist.

Option A: Barton's fracture is an intra-articular fracture of the distal radius with volar subluxation of the wrist.

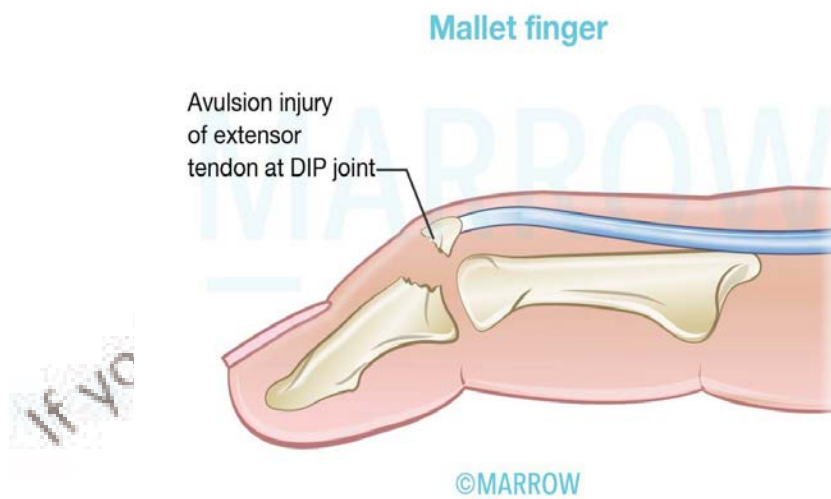
Option C: Smith's fracture is a distal radial fracture with associated volar angulation of the distal fracture fragment. It is also called reverse Colles fracture.

Option D: Rolando's fracture is an intra-articular comminuted fracture of the base of the first metacarpal.

Solution to Question 10:

The given scenario and image showing a flexed fingertip are suggestive of a mallet finger. It results from sudden, forced flexion of the fingertip.

Mallet finger is also known as baseball finger. It is caused by the disruption of the extensor tendon at the distal interphalangeal joint. This leads to unopposed action of flexor tendon resulting in a flexed fingertip. Passive extension of the distal interphalangeal joint is preserved.



Dorsal hyperextension splints are used for immobilization of the joint.

The given image shows a hyperextension splint.



Solution to Question 11:

The given scenario is suggestive of a jersey finger. Avulsion of the flexor digitorum profundus tendon from the distal phalanx results in this condition.

This injury commonly occurs in rugby and football players. Patients are unable to flex the distal end of the finger.

Option B: Boutonniere's deformity presents as a flexion deformity of the PIP joint and extension of the DIP joint. It occurs as a result of the rupture of the middle slip of the extensor tendon followed by the separation of the lateral slips. The head of the proximal phalanx thrusts through this gap like a button through a buttonhole.

Solution to Question 12:

The given scenario and image showing an increased opacity of lunate due to interrupted blood supply is suggestive of Kienbock's disease.

Kienbock's disease refers to the avascular necrosis of the lunate leading to progressive wrist pain. Patients present with tenderness over the lunate and stiffness of the wrist joint.

Option A: Sever disease or calcaneus apophysitis refers to the inflammation of the calcaneus growth plate in growing children.

Option C: Kohler's disease refers to the avascular necrosis of the navicular bone.

Option D: Osgood-Schlatter disease/ tibial tubercle apophysitis refers to the inflammation of the patellar ligament at the tibial tuberosity. It is characterized by a painful swelling just below the knee. It worsens with activity and is relieved by rest.

Regional conditions of the upper limb

Question 1:

Which of the following patients are unlikely to develop a frozen shoulder?

- a) 54-year-old man with left sided hemiplegia
- b) 34-year-old woman with hyperthyroidism
- c) 45-year-old man with psoriasis
- d) 60-year-old man with history of MI 3 months back

Question 2:

A 45-year-old painter presented with chronic right shoulder pain. The physician performed an empty can test on the patient. Which of the following muscles is he specifically testing for?

- a) Supraspinatus
- b) Infraspinatus
- c) Subscapularis
- d) Teres minor

Question 3:

Painful arc syndrome is seen in all except:

- a) Complete tear of supraspinatus
- b) Fracture greater tuberosity
- c) Subacromial bursitis
- d) Supraspinatus tendinitis

Question 4:

A 35-year-old man working as a clerk in an office presents with the following lesion in his elbow. What is your diagnosis?



- a) Hematoma
- b) Triceps brachii tendon rupture
- c) Olecranon bursitis
- d) Rheumatoid nodule

Question 5:

Which of the following tendons is most likely to be involved in patients with tennis elbow?

- a) Flexor carpi ulnaris
- b) Extensor carpi radialis
- c) Extensor carpi ulnaris
- d) Flexor carpi radialis

Question 6:

A young sportsman presented with pain in his right elbow. On examination, Cozen's test was positive. What is the probable diagnosis?

- a) Draughtman's elbow
- b) Pitcher's elbow
- c) Golfer's elbow
- d) Tennis elbow

Question 7:

A 35-year-old woman presented with left elbow pain. On examination, tenderness over the medial epicondyle was elicited on resisted forearm pronation in extension. Which of the following statements is false about her condition?

- a) It is also called as swimmer's elbow
- b) Associated with ulnar nerve neuropathy
- c) Most cases are managed conservatively
- d) Mills sign is positive

Question 8:

De Quervain's disease classically affects :

- a) Extensor pollicis longus and abductor pollicis longus
- b) Extensor pollicis longus and abductor pollicis brevis
- c) Extensor pollicis brevis and abductor pollicis brevis
- d) Extensor pollicis brevis and abductor pollicis longus

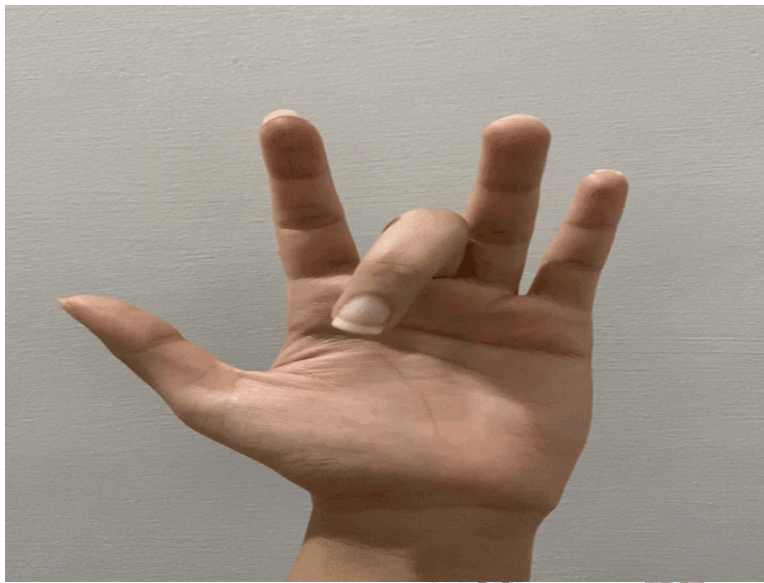
Question 9:

Finkelstein's test is negative in patients with:

- a) De Quervain's disease
- b) Arthritis of radio carpal joints
- c) Intersection syndrome
- d) Ulnar nerve entrapment

Question 10:

A 50-year-old diabetic woman noticed an audible click every time she flexed her left middle finger. The extension of the middle finger is as depicted in the clip below. This is caused due to involvement of which of the following structures?



- a) Extensor tendon
- b) Flexor tendon
- c) Palmar aponeurosis
- d) Dorsal aponeurosis

Question 11:

Which of the following statements is false about the condition shown in the image given below?



- a) X-ray is useful in the diagnosis of the condition

- b) It is more common in males
- c) Phenytoin therapy is a common cause
- d) Surgery is the best treatment

Question 12:

Which of the following is false about the gamekeeper's thumb?

- a) Caused by fall on extended thumb
- b) Caused by valgus stress on the thumb
- c) Volar plate is involved in partial rupture
- d) Ulnar collateral ligament is involved in partial rupture

Answer Key

Question No.	Correct Option
1	c
2	a
3	a
4	c
5	b
6	d
7	d
8	d
9	d
10	b
11	a
12	c

Detailed Explanations

Solution to Question 1:

Psoriasis has no association with frozen shoulder.

Frozen shoulder is defined as the disorder characterized by progressive pain and stiffness in the shoulder joint which spontaneously resolves after around 18 months.

Associated conditions include:

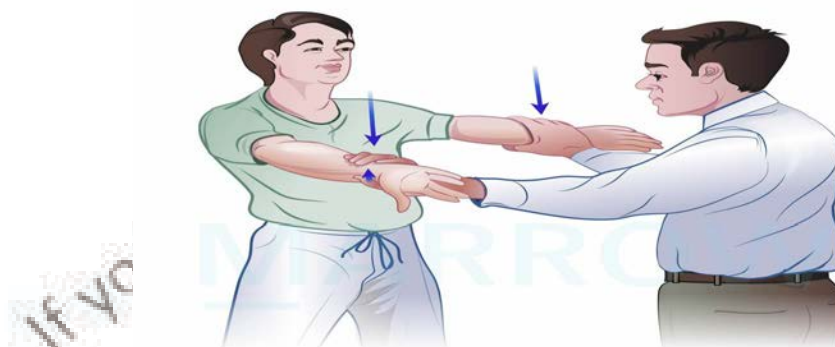
- Diabetes mellitus
- Cervical disc disease
- Hyperthyroidism
- Prolonged immobilization
- Stroke or myocardial infarction

Solution to Question 2:

Empty can test is used to assess supraspinatus muscle.

In this test, the patient is asked to resist the downward force by the examiner, when the arms are in the position of 90° abduction, 30° flexion, and complete internal rotation. The result is positive if the affected side is weaker than the normal side.

Empty Can Test



The patient is asked to resist the downward force by the examiner when the arms are in the position of 90° abduction, 30° flexion, and complete internal rotation.

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Solution to Question 3:

The partial tear of the supraspinatus tendon is responsible for painful arc syndrome rather than a complete tear.

Painful arc syndrome, also known as impingement syndrome is a condition where there is pain in the shoulder and upper arm during the mid-range of shoulder abduction (between 60-120 degrees), arising due to repetitive rubbing of the supraspinatus tendon under the coracoacromial arch.

Causes include:

- Minor tears of the supraspinatus tendon
- Supraspinatus tendinitis
- Calcification of supraspinatus tendon
- Fracture of greater tuberosity
- Subacromial bursitis

Important tests for impingement are:

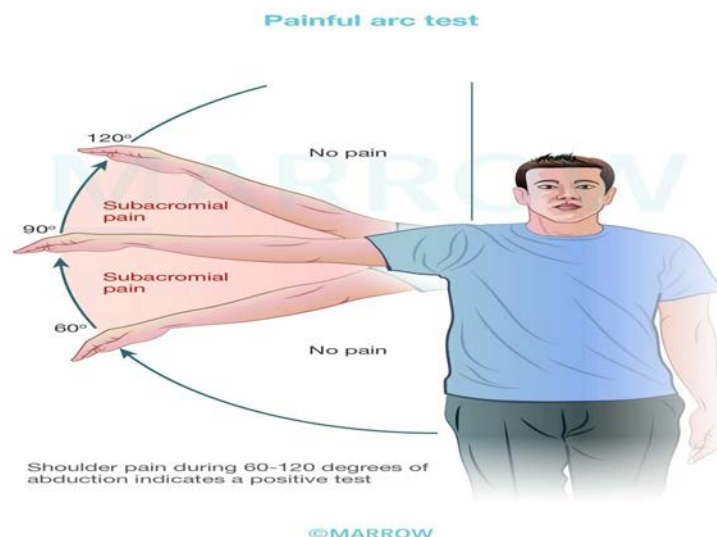
- Painful arc test
- Hawkin-Kennedy's test
- Neer's impingement sign
- Jobe's test

Investigations:

- An x-ray of the shoulder helps to detect bony avulsions, spurs, calcific deposits, sclerotic areas etc.
- Ultrasound of the shoulder joint is highly reliable with a sensitivity of 98%.
- Single contrast arthrogram is considered the gold standard in diagnosing rotator cuff tears

Management:

- Conservative: heat massage, exercises, NSAIDs, subacromial steroid injections, and temporary immobilization (90% of patients recover with these measures).
- Indications for surgery include failure of conservative measures for 3 months, increasing loss of shoulder function, and patients who are young and active.
- Surgical techniques include excision of adhesions and manipulation of the shoulder, excision of calcium deposits, repair of incomplete tear, acromioplasty, acromionectomy for more disabling pain with normal range of movements, direct suture for complete rupture of the rotator cuff, rotation and transposition of the flap, and free graft.



Hawkins–Kennedy test



The affected arm is elevated 90 degrees in the scapular plane with the elbow in 90 degrees flexion. The upper arm is then stabilized and rotated internally.

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Neer's impingement sign



Keeping the scapula stable, the affected arm is raised fully in passive flexion, abduction, and internal rotation.

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Jobe's test



Arms elevated in the scapular plane, elbows extended with the thumb pointing downwards, while the examiner applies downward pressure.

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Solution to Question 4:

The given image is suggestive of olecranon bursitis. It is also known as Draughtman's elbow/student's elbow/ miner's elbow.

Olecranon bursitis is a chronic inflammation of the olecranon bursa, as a result of repetitive minor injuries. It is seen in people who tend to keep their elbow rubbed against the desk. The constant friction against the olecranon bursa can lead to the development of bursitis.

Culture and aspiration of the bursa fluid are done to rule out infection. Most cases can be managed conservatively with NSAIDs and local steroids. A chronically enlarged bursa will require excision.

Solution to Question 5:

The Tendon of Extensor carpi radialis is most commonly involved in tennis elbow.

Solution to Question 6:

The given clinical scenario along with positive Cozen's test is suggestive of tennis elbow (lateral epicondylitis).

Solution to Question 7:

The given clinical scenario is suggestive of Golfer's elbow. Mills sign is positive in Tennis elbow.

Golfer's elbow is due to inflammation at the medial epicondyle, where the pronator muscles have their origin. It is also known as swimmer's elbow. It is less common than tennis elbow.

Tenderness is localized over the medial epicondyle. There is pain on resisted forearm pronation in extension. Ulnar nerve entrapment at the medial epicondyle can result in neuropathy symptoms.

Most of the cases are managed conservatively by activity modification and pain killers.

Solution to Question 8:

De Quervain's disease classically affects extensor pollicis brevis and abductor pollicis longus.

De Quervain's disease is a stenosing tenosynovitis of the extensor tendons of the first dorsal compartment, namely extensor pollicis brevis (EPB) and abductor pollicis longus (APL). It involves noninflammatory thickening of both the tendons and the tunnel or sheath through which they pass. This condition is prominent among females, especially women of childbearing age.

Key diagnostic factors:

- History of joint overuse at home or at work.
- Pain and tenderness at the tip of the radial styloid.
- Positive Finkelstein test: The examiner grasps the thumb of the patient and abducts the hand towards the ulnar side. This causes severe pain over the tip of the styloid process



Treatment in most patients includes conservative management with splinting and steroid injections. Only a few patients require surgical release of the 1st dorsal compartment (housing the APL and EPB tendons).

Solution to Question 9:

Finkelstein's test is negative ulnar nerve entrapment.

Finkelstein's test:

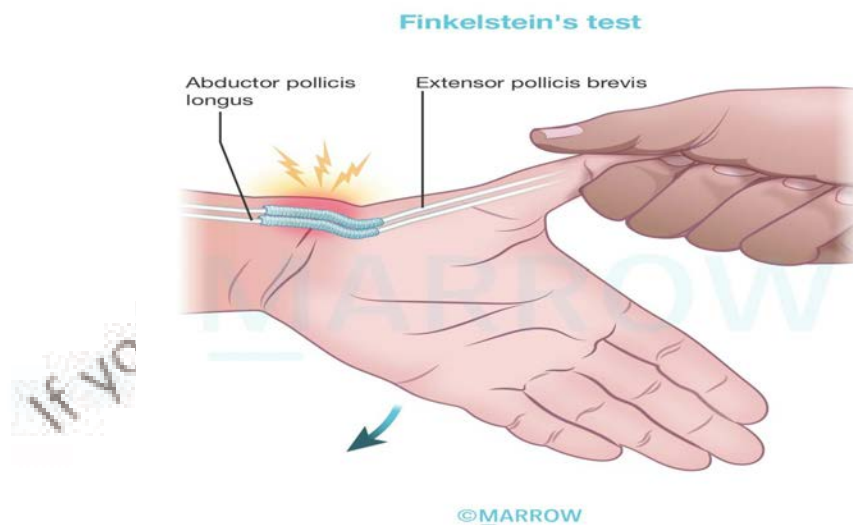
Examiner holds the patient's hand with his thumb tucked firmly and then flexes into the palm; then turn the wrist into full ulnar deviation; in a positive test, this will elicit sharp pain in the affected sheath. The pain over the radial styloid tip is excruciating.

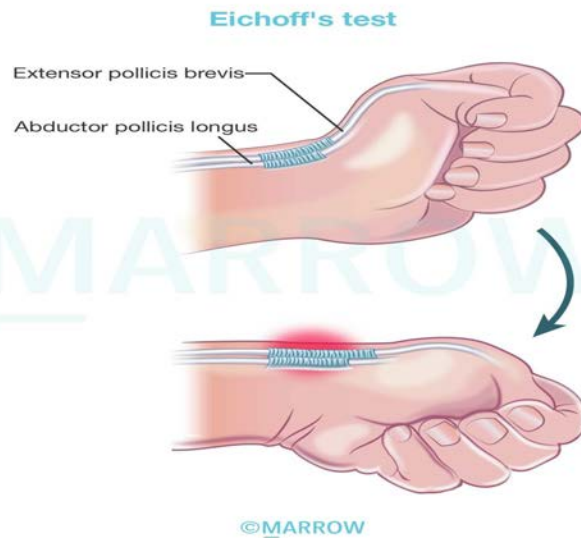
It is positive in the following conditions:

- De Quervain's tenosynovitis
- Arthritis in the intercarpal and radiocarpal joints
- Radial nerve entrapment
- Intersection syndrome i.e. tenosynovitis occurring due to friction between the obliquely placed extensor and abductor pollicis tendons and the longitudinally placed extensor tendons.

Finkelstein stated that this test is "probably the most pathognomonic objective sign

Note: Finkelstein's test is commonly confused with Eichhoff's test: Eichhoff's test is typically described as the examiner ulnar deviating the hand when the person has their thumb held within their fist. If sharp pain occurs along the distal radius, De Quervain's tenosynovitis is suspected.





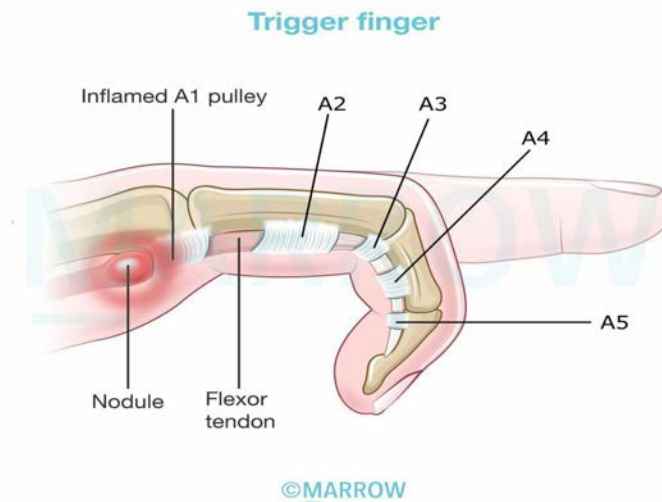
Solution to Question 10:

The clinical scenario along with the video showing the middle finger in the flexed position requiring extra force to extend it is suggestive of a trigger finger.

Trigger finger is caused by stenosing tenosynovitis of the flexor sheath. There is nodular or fusiform swelling on the flexor tendon that prevents it from moving along the A1 pulley.

A1 pulley is an annular ligament that acts as a belt that straps the flexor tendon to the underlying phalanges. There are 5 annular ligaments in each finger namely A1, A2, A3, A4, and A5.

The image given below is showing the nodule in the flexor tendon and the 5 annular ligaments of the finger.



When the finger is flexed or extended, the nodular swelling passes through the A1 pulley with a snap, leading to a triggering effect. The nodule can get trapped behind the A1 pulley leading to a locking of the finger in flexion.

Surgical treatment involves the release of the A1 pulley, which is thickened and fibrosed.

Solution to Question 11:

The condition shown above is Dupuytren's contracture. A radiograph would be the least useful in the diagnosis of this condition.

In Dupuytren's contracture, there is proliferating fibroplasia of the subcutaneous palmar tissue, forming nodules. It is more commonly seen in males.

It results in:

- Finger contractures
- Thinning of subcutaneous fat
- Pitting of skin and knuckle pads

The possible causes are:

- Inheritance
- Phenytoin therapy
- Diabetes mellitus
- Smoking
- Epileptics and alcoholics.

Though surgery is the treatment of choice, it is delayed until the contractures develop.

Treatment of Dupuytren Disease:

Nonoperative:

- External beam radiation
- Steroid injection
- Collagenase

Operative:

- Subcutaneous fasciotomy
- Staged external fixation
- Arthrodesis
- Amputation

Solution to Question 12:

Gamekeepers thumb results due to the rupture of ulnar collateral ligament of thumb metacarpophalangeal joint. The volar plate is not involved in partial rupture, it is involved only in complete rupture.

It can be caused either by fall on extended thumb (forcing it into hyperabduction) or by repeated valgus stress (i.e. radial deviation) on the thumb which occurs during twisting movement of the hand. This type of injury was seen in gamekeepers who used to twist the neck of small animals with their thumb and index finger.

The ulnar collateral ligament keeps the thumb stable in flexion and the volar plate keeps the thumb stable in extension.

In a partial rupture:

- Only the ligament is torn and the thumb is unstable only in flexion
- The volar plate is intact, keeping the thumb stable in extension

In a complete rupture:

- Both the ligament and the volar plate are torn
- The thumb is unstable in all positions

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Dislocations of the Hip joint

Question 1:

Which is the most common type of dislocation of the hip?

- a) Posterior dislocation
- b) Anterior dislocation
- c) Central dislocation
- d) Medial dislocation

Question 2:

Which of the following is likely to be seen in patients with dashboard injury?

- a) 1, 4, 5
- b) 2, 3, 4
- c) 1, 3, 5
- d) 2, 3, 5

Question 3:

A 20-year-old man who had a road traffic accident is brought to the casualty. His right leg is shortened, internally rotated and adducted. On examination, femoral artery pulsation is not felt. What is your diagnosis?

- a) Central dislocation of hip
- b) Fracture neck of femur with injury to femoral vessels
- c) Anterior dislocation of hip with femoral artery injury
- d) Posterior dislocation of hip

Question 4:

A 40-year-old patient presents to the emergency department following a road traffic accident. The radiograph of his pelvis is shown below. What is the most likely diagnosis?



- a) Central dislocation of the hip
- b) Fracture shaft of femur
- c) Posterior dislocation of the hip
- d) Anterior dislocation of the hip

Question 5:

Which of the following structures will not be visualised in the X-ray of a patient with posterior hip dislocation?

- a) Neck of femur
- b) Greater trochanter
- c) Lesser trochanter
- d) Obturator foramen

Question 6:

A 25-year-old patient presents with posterior hip dislocation. Which of the following reduction methods is not used for the management of this patient's condition?

- a) Kocher's manoeuvre
- b) Bigelow's method
- c) Stimson's gravity method
- d) Allis method

Question 7:

A 19-year-old boy is brought to the casualty after sustaining a hip injury during a rugby match. He complains of severe shooting pain in his left leg. His X-ray is given below. What is the cause of pain in this patient?



- a) Sciatic nerve injury
- b) Femoral nerve injury
- c) Inferior gluteal nerve injury
- d) Superior gluteal nerve injury

Question 8:

A 33-year-old motorcyclist presents to the emergency department following a road traffic accident with left hip pain and inability to bear weight. The affected leg is in the position as shown in the image below. What is the most likely diagnosis?



- a) Posterior dislocation of hip
- b) Neck of femur fracture
- c) Intertrochanteric fracture of femur
- d) Anterior dislocation of hip

Question 9:

A 25-year-old mason sustains a fall from the roof. He presents to the casualty with his left hip in flexion, abduction, and external rotation. Lengthening of the left leg is noted. Which of the following statements is false about the suspected diagnosis?

- a) Femoral head can be felt in the groin
- b) Femoral vessels may be injured
- c) Stimson's gravity method can be used for treatment
- d) Femoral head appears smaller than unaffected side in the radiograph

Question 10:

In which type of dislocation is the femoral head palpable per rectally and what is the mechanism of injury?

- a) Anterior - Deceleration injury
- b) Central - direct blow over greater trochanter
- c) Posterior - Direct blow over flexed knee

d) Posterior - Fall from height

Question 11:

Which of the following movements is being tested in the picture given below?



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- a) Internal rotation of hip
- b) Abduction
- c) Flexion
- d) External rotation of hip

Question 12:

A patient presented with lower limb weakness. The examiner places one hand under the patient's heel and the patient is then asked to raise his other leg against downward resistance. What is the test being performed?

- a) Hoover's Test
- b) Mc Bride Test
- c) Waddell's Test
- d) O'Donoghue's Test

Answer Key

Question No.	Correct Option
1	a
2	d
3	d
4	c
5	c
6	a
7	a
8	d
9	d
10	b
11	d
12	a

Detailed Explanations

Solution to Question 1:

The posterior dislocation is the most common type of dislocation of the hip.

There are three types of dislocations of the hip:

- Posterior - seen in motor vehicle accidents where the flexed knee of the passenger hits the dashboard
- Anterior - seen in high energy injuries when the patient falls from the height
- Central - seen when there is a blow over the greater trochanter or fall on the side

Solution to Question 2:

Dashboard injury can lead to:

- Posterior hip dislocation
- Patellar fracture
- Fracture of neck of femur
- Acetabular fracture
- Shaft of femur fracture

- Posterior cruciate ligament injury

Dashboard injury occurs when the knee is flexed and the hip of the driver/passenger thrusts forward against the dashboard of the car in road traffic accidents. Posterior dislocation is most common in this type of injury.

Dashboard injury in a flexed knee in neutral adduction causes simple posterior dislocation. Whereas, if there is slight abduction, posterior fracture-dislocation occurs.

Solution to Question 3:

The given clinical scenario is suggestive of posterior hip dislocation. In this condition, the leg will be in flexion, adduction and internal rotation.

The femoral artery pulsation is usually felt against the neck of the femur. Due to the posterior dislocation of the hip joint, the femoral vessels fall backwards and the pulsation of the femoral artery cannot be felt. This is called as vascular sign of Narath.

Solution to Question 4:

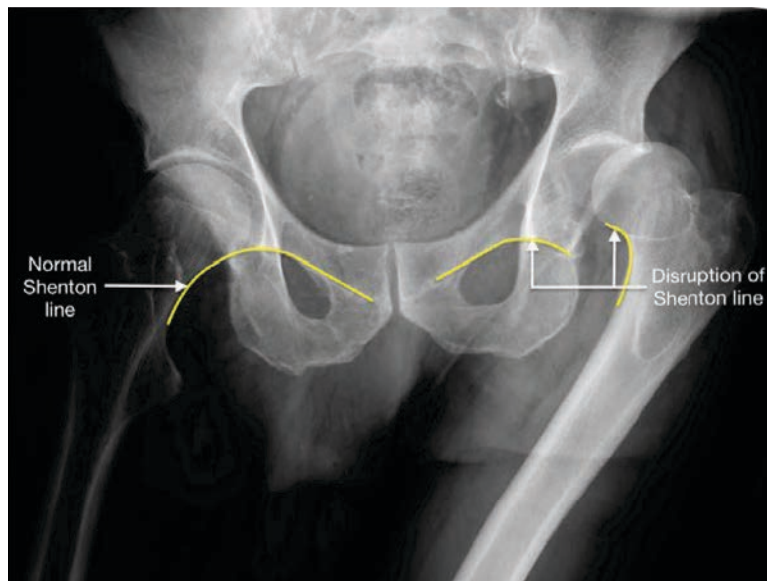
The radiograph of the patient's pelvis following a road traffic accident reveals upward and lateral dislocation of the left femoral head, accompanied by an obscured lesser trochanter, indicating a posterior dislocation of the left hip.

Posterior hip dislocation is commonly seen following dashboard injuries and the patient presents with flexion, adduction, and internal rotation deformity of the lower limb.

Radiological findings:

- Loss of continuity of acetabulum with the femoral head (break in Shenton's line)
- Upward and lateral displacement of the femoral head
- The femoral head appears smaller than normal
- The lesser trochanter is not visualized as the thigh is internally rotated
- Femoral head and posterior acetabular wall fractures may also be seen

The image below shows posterior dislocation with disruption of Shenton's line:



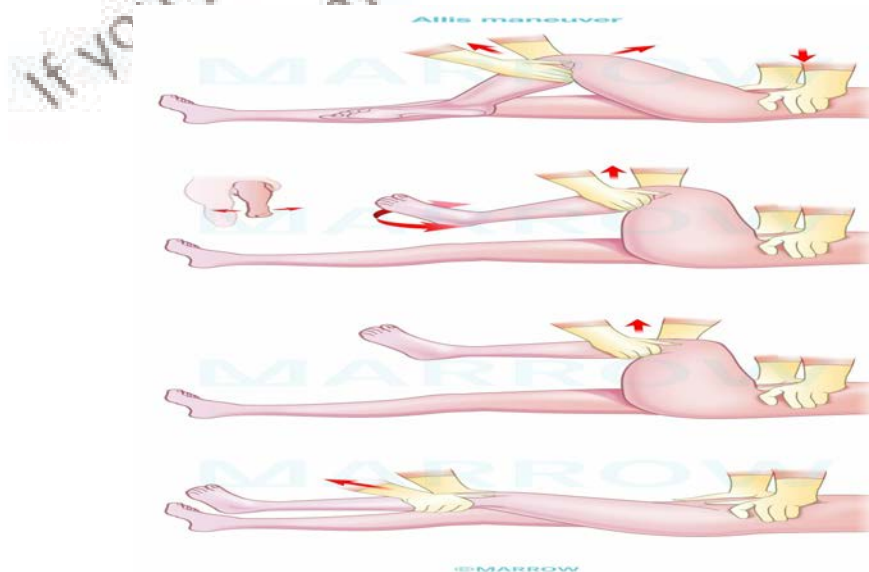
Treatment:

An early reduction should be done as the risk of osteonecrosis and subsequent osteoarthritis increases with time.

Closed reduction under sedation or general anaesthesia is done in most cases. If there is an associated femoral neck fracture, a closed reduction should not be attempted as it can lead to the displacement of the femoral neck and disrupt the blood supply to the femoral head.

In closed reduction the following steps are done:

The pelvis is kept in a steady position and traction is applied in line of the femur with the knee flexed at 90 degrees. The hip is then flexed maintaining the traction along with internal rotation and adduction. This is called Allis' maneuver. The below image describes this technique:



Other methods of closed reduction include - Stimson's maneuver, East Baltimore lift maneuver, and Bigelow's maneuver.

After reduction, the stability of the hip is tested by flexing the hip to 90 degrees, and a longitudinal and posteriorly directed force is applied. While performing this the joint is monitored in an image intensifier to look for any signs of subluxation. In case of evidence of subluxation or any significant fractures then surgical repair should be done. If there is a delay in surgical correction, skeletal traction with a distal femoral traction pin can be done.

If there is damage to the acetabulum, or intervening structures between the femoral head and the acetabular surface are present - open reduction can be considered.

Early complications:

- Sciatic nerve injury - It can be damaged in 10-20% of the cases
- Vascular injury - Superior gluteal artery tear can occur
- Concurrent femoral shaft fracture - When both occur together hip dislocation may be missed

Late complications:

- Osteonecrosis of the femoral head
- Myositis ossificans
- Secondary osteoarthritis
- Recurrent instability

Solution to Question 5:

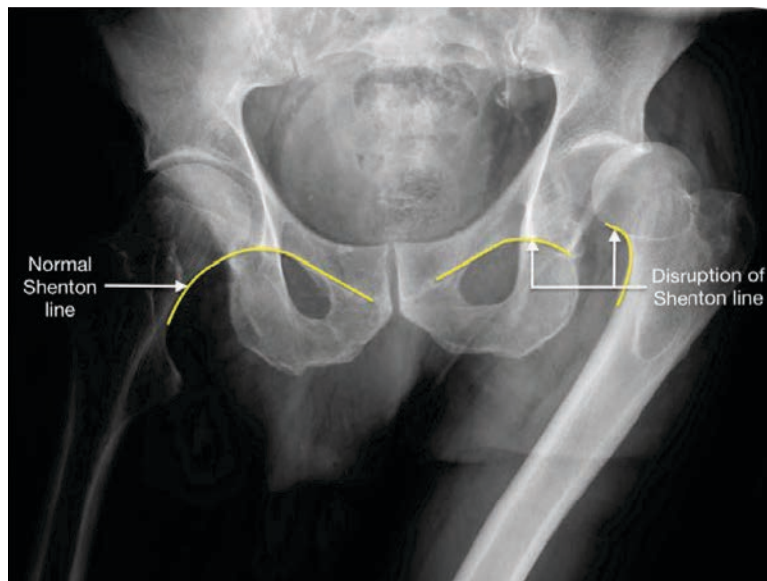
In posterior dislocation of the hip, the lesser trochanter is not visualized in the radiograph. This is due to the internal rotation of the limb.

In posterior dislocation of the hip, there is disruption of Shenton line. It is an imaginary curved line drawn along the inferior border of the superior pubic ramus and along the inferomedial border of the neck of femur. This line is continuous and smooth.

It is usually disrupted in:

- Dislocation of the hip
- Fracture neck of femur
- Developmental dysplasia of the hip

The image given below shows posterior dislocation with disruption of Shenton's line.



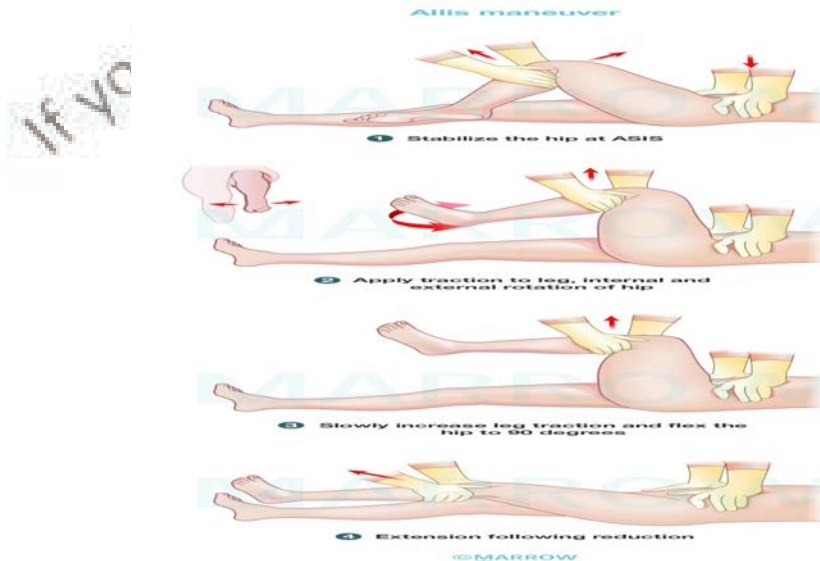
Solution to Question 6:

Kocher's maneuver is used for the management of shoulder dislocation.

Reduction of hip dislocation (closed or open) should ideally be performed within 6 hours to prevent osteonecrosis of the hip joint.

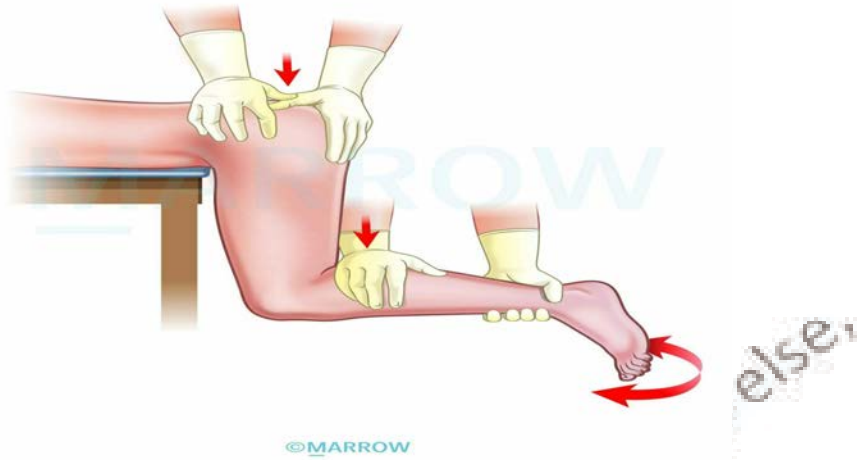
Methods of closed reduction for posterior hip dislocation are:

1. Allis maneuver- traction applied opposite to the direction of deformity



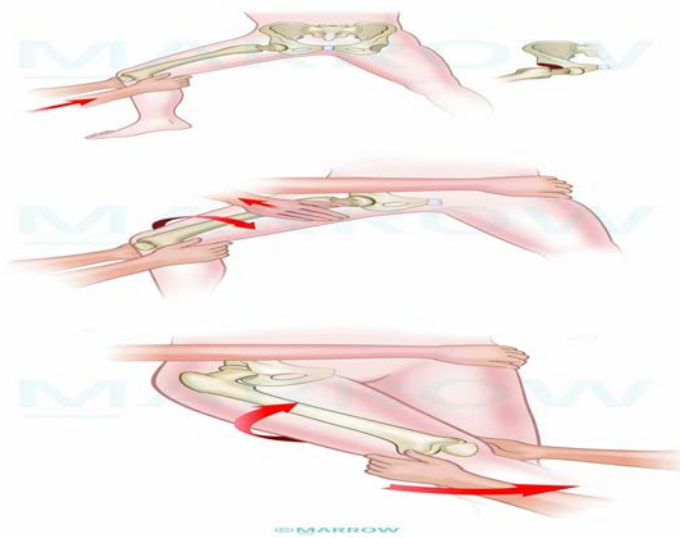
2. Stimson maneuver- downward pressure to the flexed knee (patient is prone and at the edge of the table)

Stimson maneuver



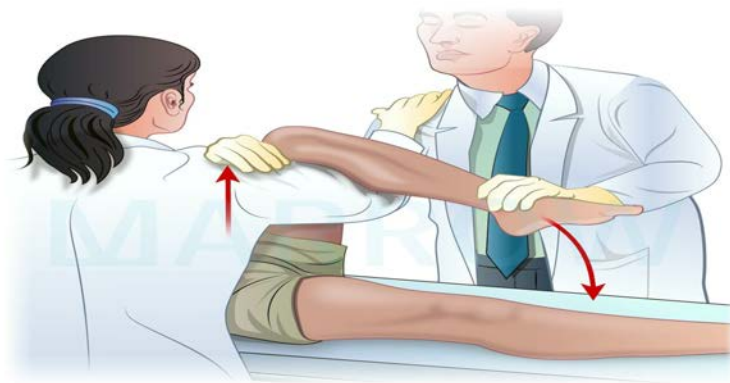
3. Bigelow maneuver- longitudinal traction with pressure on ASIS to stabilize the pelvis

Bigelow maneuver



4. East Baltimore lift maneuver- anterior force on the flexed knee (doctor's and assistant's place hands below the flexed knee)

East Baltimore Lift Manoeuvre



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Solution to Question 7:

The above radiograph shows posterior dislocation of the hip joint. The pain is due to sciatic nerve injury which is a complication in this type of dislocation.

Complications of posterior hip dislocation are:

- Sciatic nerve injury
- Injury to superior gluteal artery
- Osteonecrosis of femoral head
- Secondary osteoarthritis
- Myositis ossificans
- Recurrent instability of the reduced dislocation

Solution to Question 8:

In the given image, the affected leg is in the state of flexion, abduction and external rotation (FABER). This type of attitude of the leg is seen in anterior dislocation of the hip.

According to the position assumed by the femoral head, anterior dislocation of the hip can further be classified as superior and inferior.

- Superior or pubic type - femoral head can be palpated anteriorly
- Inferior or obturator type - femoral head can be palpated in the groin

The image given below shows anterior dislocation of both hip joints.



Solution to Question 9:

The given clinical scenario is suggestive of anterior dislocation of the hip as there is the lengthening of the limb. In this condition, the femoral head appears larger than the unaffected side on the X-ray.

In the inferior type of anterior dislocation, the femoral head is felt in the groin.

Radiographical features include:

- Femoral head appears larger than the unaffected side
- Femoral head may be seen inferior to the acetabulum
- Lesser trochanter is prominent

Complications of anterior dislocation include:

- Injury to femoral vessels
- Injury to femoral nerve
- Irreducibility
- Post-traumatic osteoarthritis
- Aseptic necrosis
- Recurrent dislocation

Methods of reduction include:

- Stimson's gravity method
- Allis's manoeuvre
- Reverse Bigelow's manoeuvre

The image given below shows anterior hip dislocation. The limb is abducted and the femoral head is displaced inferiorly.



Treatment of anterior dislocation includes a closed reduction under sedation or general anesthesia. If closed reduction fails, an open procedure may be planned.

Solution to Question 10:

The given clinical scenario is suggestive of central dislocation of the hip as the femoral head is palpated per rectal examination. The most common mechanism for this type of injury is a side blow over the greater trochanter or a fall on the side.

It is a type of fracture-dislocation where the femoral head is forced medially through the floor of the acetabulum. Hence, the femoral head can be palpated on per rectal examination.

The image given below shows central fracture-dislocation of the hip.



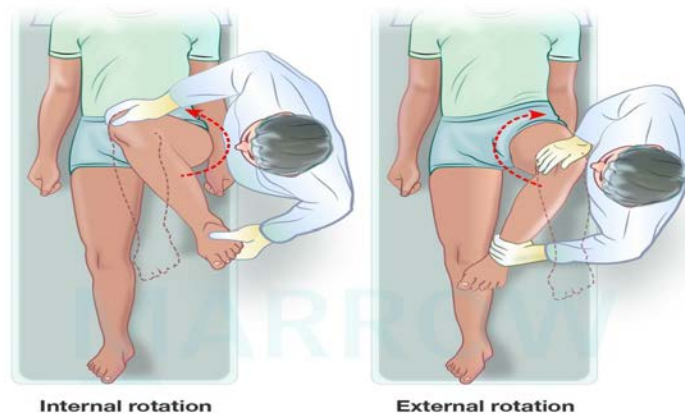
Solution to Question 11:

External rotation of hip is being tested in the given image.

Rotatory movements of the hip joint can be measured with the knee flexed or extended. However, more precise measurements are obtained when the rotation is tested with the flexed knee. The procedure involves the following steps.

- The patient is made to lie supine.
- The examiner holds the knee with one hand and ankle with the other hand.
- The knee and hip are flexed to 90 degrees.
- Rotation movement is produced at the hip joint by stabilising the knee and moving the leg as the lever.
- If the hip is rotated such that the leg moves medially, external rotation of the hip occurs.
- If the hip is rotated such that the leg moves laterally, internal rotation of the hip occurs.

Internal and external rotation of hip



Internal rotation

External rotation

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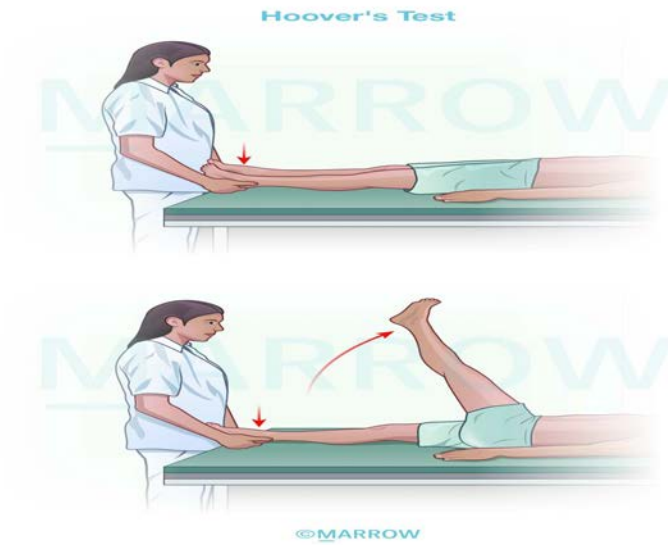
Solution to Question 12:

The test being performed by the examiner is Hoover's test. This test is useful in differentiating between the organic and functional causes of limb weakness.

Hoover's test involves the following steps:

- The examiner places both their hands under the heels of the patient.
- The patient is asked to flex the affected hip while keeping the knee extended.
- Downward pressure in the healthy limb is felt by the examiner in an organic cause of limb weakness and in healthy individuals. This pressure is not felt in the functional cause of limb weakness and malingering.

In a normal individual, when raising one leg by flexing at the hip, the other limb exerts a downward pressure which can be felt at the ankle.



The McBride's test, Waddell's test, and O'Donoghue's test are other examination techniques that help in distinguishing between organic and non-organic causes of lower back pain.

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Fractures of femur

Question 1:

Which of the following factors increases the risk of femoral neck fractures?

- a) Hypoparathyroidism
- b) Proton pump inhibitors
- c) Hypertension
- d) Increased levels of physical activity

Question 2:

Which of the following classifications is not used for neck of femur fractures?

- a) Pauwels classification
- b) Garden classification
- c) Delbet classification
- d) Neer's classification

Question 3:

The X-ray of a patient with femoral neck fracture showed that all 3 sets of trabeculae were out of alignment. Which Garden's stage of fracture shows this finding?

- a) Stage I
- b) Stage II
- c) Stage III
- d) Stage IV

Question 4:

Which of the following statements is true regarding Pauwel's classification of neck of femur fractures?

- a) Pauwel's angle is directly proportional to stability
- b) Type 2 fracture makes an angle of 60 degrees

- c) Plane of reference is the horizontal plane
- d) Pauwel's angle is formed by fracture line with inter-trochanteric line

Question 5:

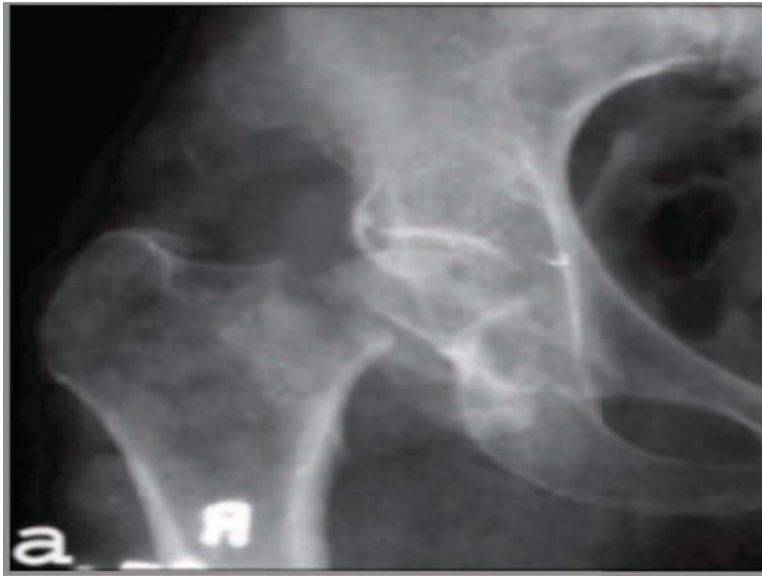
An elderly patient slipped in the bathroom and sustained injury over the left hip. The radiograph is shown below. His attitude of the leg will be:



- a) Shortened and abducted
- b) Lengthened and internally rotated
- c) Shortened and externally rotated
- d) Flexed, adducted and internally rotated

Question 6:

A 70-year-old lady, a known case of chronic osteoarthritis of the hip, has a trivial fall while climbing the stairs. Her right lower limb is in slight external rotation. X-ray pelvis is shown below. What is the next step of management?



- a) Open reduction and internal fixation
- b) Closed reduction and internal fixation
- c) Hemi-arthroplasty
- d) Total arthroplasty

Question 7:

Which of the following is most commonly used for internal fixation of fracture of femoral neck in young adults?

- a) Cannulated cancellous screws
- b) Dynamic hip screw
- c) Austin Moore implant
- d) Herbert screw

Question 8:

A 55-year-old woman presents with complaints of right-sided hip pain and restriction of movements of the right lower limb for 3 weeks. She had a history of trivial trauma 3 weeks ago. X-ray reveals an impacted fracture neck of the right femur. What is the next step of management?

- a) ORIF with fibular bone graft
- b) McMurray's osteotomy
- c) Evaluate further with MRI

d) Hemiarthroplasty

Question 9:

A 56-year-old man came to OPD with a 1-month-old fracture neck of femur. X-ray revealed Pauwel's angle to be 70° . MRI showed a normal femoral head. What is the next step in management?

- a) Open reduction and internal fixation
- b) Mc Murray's osteotomy
- c) Hemi-arthroplasty
- d) Total hip arthroplasty

Question 10:

Which of the following statements is false regarding McMurray's osteotomy?

- a) It is an oblique osteotomy in the inter-trochanteric region
- b) It involves lateral displacement and adduction of the distal fragment
- c) The line of weight bearing after the osteotomy passes from the head to the distal fragment
- d) It converts shearing stress to compressive forces

Question 11:

A 35-year-old woman with a history of ORIF for femoral neck fracture came for post-operative follow up after 7 months. She is unable to bear weight on the operated side. Her X-ray showed no evidence of healing. Which of the following is not a probable cause for this condition?

- a) Improper immobilization
- b) Avascularity of the femoral head
- c) Interference of synovial fluid
- d) Hypertrophy of cambium layer of periosteum

Question 12:

Which of the following is false about the condition shown in the image below?



- a) Malunion can happen if this condition is not treated
- b) The patient may be able to walk
- c) Avascular necrosis is the most common complication
- d) Shortening of limb is less than 1 inch

Question 13:

Which of the following is false about avascular necrosis?

- a) It can be diagnosed on X-ray only after 4 years
- b) It can also occur in united fracture neck of femur
- c) Subcapital type has worse prognosis
- d) Patients with sickle cell disease are at an increased risk

Question 14:

A 35-year-old man is brought to the casualty with a history of RTA. His left lower limb is shortened by 2 inches. The attitude of the leg is extension and externally rotated, with the lateral border of the foot touching the bed. What is the most probable diagnosis?

- a) Inter-trochanteric fracture femur
- b) Fracture neck of femur
- c) Femoral shaft fracture
- d) Anterior dislocation of hip

Question 15:

A 69-year-old woman sustains an injury to the left hip after falling sideways on the floor. She is unable to move the left leg. X-ray is given below. What is the best treatment for this condition?



- a) Proximal femoral nail
- b) McMurray's osteotomy
- c) Total hip arthroplasty
- d) Plaster in abduction and internal rotation

Question 16:

A 68-year-old lady comes with a history of fall and right-sided hip pain for 1 week. On examination, her right limb is shortened and externally rotated. Her X-ray shows no significant findings. What is your next step?

- a) Send the patient home with analgesics for pain
- b) Technetium bone scan within the next 24 hours
- c) Order an MRI of the hip joint
- d) Immobilise the limb and observe

Question 17:

A young patient was brought to the casualty following a road traffic accident. The radiograph of the limb showed a fracture in the mid-shaft of the femur. What will be the direction of displacement of the distal fragment?

- a) Abducted
- b) Adducted
- c) Flexed and externally rotated
- d) Flexed and internally rotated

Question 18:

In which of the following conditions is maximum shortening of lower limb seen?

- a) Inter-trochanteric fracture femur
- b) Fracture neck of femur
- c) Fracture shaft of femur
- d) Transcervical fracture femur

Question 19:

A 24-year old patient was brought to the emergency department after he lost control of his bike and hit a car while texting and driving. On examination, the patient had right thigh tenderness and deformity. The radiograph showed the following findings. What is the preferred method of treatment in the following scenario?



- a) Locking compression plate
- b) Intramedullary nail
- c) External fixation with K wire
- d) Traction with Thomas splint

Question 20:

A 9-year-old girl was run over by a car and was admitted to the hospital with obvious swelling and deformity of the left thigh. Her X-ray showed the following findings. What will be the preferred treatment in the given condition?



- a) Gallow's traction
- b) Locked intramedullary nailing
- c) Elastic intramedullary nailing
- d) Spica casting

Question 21:

A patient was admitted to ICU 48 hours after the fracture of the femur. The saturation of oxygen in the rebreathing unit was 100% but his Spo2 remained 60%. The patient was in a state of confusion. Chest radiograph showed lung fields to be clear. What is the most likely diagnosis?

- a) Pulmonary embolism
- b) Fat embolism

- c) ARDS
- d) Occult pneumothorax

Question 22:

Which of the following is considered a minor criterion for diagnosing fat embolism?

- a) Subconjunctival petechiae
- b) Fat globules in sputum
- c) $FiO_2 < 0.4$
- d) CNS depression

Answer Key

Question No.	Correct Option
1	b
2	d
3	c
4	c
5	c
6	d
7	a
8	c
9	b
10	b
11	d
12	a
13	a
14	a
15	a
16	c
17	b
18	a
19	b
20	c

21	b
22	b

Detailed Explanations

Solution to Question 1:

The use of proton pump inhibitors is a risk factor for femoral neck fractures.

Femoral neck fracture is a type of intracapsular hip fracture. Common risk factors for hip fractures include:

- Increasing age
- Female sex
- White population of Europe and North America
- Smoking
- Decreased level of physical activity

Comorbidities that can cause hip fractures are:

- HIV
- Celiac disease
- Diabetes mellitus
- Hypo and hyperthyroidism
- Primary hyperparathyroidism
- Chronic kidney and liver disease

Drugs that can cause hip fractures are:

- Corticosteroids
- Proton pump inhibitors
- Antipsychotic medication
- Aromatase inhibitors
- Gonadotropin-releasing hormone inhibitors
- Long-acting progesterone-only pills

Solution to Question 2:

Neer's classification is used for proximal humeral fractures.

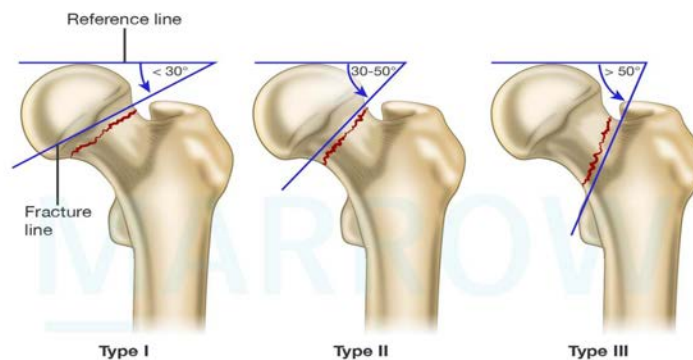
Classifications used for neck of femur fracture are:

- Based on the location of the fracture line
- Pauwels classification
- Garden classification
- Delbet classification (hip fractures in the pediatric population)

Based on the location of the fracture line it can be classified as:

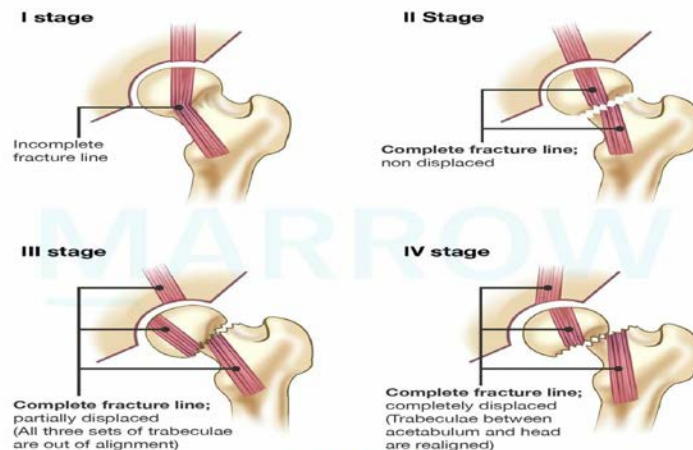
- Sub-capital - fracture at the junction of head and neck
- Transcervical - fracture in the neck
- Basi-cervical - fracture at the base of the neck

Pauwels classification of fracture neck of femur



©Marrow

Garden classification of fracture neck of femur



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Delbet classification is used for hip fractures in children. They are grouped into four types based on their location as follows:

- Type I - Transepiphyseal fracture

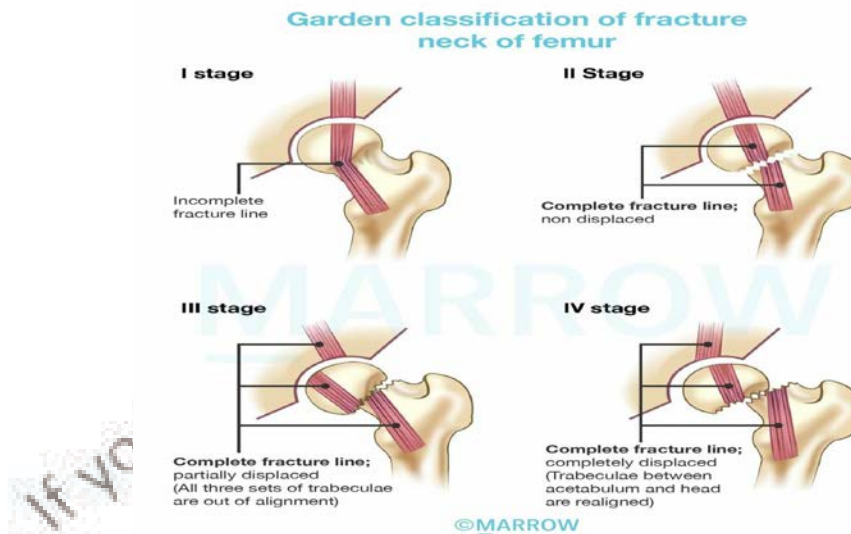
- Type II - Transcervical fracture
- Type III - Cervicotrochanteric fracture
- Type IV - Intertrochanteric fracture

Solution to Question 3:

In Garden's stage III fracture neck of femur, all the 3 sets of trabeculae are out of alignment.

Garden classification of fracture neck of femur is based on the degree of displacement.

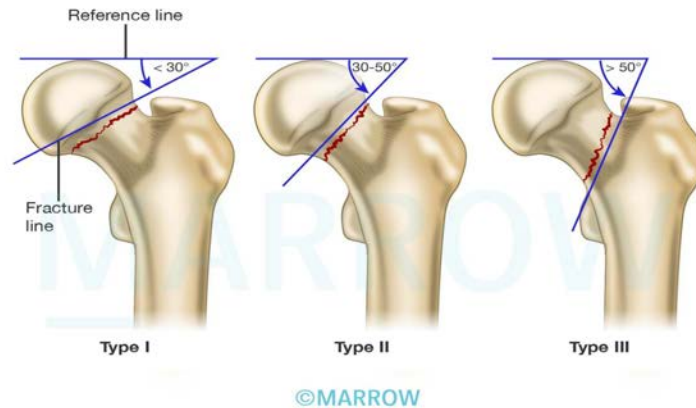
- Stage I - incomplete fracture line and femoral head is in slight valgus
- Stage II - complete fracture line and non-displaced
- Stage III - complete fracture line and partially displaced
- Stage IV - complete fracture line and completely displaced



Solution to Question 4:

The plane of reference in Pauwel's classification is the horizontal plane. This classification is based on Pauwel's angle i.e. the angle made by the fracture line in reference to the horizontal plane.

Pauwels classification of fracture neck of femur



When the Pauwel's angle is small, compressive forces act at the fracture ends and hence the fracture is stable. As Pauwel's angle increases, the fracture line becomes more vertical and the shearing forces act on the fractured ends. Hence, at higher angles the fracture becomes unstable.

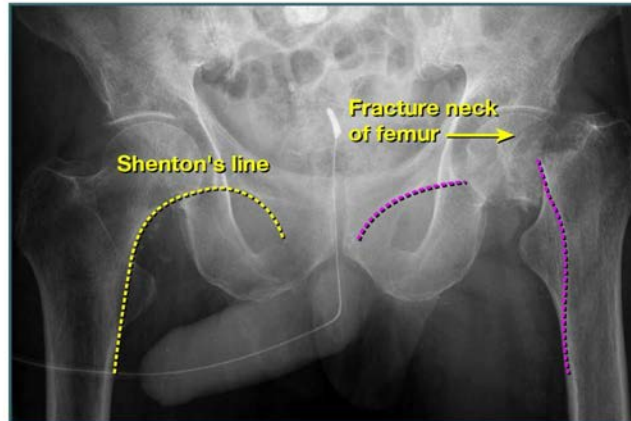
Solution to Question 5:

The history of fall and hip injury in an elderly patient along with the radiological findings of a broken Shenton's line is suggestive of a neck of femur fracture. In this condition, the attitude of the leg will be shortened and externally rotated and movements of the hip joint will be painful.

A plain radiograph may show the following features:

- Fracture line in the neck of femur
- External rotation of the femur with the lesser trochanter appearing more prominent
- Displacement of the greater trochanter
- Break in the trabecular stream
- Break in Shenton's line

Shenton's line in fracture of neck of femur

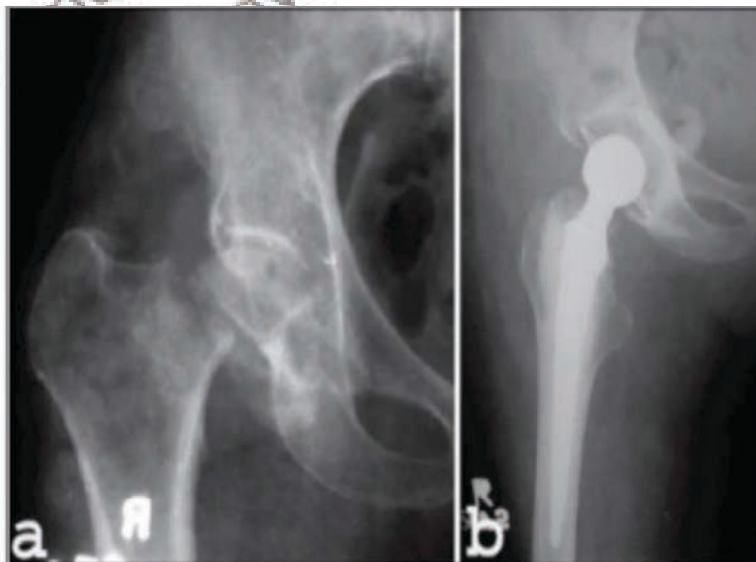


Solution to Question 6:

The given scenario and X-ray are suggestive of right-sided fracture neck of femur, Garden stage IV. Since the patient is >65 years with existing arthritis, the best choice of treatment is total hip arthroplasty.

In the absence of arthritis, fracture neck of femur in patients >65 years, is treated by hemiarthroplasty.

The image given below shows total hip arthroplasty done for fracture neck of femur.



Solution to Question 7:

The most commonly used equipment for internal fixation of fracture neck of femur in young adults is multiple cannulated cancellous screws.

The radiograph given below shows internal fixation of the neck of femur fracture with cannulated cancellous screws.



Option B: Dynamic hip screw is used in some cases of fracture neck of femur and for the internal fixation of the intertrochanteric fractures. The image below shows a dynamic hip screw.



Option C: Austin Moore's implant is an older implant used in unipolar hemiarthroplasty.

Option D: Herbert screw is used in bridging a scaphoid fracture.

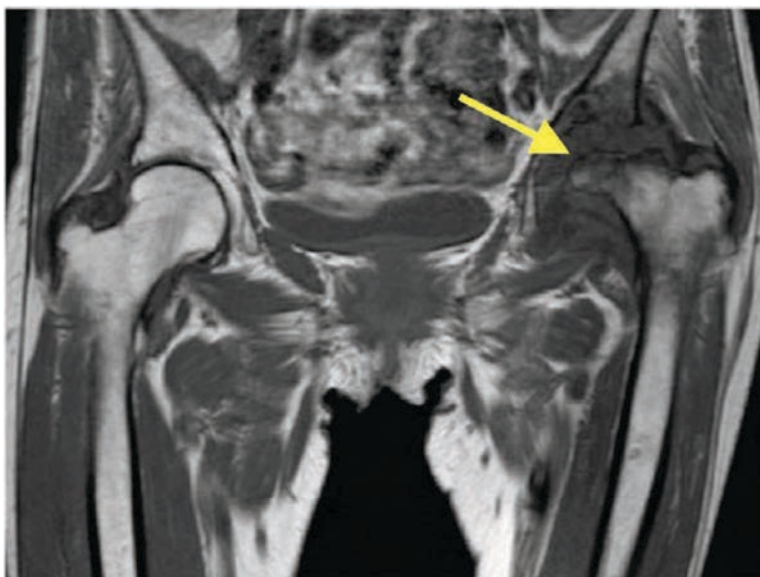
Solution to Question 8:

In the given clinical scenario with a 3-week old femoral head fracture, the next step will be to do an MRI hip. This is to evaluate the femoral head for compromise in the blood supply.

Treatment of the femoral head fracture depends on the findings seen on an MRI:

- Femoral head shows compromised blood supply - reduction with fibular bone graft or muscle pedicle graft
- Femoral head shows signs of osteonecrosis and acetabulum is normal - hemiarthroplasty
- Femoral head is normal but the fracture is nearly vertical (can develop to non-union) - osteotomy

The image given below shows osteonecrosis of the femoral head seen on an MRI.



Solution to Question 9:

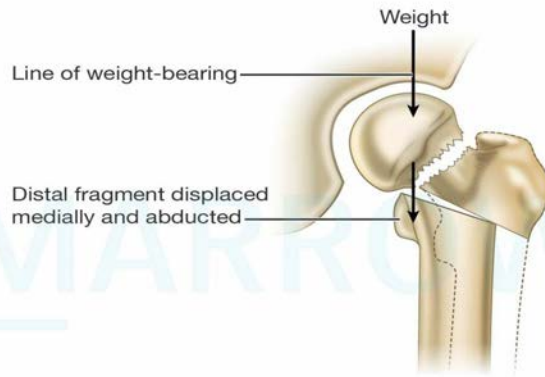
The given clinical scenario is suggestive of a 1-month-old Pauwel's type III fracture ($>50^\circ$), which is nearly vertical and has an increased chance of non-union. Hence, the best management would be to compress the fractured ends by Mc Murray's osteotomy and internal fixation.

Solution to Question 10:

In McMurray's osteotomy, the distal fragment is displaced medially and is abducted. This converts shearing stresses at the fracture site to compressive forces promoting faster healing.

McMurray's osteotomy is an oblique osteotomy directed medially upwards at the inter-trochanteric region. It is based on the biomechanical principle. After the medial displacement of the femur, the weight-bearing line passes from the head to the distal fragment. It, therefore, bypasses the fracture site.

McMurray's Osteotomy



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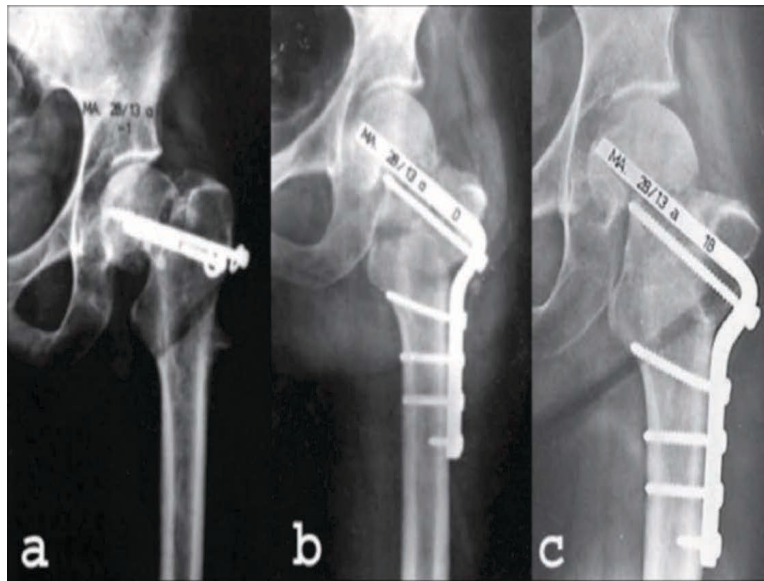
Solution to Question 11:

The given clinical scenario is suggestive of non-union of femoral neck fracture after ORIF, as there is no evidence of healing 6-12 months post-operatively. Lack of cambium layer in the periosteum of neck of femur is one of the causes of non-union.

Causes for non-union in the neck of femur fracture are as follows:

- Inadequate blood supply of femoral head
- Since the fracture is intra-articular, the synovial fluid interferes with fracture healing.
- Lack of the cambium layer of periosteum, which produces the callus
- Inadequate reduction and poor internal fixation
- Improper immobilization

The image given below shows (a) non-union of neck of femur fracture, (b) osteotomy to correct the non-union, (c) 5 months post-osteotomy with healed fracture.



Solution to Question 12:

The radiograph shows a fracture neck of the femur. Non-union is a complication of this fracture, not malunion.

Malunion is a complication of inter-trochanteric fractures.

Complications of fracture neck of the femur are:

- Avascular necrosis (most common)
- Non-union
- Osteonecrosis of the femoral head may lead to secondary osteoarthritis after many years

Option B: In impacted fracture neck of femur, the patient may be able to walk.

Option D: Shortening of the limb is less than 1 inch in fracture neck of femur.

Solution to Question 13:

Avascular necrosis is a late complication of fracture neck of the femur, which can be diagnosed on X-ray only after a few months to 2 years after the injury. Hence, MRI is the best investigation for diagnosis.

The amount of vascular damage produced at the time of fracture determines the probability of the development of osteonecrosis. In addition to this, the blood supply to the femoral head may also be disrupted during internal fixation. Hence, avascular necrosis can also occur in united femur fractures.

More proximally the fracture is located, worse is the prognosis. Hence, sub-capital fractures have the worst prognosis.

Patients with sickle cell disease are at an increased risk for developing avascular necrosis of the femoral head.

Solution to Question 14:

The given clinical scenario with the limb shortening >1 inch and pronounced external rotation is suggestive of inter-trochanteric fracture of the femur.

Differences between fracture neck of femur and inter-trochanteric fractures:

Option B: In fracture neck of femur, the limb is in slight external rotation and shortening is <1 inch.

Option C: In femoral shaft fractures, the limb is shortened with displaced proximal and distal fragments.

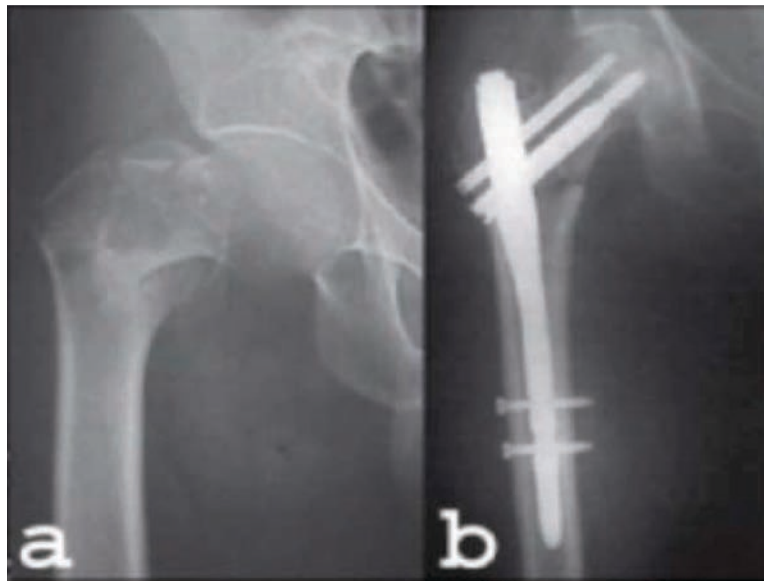
Option D: In anterior dislocation of the hip, the limb is externally rotated. There may be a true lengthening of the limb with the femoral head palpable in the groin.

Feature	Fracture neck of femur	Inter-trochanteric fracture
Age	More than 50 years	More than 60 years
Sex	Common in females	Common in males
Injury	Trivial	Significant
Ability to walk	May walk	Unable to walk
Pain	Mild	Severe
Swelling	Nil	Severe
Ecchymosis	Nil	Present
Tenderness	In Scarpa's triangle	On the greater trochanter
External rotation deformity	Less than 45 degrees	More than 45 degrees (Lateral border of foot touches the bed)
Shortening	Less than 1 inch	More than 1 inch
Treatment	Internal fixation always	Can be managed in traction
Complications	Avascular necrosis and Non-union	Malunion

Solution to Question 15:

The given clinical scenario and the X-ray is suggestive of intertrochanteric fracture of the left femur, which is best treated by closed reduction and internal fixation proximal femoral nail.

The image given below shows an intertrochanteric fracture corrected with proximal femoral nail.



The intertrochanteric fractures of the femur can be treated by:

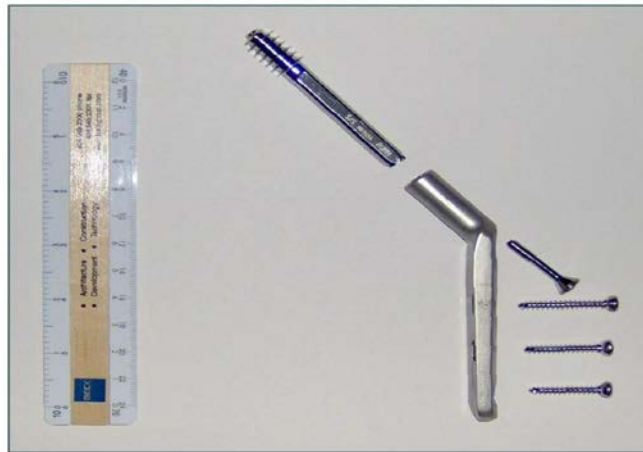
- Internal fixation with:
 - Intramedullary implants - proximal femoral nail and gamma nail
 - Extramedullary implants - dynamic hip screw
- Traction:
 - Russell's traction
 - Thomas splint

Compared to the dynamic hip screw, the intramedullary fixation with proximal femoral nails have smaller incisions, decreased blood loss, decreased femoral neck shortening and decreased risk of infection.

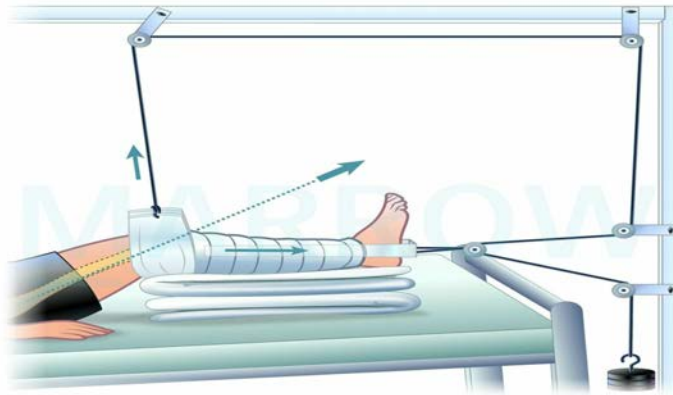
Proximal Femoral nail with locking and stabilisation screws



Dynamic Hip screw



Russell's traction



©MARROW

Thomas Splint



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Solution to Question 16:

The given clinical scenario is suggestive of occult neck of femur fracture, as the X-ray is normal but the attitude of the leg is abnormal. In such cases, MRI is the imaging study of choice.

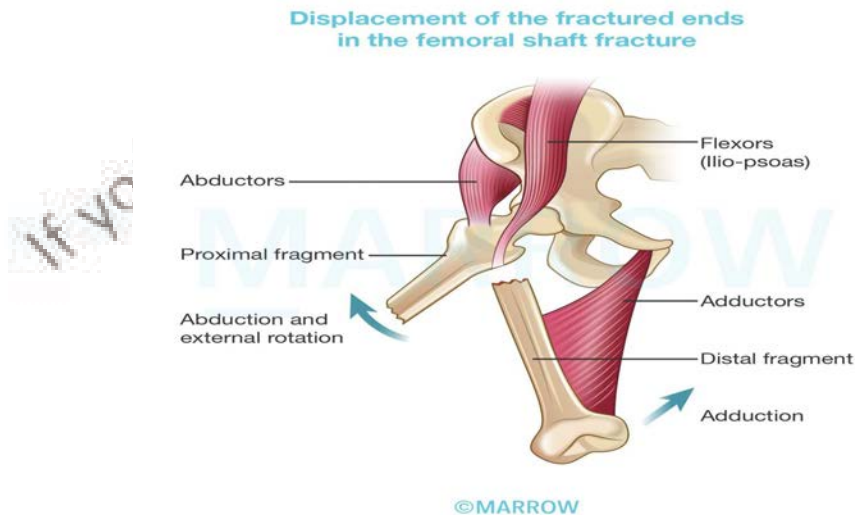
Both CT and MRI can detect the presence of fracture neck of femur. However, MRI can demonstrate the presence of soft tissue problems that can cause hip pain. It also does not expose the patient to radiation. Hence, MRI is preferred over CT in the diagnosis of occult femoral neck fractures.

Technetium bone scan is an older method to detect occult fractures. They are less specific and may not show the presence of fracture if performed within 48-72 hours and in osteopenic bones.

Solution to Question 17:

In the fracture of midshaft of the femur, the distal fragment is adducted as the adductors and the gastrocnemius are attached to the lower part of femur.

The proximal fragment is flexed and externally rotated as the gluteus medius and iliopsoas muscles are attached to the upper part of femur.





Displacement of fracture fragments in the fracture shaft of femur		
Site of fracture	Displacement of the proximal segment	Displacement of distal fragment
Proximal femoral shaft fractures	Flexed, abducted and externally rotated	Adducted
Mid-shaft femoral fractures	Flexed and externally rotated with minimal abduction	Adducted
Distal femoral shaft fractures	Adducted	Tilted by gastrocnemius pull

Solution to Question 18:

From the given options, maximum shortening of the lower limb is seen in the Inter-trochanteric fracture femur.

Overall, the maximum shortening of lower limbs is seen in posterior dislocation of the hip followed by Inter-trochanteric fracture femur.

Solution to Question 19:

The above radiograph shows a fracture in the shaft of femur with the displacement of fractured ends. The preferred method of treatment in this condition is an intramedullary nail with locking screws.

Option A: Plating can be done in cases of comminuted fractures.

Option C: External fixation is preferred in the treatment of severe open injuries, or when there is a severe bone loss that may require a bone graft.

Option D: Thomas splint is used in the emergency treatment of shaft of femur fracture and some supracondylar fractures.

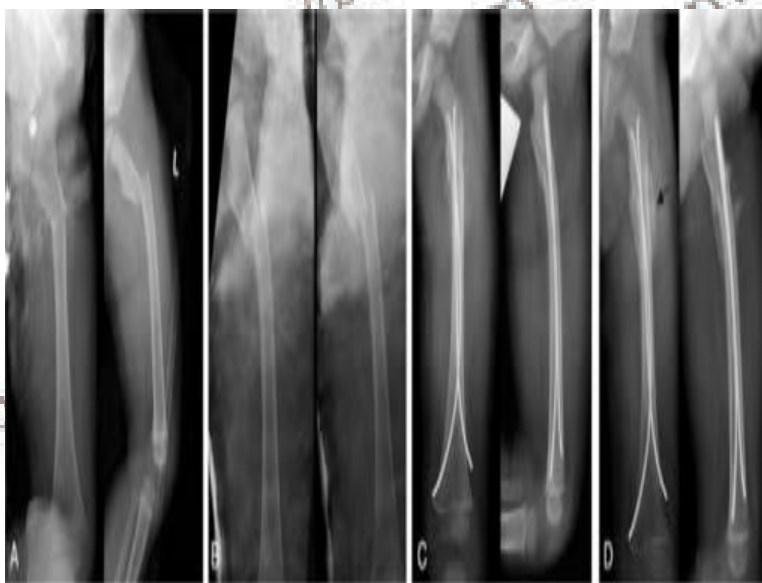
The main indications for traction are:

- (1) fractures in children
- (2) contraindications to anaesthesia or surgery
- (3) lack of suitable skill or facilities for internal fixation

Solution to Question 20:

The preferred treatment in children of ages 5-10 years with fracture shaft of the femur is elastic intramedullary nailing.

The image given below shows fracture shaft of femur treated with elastic intramedullary nailing.



Solution to Question 21:

In this clinical scenario, the presence of reduced SpO₂ and altered mental status in a patient presenting within 72 hours following a long bone fracture suggests the diagnosis of a fat embolism.

Fat embolism is caused by the fat globules originating from the bone marrow following the fracture of long bones. Clinical features of fat embolism are usually seen within 72 hours. They include tachycardia, fever, breathlessness, petechiae, confusion, and restlessness. Gurd's criteria is used for the diagnosis of fat embolism syndrome.

There is no specific diagnostic test for fat embolism. However, urine analysis to detect fat globules and monitoring of blood pO₂ levels are conducted.

The management of fat embolism primarily involves supportive care, including oxygen therapy and prompt stabilization of long-bone fractures.

Option A: Pulmonary embolism most commonly occurs as a result of thrombi from deep vein thrombosis of the leg.

Option C: Acute respiratory distress syndrome is diagnosed using the Berlin's criteria. All four of the following conditions must be met:

- It develops within 1 week of clinical insult or worsening respiratory symptoms.
- Chest radiograph shows bilateral opacities consistent with pulmonary edema. These opacities are not fully explained by effusions, lobar or lung collapse, or nodules.
- The edema is not due to cardiac failure, or fluid overload.
- There is impaired oxygenation. The ratio of arterial oxygen partial pressure to the fraction of inspired oxygen (PaO₂/FiO₂) is ≤ 300 mmHg as assessed on 5 cm H₂O of positive end-expiratory pressure (PEEP).

Option D: Occult pneumothorax is a condition that is not suspected on the basis of the symptoms or plain radiography, but is detected with CT imaging. It usually follows a thoracic injury.

Solution to Question 22:

Fat globules in sputum is a minor criterion for diagnosing fat embolism.

Injuries of knee, leg and foot

Question 1:

Insall-Salvati index is associated with which of the following bones?

- a) Tibia
- b) Patella
- c) Fibula
- d) Femur

Question 2:

Which of the following is the most common type of patellar fracture?

- a) Polar
- b) Transverse
- c) Comminuted displaced
- d) Comminuted undisplaced

Question 3:

A 25-year-old male presented to the emergency department with pain and swelling of the right knee. The radiograph showed the following finding. What is the best treatment for the given condition?



- a) Tension band wiring with K-wires
- b) Tension band wiring with cancellous screws
- c) Cylinder cast
- d) Patellectomy

Question 4:

A radiograph of a patient with knee pain following an RTA revealed a floating knee. Which of the following injuries are likely to cause this condition?

- a) Fracture of lower end of femur and dislocation of patella
- b) Fracture of lower end of femur and upper end of tibia
- c) Complete tear of medial and lateral collateral ligaments
- d) Complete tear of anterior and posterior cruciate ligaments

Question 5:

A pedestrian was brought to the casualty after being hit by the bumper of a car. X-ray showed a fracture of the lateral condyle of the tibia. What is the mechanism of injury causing this fracture?

- a) Valgus force
- b) Varus force
- c) Combination of axial loading and valgus force

- d) Combination of axial loading and varus force

Question 6:

Which of the following fractures is also known as Hoffa fracture?

- a) Fracture neck of fibula
- b) Comminuted fracture of patella
- c) Fracture of tibial condyles
- d) Fracture of femoral condyles

Question 7:

A patient presented with severe ankle pain and inability to bear weight following a motor vehicle accident. X-ray showed an intra-articular fracture of the distal tibia. What is the diagnosis?

- a) Tillaux fracture
- b) Rolando's fracture
- c) Hutchinson fracture
- d) Pilon fracture

Question 8:

A middle-aged woman was brought to the emergency ward following a road traffic accident. Radiograph of the patient revealed a displaced fracture of the right tibial shaft. What is the preferred treatment for the given condition?

- a) Compression plating
- b) Skeletal traction
- c) Open intramedullary nailing
- d) Closed intramedullary nailing

Question 9:

A 28-yr old man has recently finished a half- marathon. He complains of pain along the anterior and medial aspect of the tibia which increases on jogging & walking for a long

time. Plain X-Ray radiograph of the leg was found to be normal. What is the probable diagnosis?

- a) Jones fracture
- b) Shin splint
- c) Lisfranc fracture
- d) Nutcracker fracture

Question 10:

Which of the following structures are injured in patients with trimalleolar fracture of the ankle?

- a) Medial malleolus, lateral malleolus, posterior aspect of tibia
- b) Medial malleolus, lateral malleolus, anterior aspect of tibia
- c) Medial malleolus, lateral malleolus, head of the talus
- d) Medial malleolus, lateral malleolus, neck of the talus

Question 11:

A man presents to the emergency department with severe pain after twisting his ankle while playing football. Ottawa ankle rules will be used in this patient to _____

- a) Decide on the type of reduction
- b) Decide on immediate vs delayed treatment
- c) Determine the need for an ankle radiograph
- d) Determine the investigation of choice

Question 12:

March fracture is seen in the _____ of second metatarsal bone.

- a) Head
- b) Neck
- c) Shaft
- d) Base

Question 13:

Which of the following ligaments is most commonly injured in ankle sprains?

- a) Deltoid ligament
- b) Spring ligament
- c) Anterior talofibular ligament
- d) Medial talofibular ligament

Question 14:

A man presented with severe pain over his foot after an RTA. Examination revealed tenderness and swelling over the dorsum of his mid-foot. X-ray showed a displaced fracture of the neck of the talus. What is the likely diagnosis?

- a) Cotton's fracture
- b) Pott's fracture
- c) Aviator's fracture
- d) Tillaux fracture

Question 15:

A man was treated for a fractured neck of the talus 6 weeks back. During a follow-up visit, an x-ray was done and is given below. What does this indicate?



- a) Intact blood supply
- b) Avascular necrosis
- c) Delayed union
- d) Osteoarthritis

Question 16:

Identify the angle shown in the image given below.



- a) Neutral angle
- b) Gissane angle
- c) Kite's angle
- d) Bohler's angle

Question 17:

The radiograph of a patient with a history of an injury to the foot is given below. What is the most likely diagnosis?



- a) Charcot's fracture
- b) Lisfranc's dislocation
- c) Jones' fracture
- d) Metatarsal fracture

Question 18:

A ballet dancer came to the casualty with severe pain on the lateral aspect of her foot. Radiograph revealed a fracture in zone I of the fifth metatarsal. What is the likely diagnosis?

- a) Jones' fracture
- b) Pseudo-Jones fracture
- c) Stress fracture
- d) Pott's fracture

Answer Key

Question No.	Correct Option
1	b
2	b
3	a
4	b

5	c
6	d
7	d
8	d
9	b
10	a
11	c
12	b
13	c
14	c
15	a
16	d
17	b
18	b

Detailed Explanations

Solution to Question 1:

The Insall-Salvati index is used for the determination of patellar height.

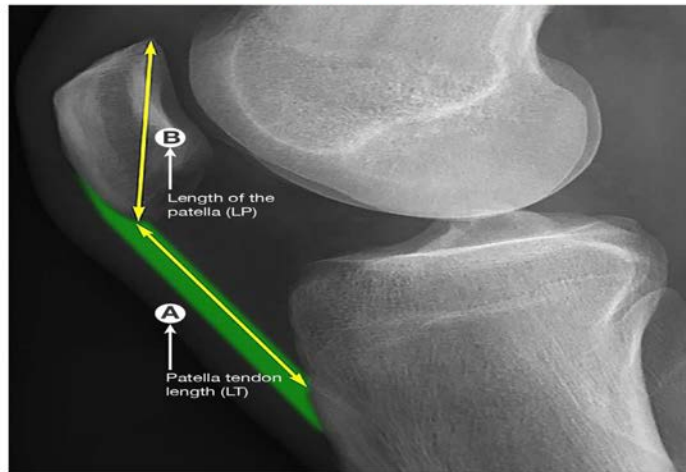
It is the ratio of the patella tendon length (LT) to the length of the patella (LP). It can be measured from a lateral radiograph of the knee.

- Ratio between 0.8 and 1.2 - normal
- Ratio above 1.2 - high lying patella (patella alta)
- Ratio below 0.8 - low lying patella (patella baja)

The high and low-lying patella are usually associated with anterior knee pain and recurrent dislocations of the patella.

The image below is the radiograph of the knee showing the calculation of Insall-Salvati index.

Insall-Salvati index
Lateral radiograph of the knee



Solution to Question 2:

Transverse fractures are the most common types of patellar fractures.

Patellar fractures are classified as:

- Transverse
- Vertical
- Polar
- Comminuted fractures

These fractures may be either undisplaced or displaced.

The tendon of the quadriceps muscle is attached to the upper surface of the patella. These fractures are usually caused by the excessive pull of the quadriceps muscle, either due to excessive contractions or sudden resisted extension of the knee.

Solution to Question 3:

The radiograph shows a displaced patellar fracture. The best treatment for the given condition is tension band wiring with K- wires. In this method, two K-wires are used to transfix the reduced patellar fragments and a flexible wire is looped around them tightly.



Treatment options for patellar fracture are:

- Undisplaced patellar fractures with minimal joint incongruity and intact extensor retinaculum - cylinder cast
- Displaced patellar fractures - tension band wiring
- Severely comminuted fractures with difficulty in reducing fragments - patellectomy

Note: Tension band wiring with cancellous screw is done when compressive forces are also needed along with tensile forces to resist the displacement of fractures e.g., olecranon fractures.

Solution to Question 4:

Fracture of lower end of femur and upper end of tibia can result in a floating knee.

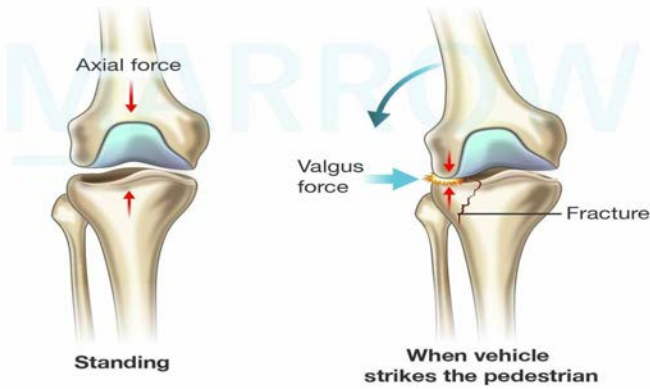
It refers to the knee that is separated from the femur and tibia. It usually results from motor vehicle accidents.

Solution to Question 5:

The mechanism of injury in the fracture of the lateral condyle of the tibia is a combination of axial loading and valgus force.

The lateral condyle fractures usually occur when the bumper of a vehicle strikes the pedestrian's knee. The weight of the person is the axial force, and the lateral blow by the vehicle is the valgus force acting on the tibial condyle. These forces together lead to the crushing of the lateral tibial condyle by the lateral femoral condyle.

Mechanism of fracture of lateral condyle of Tibia



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Solution to Question 6:

Hoffa fracture is the intraarticular fracture of femoral condyles in a coronal plane. These are a variant of supracondylar fractures.

The given image shows mediolateral radiographs of the knee joints showing a bilateral Hoffa fracture of the medial femoral condyle. (A) right knee; (B) left knee.



Solution to Question 7:

Pilon fracture refers to a comminuted intra-articular fracture of the distal tibia.

These fractures are most often due to high-energy trauma such as a motor vehicle accident or a fall from a height.

The below image shows Pilon fracture.



Option A: Tillaux fracture is avulsion fracture of the tibia by the anterior tibiofibular ligament. common in children, unusual injuries of the growing ankle. Fragment is the lateral part of the epiphysis and the injury is therefore a Salter–Harris type 3 fracture.

Option B: Rolando's fracture is an intra-articular comminuted fracture of the base of the first metacarpal with a T or Y configuration.

Option C: Hutchinson fracture is a fracture of the radial styloid.

Solution to Question 8:

Closed intramedullary nailing is the preferred treatment for a displaced fracture of the tibial shaft.

Undisplaced fractures can be treated by closed reduction with full length cast from the upper thigh to the metatarsals. After 4-6 weeks when the fractures become sticky, the above-knee cast is removed and replaced by the below-knee cast (patellar tendon bearing cast).

Solution to Question 9:

The given clinical scenario, with a history of lower limb overuse (marathon running) and pain along the medial tibial border which increases with activity (jogging and long walks), along with a normal radiograph, suggests medial tibial stress syndrome (MTSS), also known as shin splints.

MTSS is a stress injury of the tibia which occurs due to the frequent overuse of lower limbs. It is commonly seen in athletes and military personnel.

Exercise-induced pain along the distal two-thirds of the medial tibial border is typical. Since it is a stress injury, the radiograph of the leg appears normal.

Management is mainly conservative with rest and activity modification with less repetitive and load-bearing exercises.

Solution to Question 10:

The structures injured in a trimalleolar fracture of the ankle (Cotton's fracture) are medial and lateral malleoli with the posterior aspect of the tibia.

The posterior aspect of the distal tibia contains a bony projection known as the posterior malleolus.

Fracture of the ipsilateral medial and lateral malleoli is known as a bimalleolar fracture (Pott's fracture).

Ankle fractures are unstable fractures and usually require surgical fixation with open reduction and internal fixation (ORIF).

Solution to Question 11:

Ottawa ankle rules are used in patients with ankle injuries to determine the need for radiographs.

A radiograph of the ankle is suggested if there is:

- Pain around the malleolar zone
- Bone tenderness at the posterior edge or tip of the lateral or medial malleolus/ base of the 5th metatarsal bone
- An inability to bear weight immediately after the injury
- Inability to walk 4 steps in the emergency department

Solution to Question 12:

March fracture/stress fracture is seen most commonly in the neck of the second metatarsal bone.

It results from long, repeated stresses like prolonged walking or running, usually seen in military men, athletes, and dancers. They may complain of gradual onset of pain over the 2nd metatarsal neck starting 2-4 weeks after the beginning of stressors. On examination, a tender lump may be noted. The x-ray may be normal initially but later show a hairline crack. After a period of 4-6 weeks, a mass of callus can be identified.

Management: Reduction and splinting are not necessary as it is an undisplaced fracture. Normal walking is permitted while using an elastic bandage on the forefoot.

The below image shows a March fracture of the second metatarsal bone.



Note: According to Campbell orthopedics (14th edition) in March fractures, patients often note the gradual onset of pain directly over the second metatarsal neck region. In Uptodate, it is mentioned that many of the stress fractures occur in the second metatarsal shaft, especially at the neck. Hence, neck is considered a more correct answer than shaft.

Solution to Question 13:

The anterior talofibular ligament of the lateral ligament complex is most commonly injured in ankle sprains.

Ankle sprains are the most common type of sports-related injury. It is caused due to excessive loading on the joint when the ankle is in inversion and plantar flexion.

Solution to Question 14:

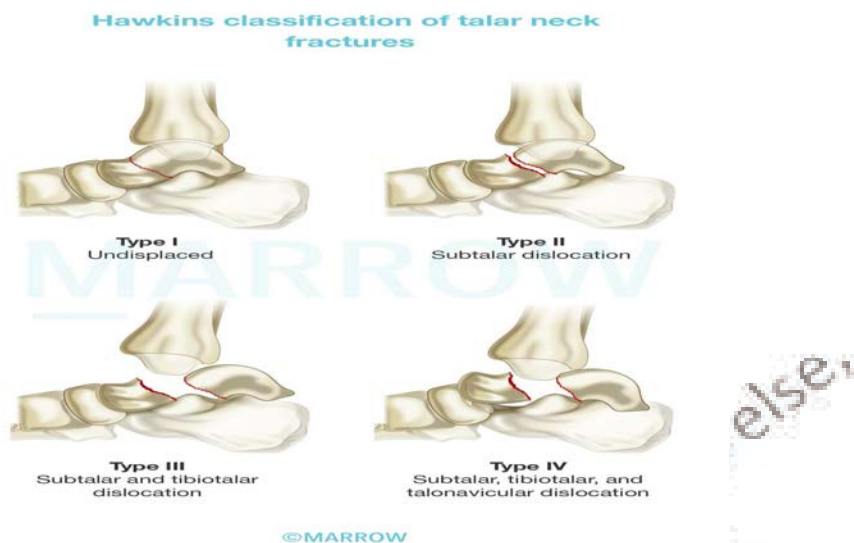
The given scenario and x-ray showing a fracture of the neck of the talus point to a diagnosis of aviator's fracture.

These fractures most commonly occur following a high-energy injury causing forced dorsiflexion with axial load. They can be further classified using Hawkin's classification:

- Type I - Undisplaced
- Type II - Subtalar dislocation
- Type III - Subtalar and tibiotalar dislocation
- Type IV - Subtalar, tibiotalar, and talonavicular dislocation

Undisplaced fractures are managed conservatively in a short leg cast for 8-12 weeks and a non-weight bearing cast for 6 weeks. Hawkin's type II-IV are managed by open reduction with internal fixation (ORIF).

The below image shows the Hawkins classification of talar neck fractures.



Solution to Question 15:

The radiograph shows the presence of subchondral lucency which is indicative of intact blood supply to the talus. This is known as the Hawkins sign.

The presence of this sign excludes the complication of avascular necrosis of the body of the talus. It is usually seen 6 weeks after of the fracture.

Complications of fracture of the talus are:

- Osteoarthritis of the subtalar joint - most common
- Avascular necrosis of body of the talus
- Malunion

The below radiograph shows the presence of subchondral lucency or Hawkins sign.

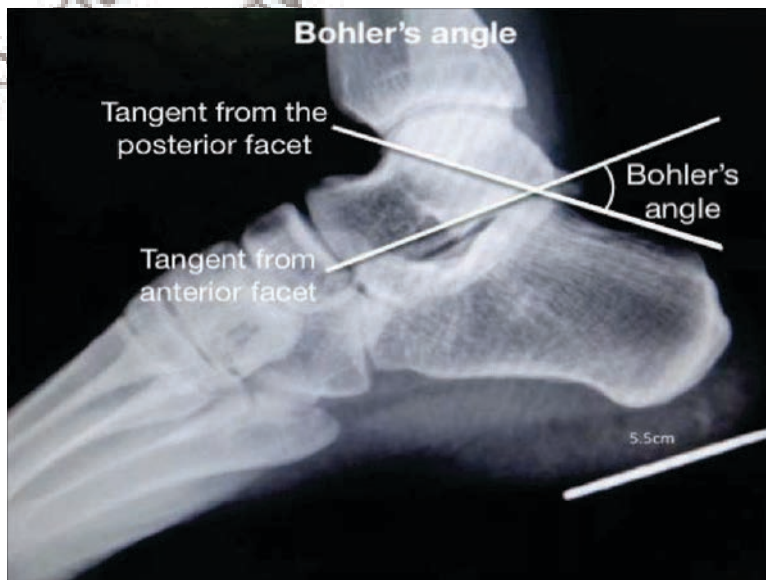


Solution to Question 16:

The angle shown in the radiograph is Bohler's angle which is used in the assessment of calcaneum fractures.

It is the angle formed by two lines that are tangents to the highest points of the anterior and posterior facets of the calcaneum respectively. This angle is decreased in calcaneal fractures.

CT is the investigation of choice for suspected tarsal fractures. Assessment of the bone cortex is best done by CT. Whereas stress fractures or occult fractures are best assessed by MRI.



A neutral triangle is an area inside the calcaneum, that contains a relatively less amount of trabecular bone. Hence, it is more prone to calcaneal fractures.

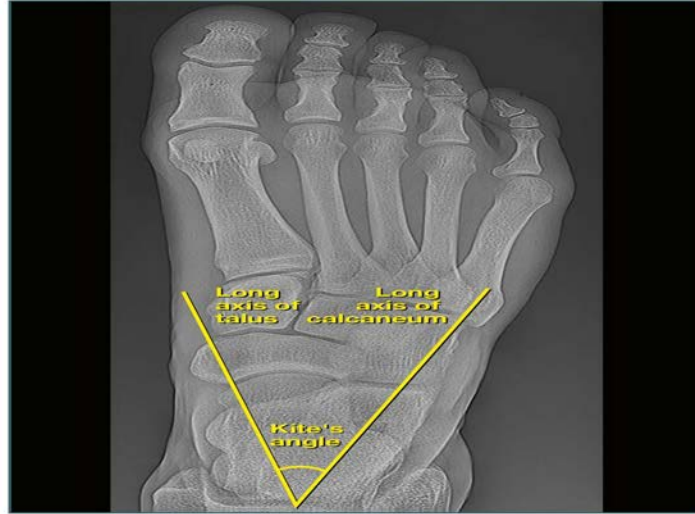


Option B: The critical angle of Gissane is formed by the downward and upward slopes of the superior surface of the calcaneum. It is increased in intraarticular fracture of the calcaneum.



Option C: Kite's angle is the angle between the long axis of the talus and the long axis of the calcaneum. The normal Kite's angle is 30-55 degrees. In CTEV, the Kite's angle is less than 25 degrees.

Kite's angle



Solution to Question 17:

The given radiograph showing fracture and dislocation in the tarsometatarsal region points to a diagnosis of Lisfranc's fracture-dislocation.

The base of the second metatarsal base is dislocated from the middle cuneiform resulting in the widening of the first intermetatarsal space.

Chopart's fracture-dislocation is the dislocation of the midtarsal joint of the foot. It is associated with the fractures of the calcaneum, cuboid, and navicular bones.

Lisfranc fracture dislocation



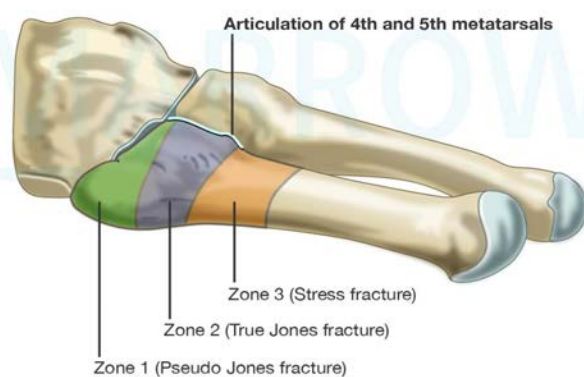
Solution to Question 18:

The given scenario and radiograph showing a fracture in zone I of the fifth metatarsal point to a pseudo-Jones fracture.

The proximal part of the fifth metatarsal can be divided into three zones:

- Zone I - proximal to the fourth and fifth intermetatarsal articulation. Avulsion fractures or pseudo-Jones fractures occur in this zone
- Zone II - involves the area of the shaft which articulates with the fourth metatarsal bone. True Jones fractures occur in this zone
- Zone III - distal to the fourth and fifth intermetatarsal articulation. Stress fractures occur in this zone

Fractures of fifth metatarsal



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AVN and Regional conditions of lower limb

Question 1:

Which of the following parts of bones are least likely to undergo to avascular necrosis?

- a) Neck of femur
- b) Proximal pole of scaphoid
- c) Body of talus
- d) Head of humerus

Question 2:

Patients with which of the following conditions are at an increased risk of developing avascular necrosis of the femoral head?

- a) Tay-Sachs disease
- b) Sarcoidosis
- c) Syphilis
- d) HIV

Question 3:

A 47-year-old woman presents with pain in the right hip during ambulation for the past few months. There is no history of trauma. An X-ray done is shown below. Which of the following is the most sensitive investigation to confirm the diagnosis of this condition?



- a) MRI scan
- b) CT scan
- c) DEXA scan
- d) Tc bone scan

Question 4:

An overweight man (90 kg) presented with complaints of not being able to squat and rest pain of left hip for 6 months duration. He had a past history of steroid and creatine use. His X-ray revealed destruction of the articular surface of femoral head with the presence of subchondral cysts and positive crescent sign. His MRI is suggestive of marrow edema. What is your diagnosis?

- a) Tuberculosis of hip
- b) Fracture neck of femur
- c) Osteochondroma of femur
- d) Osteonecrosis of femoral head

Question 5:

Freiberg osteochondritis affects which of the following bones?

- a) Tibial tuberosity
- b) Calcaneum apophysis
- c) Body of talus

d) 2nd metatarsal head

Question 6:

Haglund deformity is seen around which of the following joints?

- a) Knee
- b) Ankle
- c) Wrist
- d) Elbow

Question 7:

Osgood-Schlatter disease involves which one of the following?

- a) Talus
- b) Calcaneum
- c) Ring epiphysis of vertebra
- d) Tibial tuberosity

Question 8:

A young patient presents with complaints of episodes of sudden locking of the right knee. There is no history of trauma. X-ray of the knee joint reveals the presence of a loose body around the joint. What is the most likely cause for his presentation?

- a) Osteoarthritis
- b) Hemarthrosis
- c) Tuberculous arthritis
- d) Osteochondritis dissecans

Question 9:

What is the most common site of osteochondritis dissecans of the knee?

- a) Lateral part of medial femoral condyle
- b) Medial part of lateral femoral condyle

- c) Lateral part of medial tibial condyle
- d) Medial part of lateral tibial condyle

Question 10:

Which of the following is not a feature of chondromalacia patellae?

- a) Anterior knee pain is common
- b) Theatre sign is seen
- c) Associated with low Q angle
- d) Caused by mechanical stress to patellofemoral joint

Question 11:

Where is Baker's cyst seen?

- a) First intermetatarsal space
- b) Second intermetatarsal space
- c) Knee
- d) Hip

Question 12:

What is jumper's knee?

- a) Apophysitis of insertion of tibial tubercle leading to tendinitis
- b) Loose bodies in the knee joint
- c) Patellar tendonitis at the tendo-osseous junction of patella
- d) Habitual dislocation of the patella

Question 13:

A 45-year old patient who is a known case of rheumatoid arthritis presented to the clinic with the following deformity. What is it called?



- a) Hallux valgus
- b) Hallux varus
- c) Gout
- d) Hammertoe

Question 14:

A diabetic patient was observed to have hammertoe deformities of the feet. What is the underlying mechanism for the same?

- a) Hyperextension at the metatarsophalangeal joint
- b) Flexion at the proximal interphalangeal joint
- c) Flexion at the distal interphalangeal joint
- d) Flexion at the metatarsophalangeal joint

Answer Key

Question No.	Correct Option
1	a
2	d
3	a
4	d

5	d
6	b
7	d
8	d
9	a
10	c
11	c
12	c
13	a
14	b

Detailed Explanations

Solution to Question 1:

Of the following, the neck of the femur is least likely to undergo Avascular Necrosis (AVN).

The fracture of the neck of the femur can most commonly cause AVN of the head of the femur.

Solution to Question 2:

Patients with HIV are at an increased risk of developing avascular necrosis of the femoral head.

Etiology of avascular necrosis (primary):

- HIV
- Caisson's disease
- Sickle cell disease
- Hemoglobinopathies
- Hypercoagulable states (Protein C and S deficiency)
- Anti-phospholipids antibody syndrome
- Systemic lupus erythematosus
- Hyperlipidemia
- Gaucher's disease
- Steroids
- Radiotherapy
- Chemotherapy
- Alcohol excess

Avascular necrosis is found in Gaucher disease and not Tay Sachs disease. In Tay-Sachs disease, there is an accumulation of gangliosides mainly in the nerve cells.

Solution to Question 3:

The radiograph shows flattening of the femoral head and degenerative changes associated with avascular necrosis or osteonecrosis of the femoral head. The most sensitive investigation to diagnose avascular necrosis is MRI.

MRI allows identification of avascular necrosis of the femoral head in earlier stages and also determines the exact stage and extent of the pathologic process.

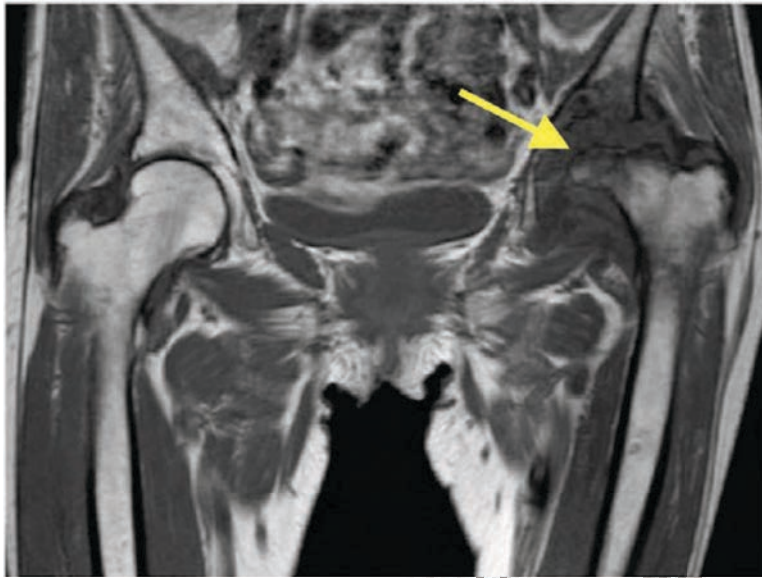
The radiograph below shows the flattening of the femoral head in a patient with avascular necrosis.



The radiographic appearance of avascular necrosis of the femoral head may show the following changes:

- Sclerosis of the femoral head
- Flattening or loss of sphericity of femoral head
- Crescent sign
- In severe stages, it may show femoral head collapse and arthritic changes in the joint

The image given below shows osteonecrosis of the femoral head seen on an MRI.



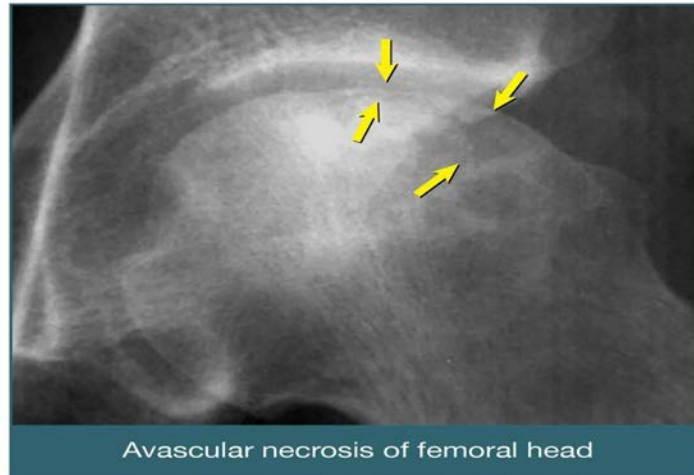
Solution to Question 4:

The complaints of hip pain in an overweight man with a history of long-term steroid use along with the radiological findings of subchondral cysts and positive crescent sign in the femoral head are characteristic of osteonecrosis of the femoral head.

Avascular necrosis or osteonecrosis is a painful bone condition that results from diminished blood supply mainly due to trauma or non-traumatic etiologies. Alcohol, corticosteroids, immunosuppressives, and cytotoxic drugs, either singly or in combination, are the most common causes of non-traumatic osteonecrosis. The typical features are pain with movements in or near the joint, click in the joint, joint stiffness, limping gait, and deformity. Restriction of movements is also a feature of this condition.

An x-ray shows reactive new bone formation, increased radiolucency in the subchondral bone, and a distorted articular surface. The crescent sign is a subchondral fracture overlying the necrotic segment of the femoral head seen on radiography. MRI is the investigation of choice in early disease. It allows the identification of AVN of the femoral head and also determines the exact stage and extent of the pathologic process.

Crescent sign



Management is based on Ficat and Arlet Classification:

Other options:

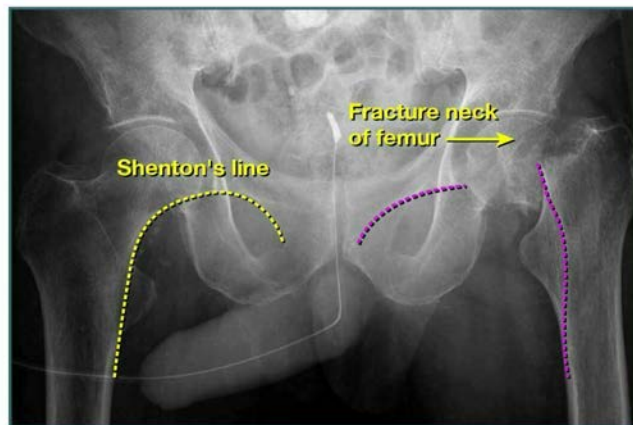
Option A: Tuberculosis of the hip is characterized by painful and restricted movements of the hip, especially at night. The radiographic findings are not appreciable in the early stages. Later stages show periarticular osteoporosis, hazy and irregular joint margins with a reduction in the joint space, and wandering acetabulum.

Stage	Findings	Management	Method
1	X-ray normal, MRI +ve	Conservative	Bisphosphonates
2a	X-ray: sclerosis, cysts, no collapse	Conservative	Bisphosphonates
2b	X-ray: crescent sign, no collapse	Surgical decompression	Core decompression
3	Collapse+loss of sphericity	Surgical	Osteotomy
4	Advanced arthritis	Reconstructive	Total hip replacement



Option B: Fracture neck of femur is common in elderly people after a trivial fall due to osteoporosis. Examination reveals tenderness in the groin along with shortening and external rotation of the leg. Xrays show a break in Shenton's line and trabecular stream, overriding of greater trochanter so that it lies at the level of the head of the femur, and external rotation of the femur is evident by prominent lesser trochanter.

Shenton's line in fracture of neck of femur



Option C: Osteochondromas are common benign bone tumors commonly present in adolescents. The lesions consist of a bony mass, often in the form of a stalk, produced by endochondral ossification of a growing cartilaginous cap. They are usually painless. The common sites of involvement are the distal femur, proximal tibia, and proximal humerus.



Solution to Question 5:

Freiberg osteochondritis affects the 2nd metatarsal head.

Osteochondritis or osteochondrosis refers to the condition where there is separation and necrosis of small fragment of articular cartilage and bone.

Solution to Question 6:

Haglund deformity, pump bump, or Mulholland deformity is seen around the ankle joint. It refers to retrocalcaneal exostosis formed at the posterosuperior aspect of the calcaneum.

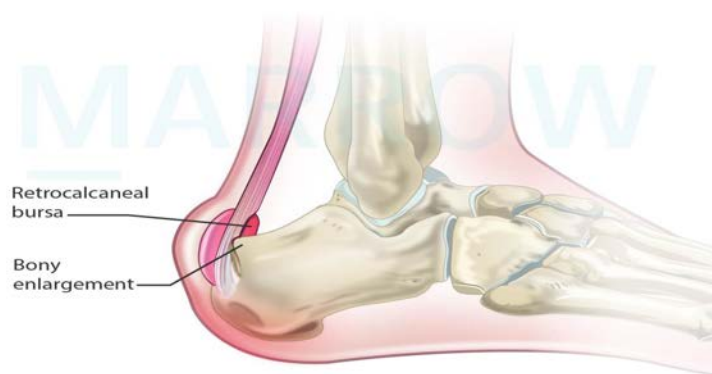
retrocalcaneal bursa usually protects the Achilles tendon from the calcaneal tuberosity. But in Haglund deformity, there is chronic inflammation of this retrocalcaneal bursa due to increased or repetitive chafing between the tuberosity and Achilles tendon. Due to prolonged inflammation, degenerative changes occur and osteophytes form within the tendon leading to calcification at the site of the tendon insertion. This leads to deformity and pain symptoms.

Management is usually conservative, using a heel lift, silicone pads in closed shoes, ice application, anti-inflammatory drugs, and stretching exercises of the calf.

The image below shows the Haglund deformity.



Haglund deformity



©Marrow

Solution to Question 7:

Osgood-Schlatter disease is the epiphysitis of the tibial tuberosity.

Solution to Question 8:

Osteochondritis dissecans is the most common cause of loose bodies in the knee joint of a young individual.

Loose bodies are fragments of bone, cartilage, or fibrous tissue that are present within the joint cavity. The common causes of loose bodies in the knee joint are:

- Osteochondritis dissecans (most common cause in young)

- Osteoarthritis (most common cause in old)
- Rheumatoid arthritis
- Charcot's disease
- Osteochondral fractures
- Synovial osteochondromatosis (associated with multiple loose bodies)
- Tubercular arthritis
- Foreign bodies like bullets, needles, and broken arthroscopic instruments.

Solution to Question 9:

The most common site of osteochondritis dissecans of the knee is the lateral part of the medial femoral condyle.

Osteochondritis dissecans develops in the joint when a small, avascular, well-demarcated fragment gets separated from the surrounding bone. It most commonly occurs in the knee joint.

On examination, the patient feels pain when the knee is medially rotated and then extended. On the contrary, the pain is relieved when the knee is laterally rotated and then extended. This is known as Wilson's sign.

In the initial stages, it is treated conservatively. In later stages, it is treated either by removal of the fragment or the cartilage repair techniques like microfracture techniques and autologous cartilage implantation.

Solution to Question 10:

A low Q angle is not a feature of chondromalacia patellae, on the contrary, it has a high Q angle (quadriceps angle).

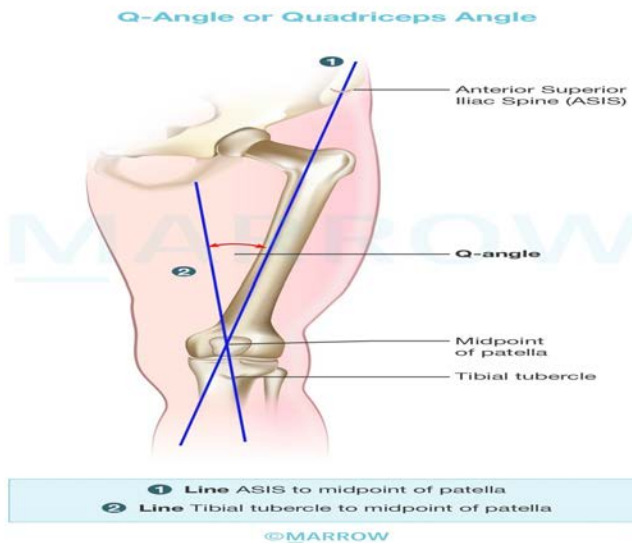
Q angle is the angle made by the line of the quadriceps pull with the patellar tendon. The line of quadriceps pull extends from the middle of the patella to the anterior superior iliac spine. Normal range is 14-17 degrees. An angle of more than 20 degrees predisposes to anterior knee pain.

This condition is commonly seen in young women and athletes and is mainly caused due to the mechanical overload of the patellofemoral joint.

Patients commonly present with anterior knee pain. The pain is increased by climbing stairs and standing after prolonged sitting. This is known as the theatre sign or movie sign (pain and stiffness after sitting for a long time in a theatre).

It can also be associated with knee swelling and catching sensation (not true locking) of the knee joint.

It is treated conservatively by anti-inflammatory medications, avoiding stressful exercises, and physiotherapy.



Solution to Question 11:

Baker's cyst or popliteal cyst is seen in the knee.

It is caused usually due to the distension of bursae present in the popliteal fossa or posterior herniation of the synovial membrane of the knee joint. It usually develops as a consequence of osteoarthritis, rheumatoid arthritis and lesions of the menisci.

Solution to Question 12:

Jumper's knee is the patellar tendonitis at the tendo-osseous junction of the patella.

It is due to the overuse of the patellofemoral extensor mechanism and is commonly seen in athletes.

Solution to Question 13:

The deformity shown is the hallux valgus. It is caused due to the excessive lateral deviation of the great toe with the prominence of the head of the first metatarsal.

It can be congenital or a consequence of rheumatoid arthritis or excessive usage of footwear with narrow toe space.

On the contrary, hallux varus is the excessive medial deviation of the great toe.

Hallux varus

Hallux valgus



In gout, there is redness and swelling over the first metatarsophalangeal joint but there is no lateral deviation of the toe.

Gout



Solution to Question 14:

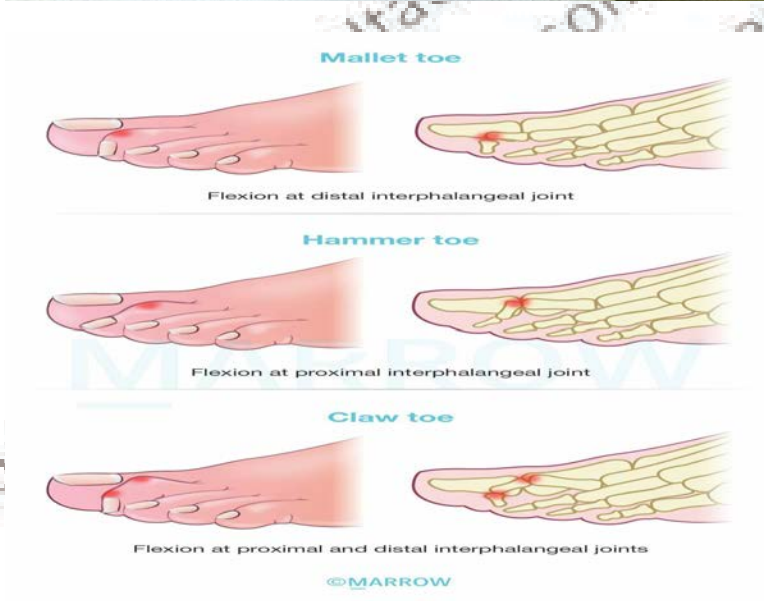
Hammertoes deformities are due to the flexion at the proximal interphalangeal joint (PIP).

This is usually seen in neuromuscular diseases. In neuromuscular diseases where there is a loss of function of intrinsic muscles of the foot (especially interossei), the flexor digitorum longus causes increased flexion at the proximal interphalangeal joint.

Claw toe is characterized by hyperextension at the metatarsophalangeal (MTP) joint and flexion at both IP joints (similar to claw hand)

Mallet toe is characterized by flexion deformity of the distal IP joint (similar to mallet finger).

The image below shows hammertoes in a patient.



Injuries of spine

Question 1:

A patient was brought to the emergency department with an injury to the neck following a road traffic accident. On examination, she was found to have decreased sensations over the back of the scalp. Which nerve root has likely been injured in this patient?

- a) C2
- b) C3
- c) C4
- d) C5

Question 2:

A patient with a spinal injury presents with decreased sensation over the radial aspect of the forearm, thumb, and index finger. There is weakness of wrist extension on examination. Which nerve root has been damaged here?

- a) C8
- b) C5
- c) C6
- d) C7

Question 3:

A patient has decreased sensation over the medial part of the forearm around the elbow. Which nerve root is involved here?

- a) C8
- b) C7
- c) T1
- d) C6

Question 4:

Which of these muscles can be tested to evaluate C5 root motor function in a patient with spinal injury?

- a) Trapezius
- b) Biceps
- c) Extensor carpi radialis longus
- d) Triceps

Question 5:

Which of the following reflexes is commonly tested to detect spinal shock in a patient?

- a) Pupillary reflex
- b) Gag reflex
- c) Abdominal reflex
- d) Bulbocavernous reflex

Question 6:

Which of the following is not seen in a patient with cauda equina syndrome?

- a) Absent bulbocavernosus reflex
- b) Asymmetric saddle-shaped anesthesia
- c) Flaccid paralysis below the knee
- d) Exaggerated knee jerk

Question 7:

Which of the following statements is false?

- a) In automatic bladder, the level of injury is above S2
- b) In automatic bladder, reflex center takes control
- c) In autonomous bladder, residual urine is minimal
- d) In autonomous bladder, the injury is LMN type

Question 8:

Which of the following statements regarding whiplash injury is false?

- a) It is a ligamentous injury of the cervical spine
- b) Neck stiffness is a presenting symptom
- c) X-ray shows vertebral fracture in most cases
- d) There is hyperextension followed by flexion

Question 9:

Which of the following statements about SCIWORA is false?

- a) It is a condition prevalent in the geriatric population
- b) There is a temporary occlusion of vertebral arteries
- c) These lesions are mainly found in cervical spine
- d) MRI is the gold standard investigation

Question 10:

Identify the radiographic view shown below.



- a) Open mouth view
- b) Swimmer's view
- c) Water's view
- d) Schuller's view

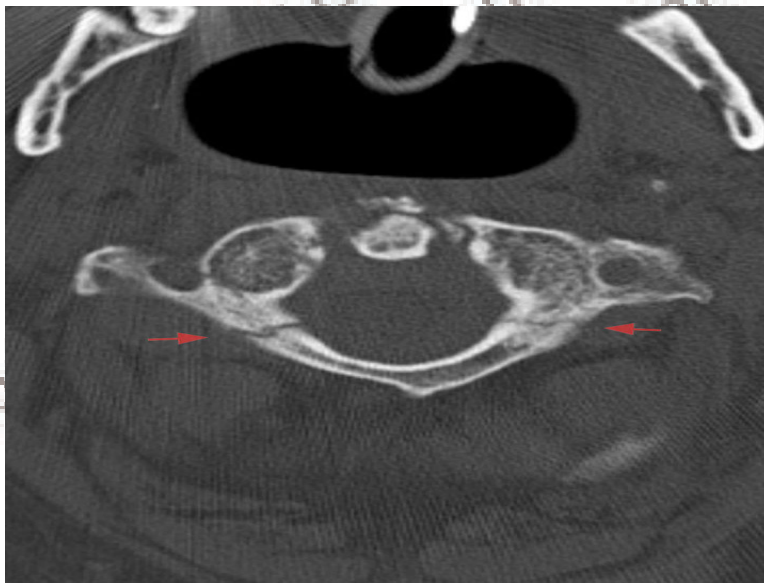
Question 11:

An open mouth X-ray was performed in a patient suspected to have a Jefferson's fracture. The transverse ligament is likely to be ruptured if the overhang of C1 over C2 is more than:

- a) 13.1 mm
- b) 3.4 mm
- c) 11.1 mm
- d) 6.9 mm

Question 12:

An unconscious road traffic accident victim was brought to the emergency department. After resuscitation and stabilization, a CT scan of the cervical spine was performed which is given below. What is the preferred management in this case?



- a) Atlantoaxial fusion
- b) Rigid cervical collar
- c) Anterior decompression
- d) Vertebroplasty

Question 13:

Which of the following statements about Hangman's fracture is false?

- a) It is fracture of pars interarticularis of atlas
- b) Most fractures are minimally displaced
- c) Most fractures can be managed conservatively
- d) Neurological injury is less common

Question 14:

Which is the most dangerous type of odontoid fracture?

- a) Type I
- b) Type II
- c) Type III
- d) Type IV

Question 15:

A patient in the ER was found to have subaxial cervical spine fractures. Which of the following statements about the management of his condition is false?

- a) Cervical collar is preferred for single-column injuries
- b) Management is based on Anderson and D'Alonzo classification
- c) Cervical collar can be used in some two-column injuries
- d) Operative treatment is preferred for three-column injuries

Question 16:

According to the Denis classification, which of the following is not included in the middle column of the spine?

- a) Posterior part of the vertebral body
- b) Posterior part of the vertebral disc
- c) Posterior part of the pedicles
- d) Posterior longitudinal ligament

Question 17:

Which of the following is known as clay-shoveler's fracture?

- a) Vertical compression injury of cervical spine
- b) C-spine fracture with C6-C7 disc disruption
- c) Avulsion fracture of C7 spinous process
- d) Horizontal fracture in the cervical spine

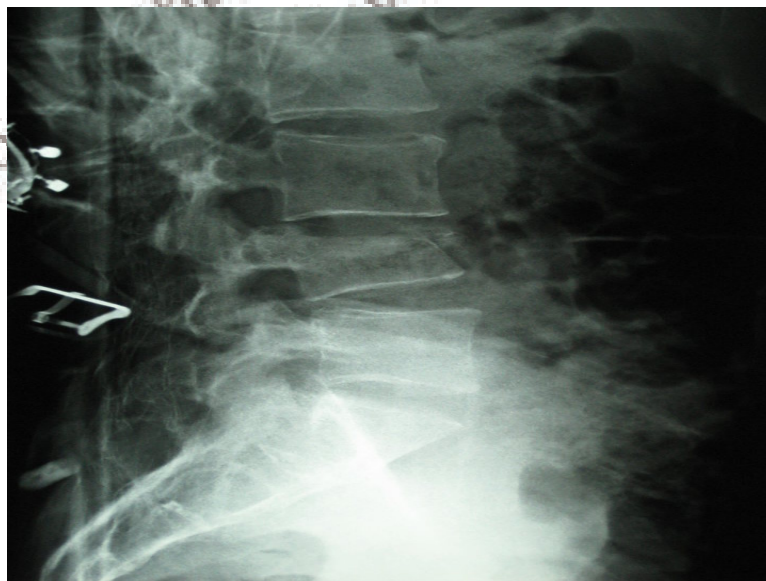
Question 18:

A young man who got injured in the neck while diving is brought to the emergency. Which of the following classifications systems is unlikely to be used to classify his injury?

- a) AO-Magerl classification
- b) Allen and Ferguson classification
- c) Anderson and D'Alonzo classification
- d) Levine and Edwards classification

Question 19:

A patient presents to you with severe pain in his lower back after jumping from a height to the ground level. His X-ray is given below. What is your diagnosis?



- a) Stable burst fracture
- b) Unstable burst fracture
- c) Compression fracture
- d) Chance fracture

Question 20:

A 30-year-old male patient accidentally fell from a ladder and sustained injuries to his back. His spine X-ray reveals a stable anterior wedge compression fracture of T10 vertebra. He has no neurological deficit. What would be the preferred management approach in this patient?

- a) Early ORIF and bone fusion
- b) Anterior decompression
- c) External spine support
- d) IV Dexamethasone

Question 21:

A 26-year-old patient sustained injuries when he fell off while placing lights for Christmas on the second floor. The CT scan of his lumbosacral spine is given below. What is your diagnosis?



- a) Holdsworth fracture
- b) Chance fracture
- c) Compression fracture
- d) Burst fracture

Question 22:

The X-ray of a patient with a spinal fracture following a road traffic accident is given below. Which of the following statements about the injury seen is false?



- a) It is an inherently stable horizontal fracture
- b) It is horizontal avulsion fracture of vertebral bodies
- c) It is seen in people who wear a seat belt without shoulder harness
- d) Associated abdominal injuries are seen in 50% of these injuries

Question 23:

A patient with a pathological fracture of the L4 vertebra is posted for a vertebroplasty. What does this procedure involve?

- a) Strut grafting and internal fixation
- b) Insertion of an anterior plate system to stabilize the vertebra
- c) Injecting liquid bone cement into vertebra under high pressure
- d) Restoring the height of a collapsed vertebral body by inflating a balloon

Answer Key

Question No.	Correct Option
1	a

2	c
3	c
4	b
5	d
6	d
7	c
8	c
9	a
10	a
11	d
12	b
13	a
14	b
15	b
16	c
17	c
18	a
19	c
20	c
21	d
22	a
23	c

Detailed Explanations

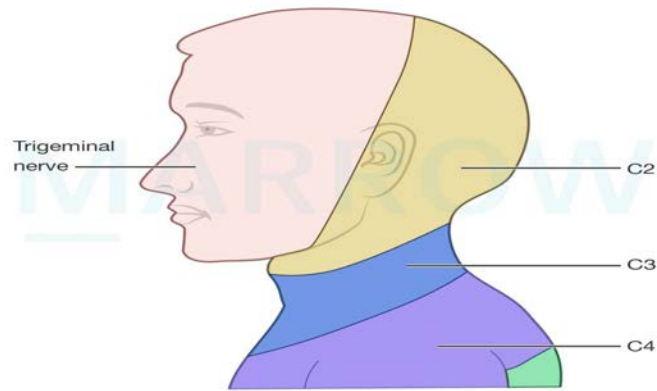
Solution to Question 1:

The nerve root likely injured in a patient having decreased sensation over the back of the scalp is C2.

Area of loss of sensation following nerve root injury varies depending upon level of nerve root as follows:

- C2 injury leads to decreased sensation over the back of the scalp
- C3 injury leads to decreased sensation over the anterior aspect of the neck
- C4 injury leads to decreased sensation over the lateral aspect of the neck and inferiorly over clavicles down to the rib space
- C5 injury leads to decreased sensation over the deltoid

Sensory supply of head and neck



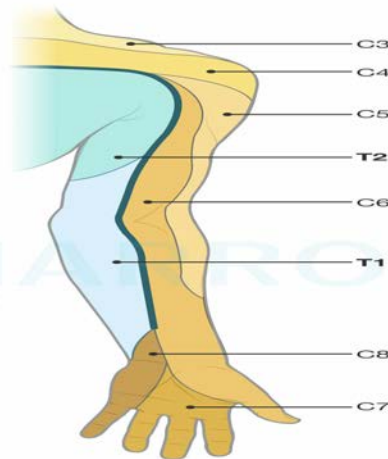
Solution to Question 2:

The C6 nerve root has been damaged in this case of loss of sensation over the radial aspect of forearm and weakened wrist extension.

Solution to Question 3:

Decreased sensation over the medial aspect of the forearm around the elbow is seen due to injury to T1 nerve root.

T1 is the nerve root for the sensory supply of the medial aspect of the forearm.



Dermatomes in the Upper Limb
Anterior aspect
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Solution to Question 4:

The biceps muscle can be used to test the C5 root motor function. It causes elbow flexion.

In spine injuries, a full neurological examination is performed in all cases. Tests performed for nerve root motor function are summarized in the table below.

Spinal Segment	Muscle Supplied	Action to Test
C5	Biceps, Brachialis	Elbow flexion
C6	Extensor carpi radialis longus and brevis	Wrist extension
C7	Triceps	Elbow extension
C8	Flexor digitorum profundus to the middle finger	Flex middle distal phalanx
T1	Abductor digiti minimi	Abduct little finger
L2	Iliopsoas	Flex hip
L3	Quadriceps	Straighten knee
L4	Tibialis anterior	Dorsiflex foot
L5	Extensor hallucis longus	Dorsiflex big toe
S1	Gastrocnemius, Soleus	Plantarflex foot

Solution to Question 5:

The bulbocavernosus reflex is commonly tested to detect spinal shock.

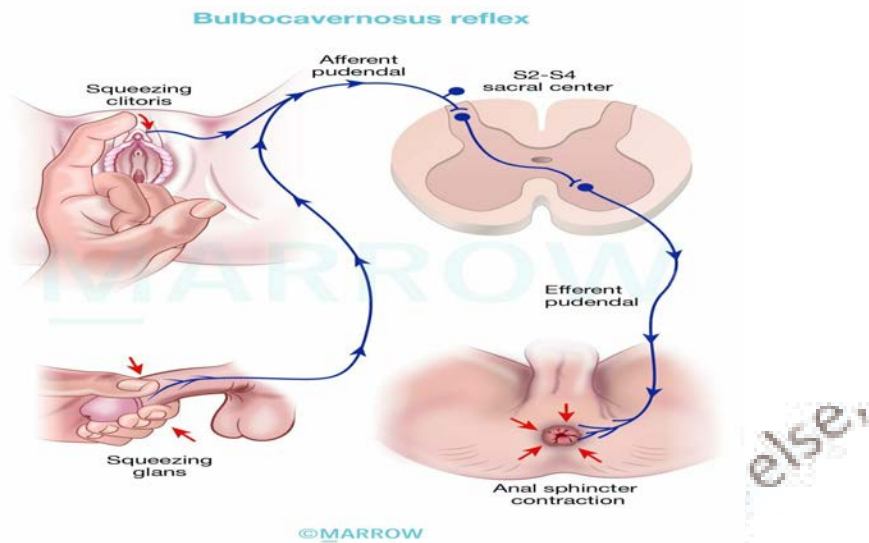
Spinal shock is the physiological dysfunction that follows structural injury to the spine. It manifests as flaccidity, loss of sensation, and absence of reflexes below the level of the injury.

The primitive reflexes are absent in spinal shock. These include:

- Bulbocavernosus reflex (root value S2- S4): Tested by squeezing the penis in males or applying pressure on the clitoris in females. The normal response is the contraction of the anal sphincter. If the patient has in situ Foley's catheter, it can be gently pulled to test anal contraction in both genders.
- Anal wink reflex (root value S2- S4): Tested by stroking the skin around the anus. The normal response is the contraction of the anal sphincter.

Spinal shock usually lasts less than 48 hours and the reflexes return to normal. Resolution of spinal shock is indicated by the return of the bulbocavernosus and the anal wink reflex.

The path of the bulbocavernosus reflex is depicted below.



Solution to Question 6:

In cauda equina syndrome, the knee jerk is lost.

Causes for cauda equina syndrome include:

- Tumours of the spine
- Pott's disease
- Protrusion of disc
- Fracture-dislocation of the thoracolumbar spine.

Initially, there is saddle-shaped hyperesthesia and later anesthesia involving buttocks, anus, and perineum. Along with this, there is flaccid paralysis below the knee and ankle reflex is lost. Bulbocavernosus reflex is also absent.

Solution to Question 7:

The quantity of residual urine is large, not minimal, in autonomous bladder.

Differences between an automatic bladder and autonomous bladder are highlighted in the table.

Automatic bladder	Autonomous bladder
Level of injury above S2	Injury below/at S2
UMN type lesion	LMN type lesion
Controlled by reflex center of bladder	Controlled by intrinsic plexus of bladder
Emptying is involuntary	Emptying is voluntary

Automatic bladder	Autonomous bladder
Residual urine volume is minimal	Residual urine volume is large (200-300 cc)

Solution to Question 8:

Cervical vertebral fracture is not seen in most cases with whiplash injury. It is seen in severe cases only.

Whiplash is a form of cervical acceleration-deceleration injury. There is hyperextension of the spine followed by flexion during the recoil.

The main pathological features seen in these cases include tear (strain) of the anterior longitudinal ligament and the capsular fibres of the facet joints in the spine. In some cases, the intervertebral discs may be damaged.

Solution to Question 9:

SCIWORA is Spinal Cord Injury Without Radiographic Abnormality. It is very common in children.

Such injuries are most often seen in the cervical spine. Specific biomechanics of the vertebral column in children allows the musculoskeletal system to move beyond the normal physiological range of motion without the risk of fracture. However as the spinal cord is not as flexible, neurological deficits may be seen.

Investigations available earlier like X-rays could not detect such lesions. However, new imaging modalities like MRI have increased the rate of detection of such lesions and is considered gold standard.

Solution to Question 10:

The given radiograph is that of open mouth view or odontoid view.

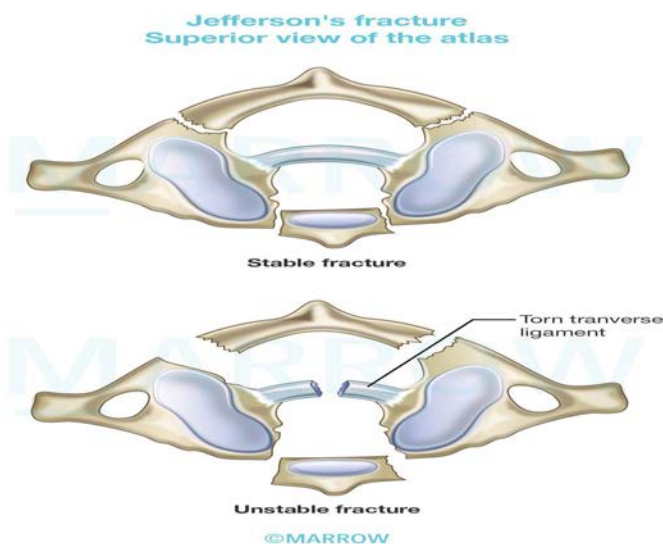
The open-mouth view is used to diagnose:

- Jefferson fracture - Burst fracture of C1 vertebra
- Odontoid fractures - Fracture of odontoid process of C2 vertebra
- Basilar invagination - Upward migration of superior part of the odontoid process

Solution to Question 11:

In Jefferson's fracture, the transverse ligament is likely to be ruptured if the combined overhang of C1 lateral processes over C2 is more than 6.9 mm.

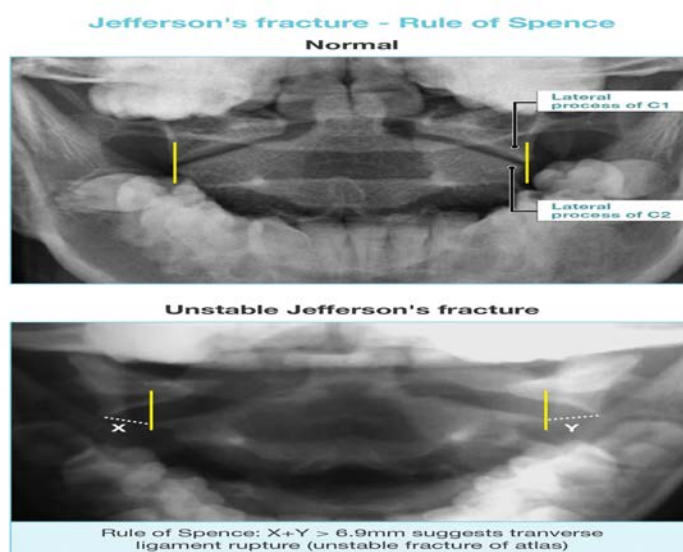
Jefferson's fracture is a burst fracture of the ring of the atlas (C1). It occurs due to axial forces and can be stable or unstable as shown below.



Jefferson's fracture is identified in an open-mouth X-ray view (odontoid view). The displacement of the lateral process of C1 over C2 is checked in this X-ray to evaluate if the transverse ligament is torn.

If the total displacement (sum of displacement on both sides) of C1 lateral masses relative to C2 is more than 6.9 mm, the transverse ligament is likely to be damaged. This is known as the rule of Spence which is used to determine if the fracture is stable or unstable. If the transverse ligament is torn, it is classified as an unstable fracture.

The image below depicts the use of the rule of Spence in an odontoid view X-ray.



Note: Some experts suggest that this measurement has to be 8.1 mm to account for magnification on plain radiographs.

Solution to Question 12:

The image reveals a stable burst fracture (Jefferson fracture) of the ring of the atlas (C1 vertebra). This condition is preferably managed by the application of a rigid cervical collar until the fracture heals.

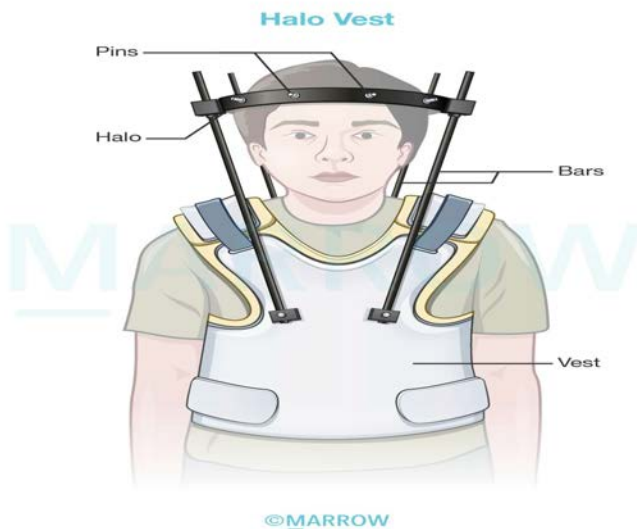
The treatment approach for Jefferson's fracture is as follows:

- Stable burst fractures are treated using a rigid cervical collar for 8 to 12 weeks.
- Unstable fractures (with injured transverse ligament assessed by the rule of Spence) may be reduced by halo traction and managed in a halo vest for 12 weeks.
- If there is a residual C1-C2 instability despite the above treatment, then surgical posterior atlantoaxial fusion (C1-C2 fusion) is performed.

The below image shows a rigid cervical collar.



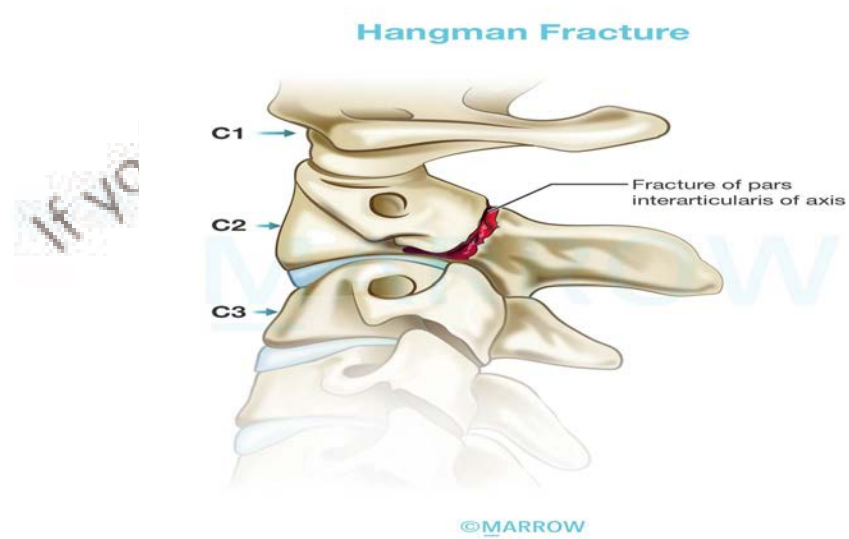
The image below shows a halo vest.



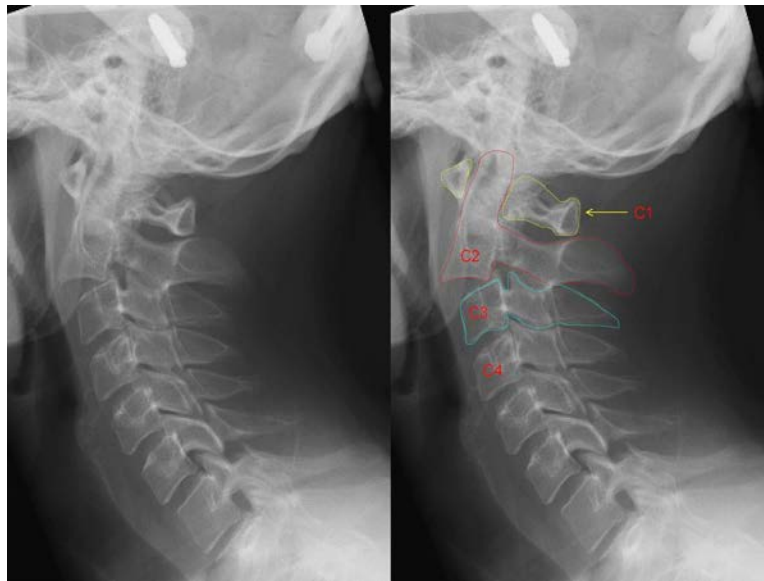
Solution to Question 13:

Hangman's fracture is a fracture of pars interarticularis of axis (C2 vertebra).

It is also known as traumatic C2 spondylolisthesis. In most cases, there is no neurological deficit as pars fractures expand the spinal canal.



In the below X-ray of the cervical spine, a Hangman's fracture can be noted. It can be observed that C2 (red outline) has moved forward with respect to C3 (blue outline).



The Levine and Edwards classification is used commonly for these fractures.

Most of these fractures can be managed conservatively. The treatment approach is as below:

- Minimally displaced fractures: Cervical collar.
- Highly displaced and angulated fractures: Traction followed by Halo vest
- Fractures with dislocation of the C2–C3 facet joint and neurological injuries: Open reduction and stabilization

Solution to Question 14:

The most common and most dangerous type of odontoid fracture is Type II. These fractures are unstable and prone to non-union.

Odontoid fractures are classified by Anderson and D'Alonzo classification into 3 types given below:

Type	Features	Management
I	Avulsion fracture of the tip of the odontoid	Rigid collar
II	Fracture at the junction of the odontoid process and the body of the axis	Young patient and stable fracture: traction followed by a collar or halo vest Unstable fractures: anterior odontoid screw, or C1–C2 fusion
III	Fracture through the body of the axis	Undisplaced fractures: halo vest (8-12 wks) Displaced fractures: halo traction followed by halo vest (8-12 weeks)

Types of Odontoid Fractures



Type I- Fracture of the tip of the odontoid



Type II- Fracture at junction of the odontoid process and the body of axis



Type III- Fracture through the body of the axis

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Solution to Question 15:

Anderson and D'Alonzo classification is used to determine the management of C2 odontoid process fracture, and not in subaxial cervical spine fractures.

For subaxial (C3-C7) cervical injuries, the classification systems used include Ferguson and Allen classification and the subaxial cervical spine injury classification (SLIC).

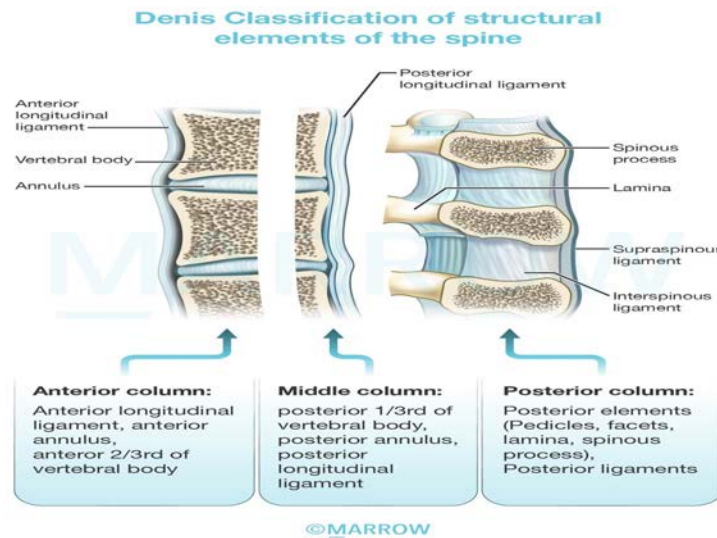
Management of subaxial (C3-C7) injuries: Individual injuries are evaluated based on the three-column biomechanical model and treatment is planned accordingly.

- Single-column injuries without neurologic deficit are managed with immobilization using a cervical collar.
- Two-column injuries are considered unstable and tend to be treated operatively, but some of these injuries can be treated with immobilization using a cervical collar. When neurologic deficits are present, operative treatment is recommended.
- Three-column injuries are considered unstable even when there is no neurologic deficit and usually require operative stabilization.

Solution to Question 16:

According to the Denis three-column theory, the posterior part of the pedicles is included in the posterior column of the spine, not in the middle column.

The 3 columns of the spine according to Denis classification are depicted in the image below.



The Denis classification is used to describe spinal injuries and classify them as stable or unstable. As per this system, any injury involving 2 columns or more is classified as unstable. Unstable injuries require surgical fixation.

The current AO/ASIF classification that replaced Denis classification reverts back to the previously prevalent two-column theory. It divides the spine as follows:

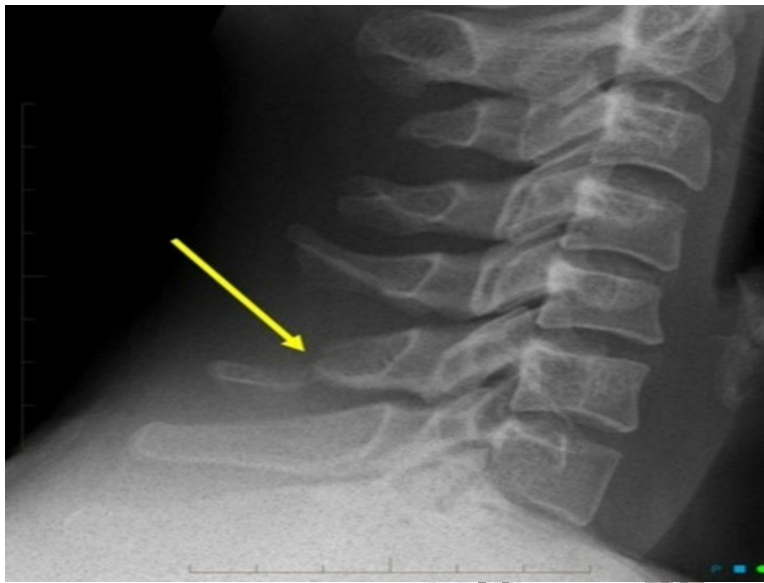
- Anterior column: vertebral body and disc
- Posterior column: pedicles, laminae, facets and posterior ligamentous complex

Solution to Question 17:

Clay-shoveler's fracture refers to avulsion fracture of the C7 spinous process.

It occurs due to the powerful contraction of the back muscles inserted into the spinous process. The injury is painful but harmless. No treatment is usually required. As soon as the pain subsides, neck exercises are encouraged.

The X-ray below shows a clay-shoveler's fracture.



Solution to Question 18:

In the given scenario, the patient has suffered a cervical spinal injury. The AO-Magerl classification is used for the classification of thoracolumbar spinal injuries.

In AO-Magerl classification, thoracolumbar injuries are classified into 3 types based on the primary force that caused injury:

- Type A (compression force)
- Type B (distraction force)
- Type C (torsional/rotational force)

The various classification systems used to classify cervical spinal injuries include:

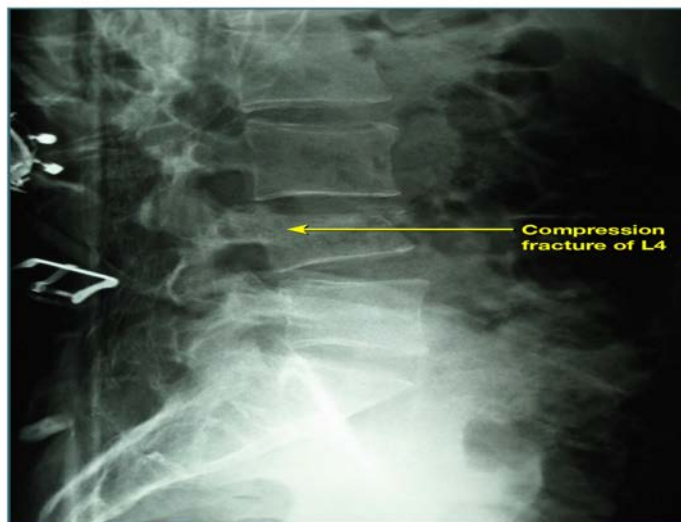
- The Anderson and D'Alonzo classification is used for odontoid fracture in the C2 vertebra.
- The Levine and Edwards classification is used for Hangman's fracture (traumatic spondylolisthesis of C2 over C3).
- The Allen and Ferguson classification is used for subaxial cervical spine (C3-C7) injuries.

Solution to Question 19:

The given patient has a compression fracture of the L4 vertebra. It can be diagnosed radiographically by the wedge-shape and loss of anterior height compared to the posterior height of the affected vertebra.

Compression fractures occur due to axial loading of the vertebra. They result from severe spinal flexion. They can also occur with minimal trauma in osteoporotic individuals or as pathological fractures in other conditions.

They are characterized by loss of vertebral height anteriorly, with no loss of posterior vertebral height and no posterior ligamentous or bony injury. In most cases, there is no spinal cord damage.



Solution to Question 20:

A stable thoracolumbar anterior wedge compression fracture without any neurological deficit is preferably treated with external spine support, bed rest, and pain killers.

Management of stable vertebral compression fracture is done by application of thoracic lumbar sacral orthosis (TLSO) for 12 weeks with pain management. This is followed by a gradual return to activity.

Some injuries that are predisposed to further collapse and progressive deformity despite the TLSO includes:

- Injuries that have > 40-50% anterior height loss
- Injuries with > 25 degrees of focal kyphosis
- Disruption of the posterior ligamentous complex
- Signs of instability seen on imaging studies

These injuries need to be closely monitored or surgically fixed (Posterior fixation is preferred).

Solution to Question 21:

The given patient has a burst fracture of L4 vertebra.

The given lateral view CT image shows that the L4 vertebra has exploded. The posterior border of L4 has lost its concavity and has become convex. There is posterior displacement of the bone into the spinal canal. This is diagnostic of burst fracture of the L4 vertebra with retropulsion.

Burst fracture results from severe axial compression that explodes the vertebral body.

Radiological findings:

- AP view X-rays: Spreading of the vertebral body with an increase of the interpedicular distance may be seen.
- Lateral view X-rays: Posterior displacement of bone into the spinal canal (retropulsion) can be seen at the posterosuperior border of the vertebral body. The normal concavity of the posterior vertebral body becomes convex in retropulsion.

Management of burst fractures:

- Stable burst fracture:
 - Minimal anterior wedging and posterior ligament complex intact
 - No neurological deficits
 - Conservatively managed with bed rest until acute symptoms settle, followed by a thoracolumbar brace (TLSO) or body cast for about 12 weeks
- Unstable burst fracture:
 - Cases of neurological injury
 - Disruption of the posterior ligamentous complex (PLC)
 - More than 50% canal compromise on CT
 - Operative management done
 - Posterior pedicle screw fixation is the standard treatment for PLC disruption

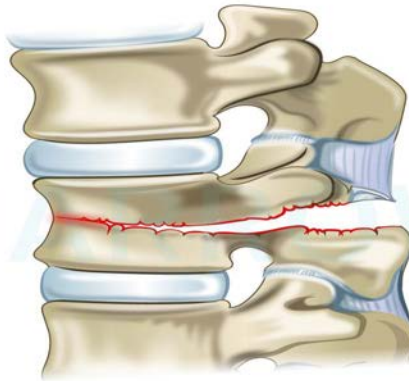
Solution to Question 22:

The X-ray image shows a Chance fracture, which is by definition unstable as it can involve middle and posterior columns.

Chance fracture is also known as seat-belt injury or the jack-knife injury. This injury is typically located in the upper lumbar spine in people involved in motor vehicle collisions while wearing a lap seat-belt without a shoulder harness. The sudden deceleration causes flexion and posterior distraction of the spine. This causes the mid-lumbar spine to bend like a jack-knife around an axis anterior to the vertebral column.

There is a tear in the vertebra that passes transversely through the bones (bony Chance fracture), or the ligamentous structures (soft Chance fracture), or both. There is little or no crushing of the vertebral body. However, it is an unstable injury as the posterior and middle columns are distracted. Neurological damage is uncommon. Associated intra-abdominal injuries are seen in 50% of these injuries.

Chance Fracture



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X-rays may show a horizontal fracture with the split running through the vertebra. It may involve the spinous process, the transverse processes, pedicles and the vertebral body. There may be opening up of the disc space posteriorly.

Most Chance fractures can be managed conservatively with bed rest and bracing. If posterior fixation is done, it will allow early mobilization. Ligamentous Chance fractures require posterior instrumented fusion.

Solution to Question 23:

Vertebroplasty is a procedure of injecting liquid bone cement into the vertebral body.

In vertebroplasty, polymethyl methacrylate (PMMA) is injected percutaneously into the vertebra through the pedicle to maintain the vertebral height. In kyphoplasty, a balloon is used to expand a compression fracture to regain height before the PMMA is injected.

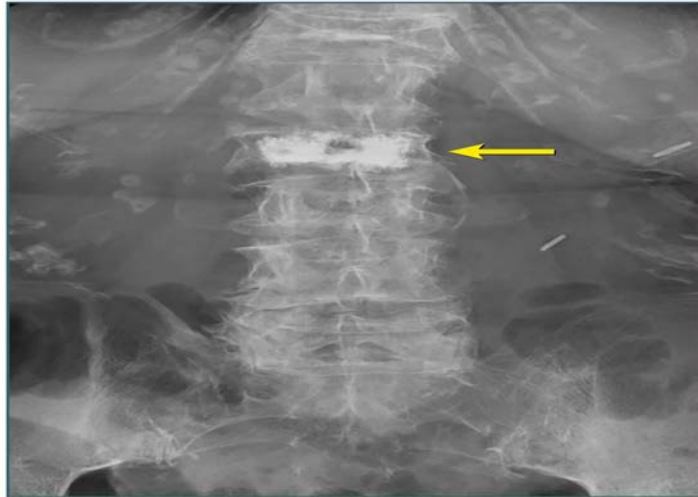
Indications for these 2 minimally invasive procedures include:

- Pathological vertebral body fractures caused due to osteoporosis, metastatic carcinoma, or multiple myeloma.
- In some cases of stable compression fractures with no neurological deficits, to manage persistent pain due to the collapse.
- Kyphoplasty has been used to correct sagittal deformity and prevent kyphosis

Risks of these procedures include the possibility of disruption of the posterior cortex and cement material leaking out into the spinal canal and causing neurological deficits. Therefore, these procedures must be done after careful consideration.

The below plain X-ray shows the spine of a person who has undergone vertebroplasty.

Vertebroplasty

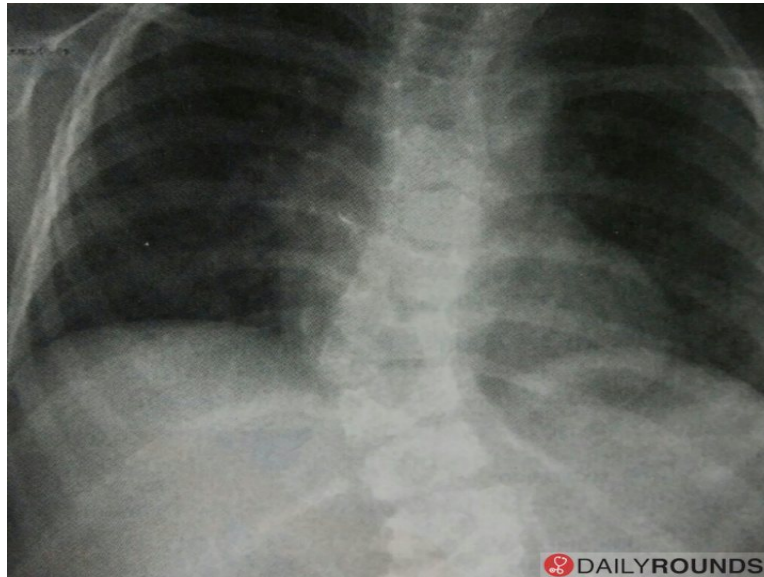


else,
Sold by @Itachi
If you purchased this from some
you may have been scammed.

Regional Conditions of Spine

Question 1:

A 63-year-old woman presented with low back pain and back stiffness. An X-ray spine was done which is shown below. Which of the following statements is true regarding the condition she is suffering from?



- a) It does not require medical intervention
- b) Lateral curve >10 degrees is seen in this condition
- c) It does not affect the functioning of vital organs
- d) It is rarely idiopathic

Question 2:

What is the most common type of scoliosis?

- a) Neuromuscular scoliosis
- b) Sciatic scoliosis
- c) Idiopathic scoliosis
- d) Congenital scoliosis

Question 3:

Which of the following is not seen in non-structural scoliosis?

- a) Contracture of the hip
- b) Lumbar disc prolapse
- c) Rotated vertebrae
- d) Short leg

Question 4:

The following test is performed on a patient being evaluated for scoliosis. Identify this test.



- a) Adam's test
- b) Schoeber's test
- c) Gerber's test
- d) McCarthy's test

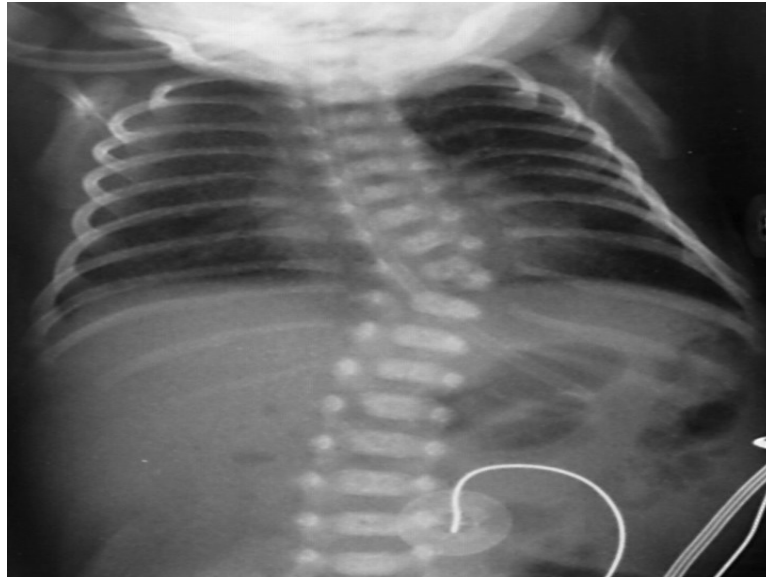
Question 5:

Which is the most common type of idiopathic scoliosis?

- a) Adolescent
- b) Juvenile
- c) Infantile
- d) Adult

Question 6:

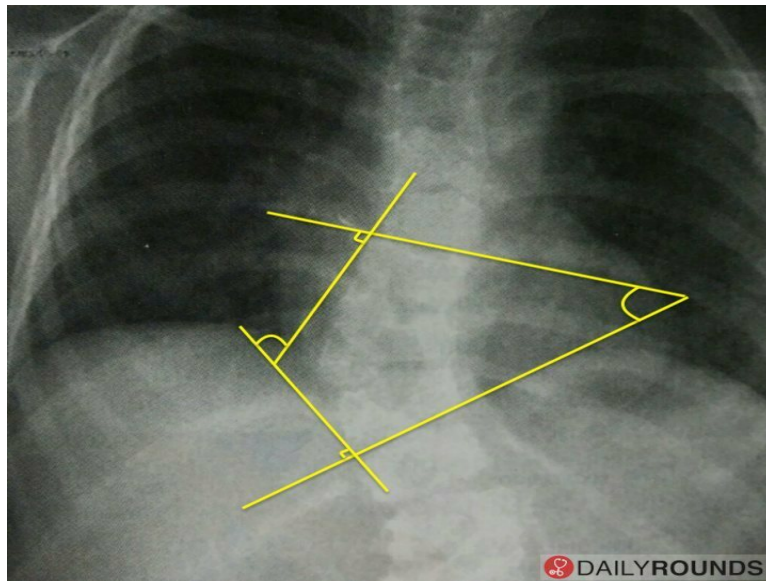
What is the type of scoliosis shown in the X-ray given below?



- a) Congenital scoliosis
- b) Postural scoliosis
- c) Infantile scoliosis
- d) Degenerative scoliosis

Question 7:

You are asked to measure the degree of lateral curvature present in a patient with scoliosis using the method depicted below. Identify this method.



- a) Nash and Moe's method
- b) Perdrille and Vidal method
- c) Cobb's method
- d) Stokes method

Question 8:

Risser's sign evaluates skeletal maturation using the ossification of _____.

- a) Iliac apophysis
- b) Olecranon apophysis
- c) Triradiate cartilage
- d) Tibial tubercle apophysis

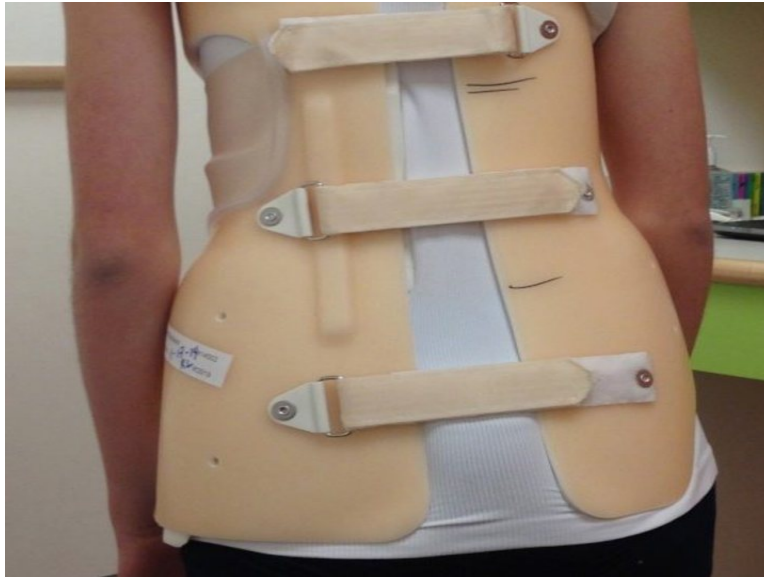
Question 9:

Which of the following is not an unfavorable prognostic factor for idiopathic scoliosis?

- a) Presence of osteoporosis
- b) Male gender
- c) Previous laminectomy
- d) Presence of thoracic curve

Question 10:

A patient with scoliosis was prescribed the given brace. What is this brace known as?



- a) Milwaukee brace
- b) Boston brace
- c) SOMI brace
- d) ASHE brace

Question 11:

The brace shown in the given image is _____.



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- a) Boston brace
- b) Milwaukee brace
- c) Taylor brace
- d) ASHE brace

Question 12:

What is the most common complication of bracing in scoliosis?

- a) Poor compliance
- b) Skin breakdown
- c) Allergic skin reaction
- d) Spontaneous sternum fracture

Answer Key

Question No.	Correct Option
1	b
2	c
3	c
4	a
5	a
6	a
7	c
8	a
9	b
10	b
11	b
12	a

Detailed Explanations

Solution to Question 1:

The given clinical scenario and X-ray are suggestive of scoliosis. In this condition, the lateral curvature of the spine is > 10 degrees in the coronal plane, in the upright position.

Scoliosis deranges the load and force transmission mechanism through the spine. It is most commonly an idiopathic condition. It jeopardizes the functioning of vital organs like the lungs and heart through overcrowding of ribs.

Medical intervention is indicated if the lateral curvature is > 25 degrees. Various modalities include brace application and surgical correction.

Note: If the lateral curve of the spine is < 10 degrees then it is known as spinal asymmetry.

Solution to Question 2:

Idiopathic scoliosis is the most common type of scoliosis.

Scoliosis may be classified as:

- Idiopathic scoliosis - No obvious cause is detected. Several genetic associations have been noted
- Congenital scoliosis - Caused due to failure in vertebra formation or segmentation during development
- Neuromuscular scoliosis - Caused due to neuromuscular disorders like cerebral palsy, muscular dystrophy, etc.
- Scoliosis due to generalized diseases - Seen in conditions such as:
 - Neurofibromatosis
 - Marfan syndrome
 - Bone dysplasia
 - Tumors
 - Due to irradiation

Solution to Question 3:

Rotated vertebrae are seen in structural scoliosis.

Scoliosis is classified into 2 types:

- Structural scoliosis - There is a non-correctable deformity due to vertebral rotation in the affected spinal segments
- Postural scoliosis (non-structural) -
 - The deformity is secondary to a condition outside the spine
 - Seen in conditions such as:
 - Short leg: curvature disappears when the patient is made to sit)
 - Hip contracture with pelvic tilt: disappears after the disc prolapse is managed)

- Lumbar disc prolapse (sciatic scoliosis)
- If scoliosis is due to poor posture, the deformity disappears when the person is asked to bend forward

Solution to Question 4:

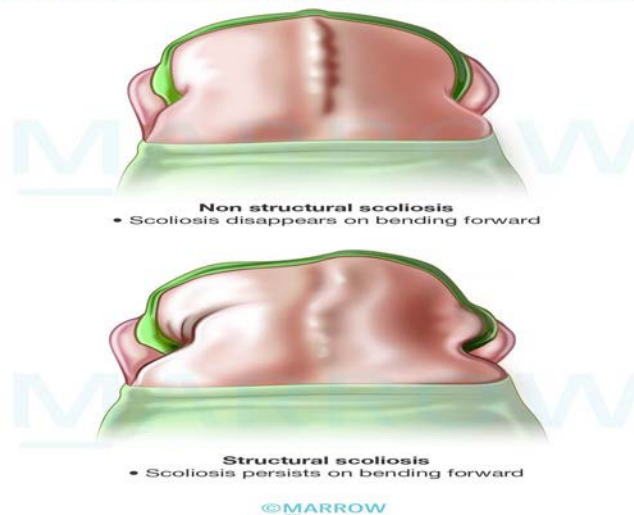
The test shown in the image is Adam's forward bending test. This is the best clinical test for evaluating spinal curvature in scoliosis.

Steps of Adam's test :

- Patient is asked to bend forward at the waist until the spine is at the horizontal level
- Knees must be maintained straight, with the feet together, the arms dependent, and the palms in opposition
- Examiner observes the trunk from behind (to assess midthoracic and lumbar rotation) and from the front (to assess upper thoracic rotation)

It is used to differentiate between structural and non-structural curves in scoliosis. On bending forward, non-structural scoliosis disappears, while structural scoliosis persists.

Interpretation of Adam's forward bending test



Solution to Question 5:

The most common type of idiopathic scoliosis is adolescent idiopathic scoliosis.

Based on the age of onset, idiopathic scoliosis is subclassified into 3 types as given below.

Note: ASF - Anterior spinal fusion, PSF - Posterior spinal fusion

	Infantile scoliosis	Juvenile idiopathic scoliosis	Adolescent idiopathic scoliosis
Age of onset	Birth to 3 years	4 to 9 years	10 years to skeletal maturity
Commonly seen curvature	Left thoracic	Right thoracic	Right thoracic
Self resolution	Resolves in 90%	Resolves in 20%	Rare
Surgical management	<8 yr: Instrumentation without fusion After 8 yr: ASF -PSF After 11 yr: PSF	<8 yr: Instrumentation without fusion After 8 yr: ASF -PSF After 11 yr: PSF	PSF with instrumentation ASF if < 11 yrs with open t irradiate cartilage

Solution to Question 6:

In the given radiograph, the presence of a single hemivertebra at T9 and concavity to the right in the lower thoracic region is suggestive of congenital scoliosis.

Congenital scoliosis is a lateral curvature of the spine which is always associated with a radiologically demonstrable anomaly of the vertebral bodies, which includes:

- Hemivertebrae (where only one-half of the vertebra grows)
- Block vertebrae (where two vertebral bodies fuse)
- An unsegmented bar (a bone bar joining two adjacent vertebrae on one side, which hinders growth on that side)

The image below shows a unilateral and unsegmented bar with contralateral hemivertebra:



In infantile scoliosis (option C), most curves are thoracic with convexity to the left and the anomalies described above are absent.

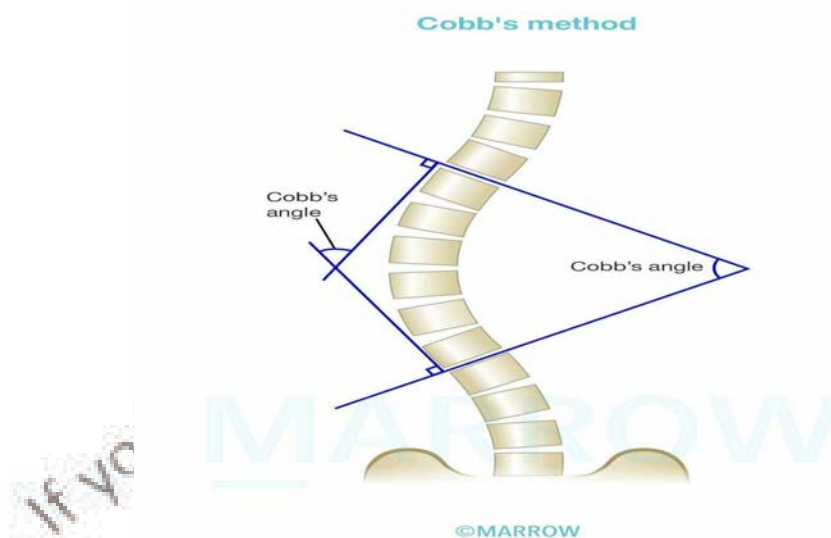
Note: The most progressive type of congenital scoliosis is a concave, unilateral unsegmented bar with a convex hemivertebra.

Solution to Question 7:

In the given X-ray of a patient with scoliosis, the degree of lateral curvature is measured using Cobb's method. The degree of curvature of scoliosis on plain radiographs is measured using Cobb's angle.

To measure the Cobbs's angle, first locate the superior-end vertebra and inferior-end vertebra of the curve. Then draw perpendicular lines to the superior surface of the superior-end vertebra and to the inferior surface of the inferior-end vertebra.

The angle formed at the intersection of these perpendiculars is the angle of the spinal curve known as Cobb's angle. It can also be measured by measuring the angle made by the intersection of the end-plate lines.



Note: Nash and Moe's method, Perdriolle and Vidal method, and Stokes method are methods of assessing vertebral rotation.

Solution to Question 8:

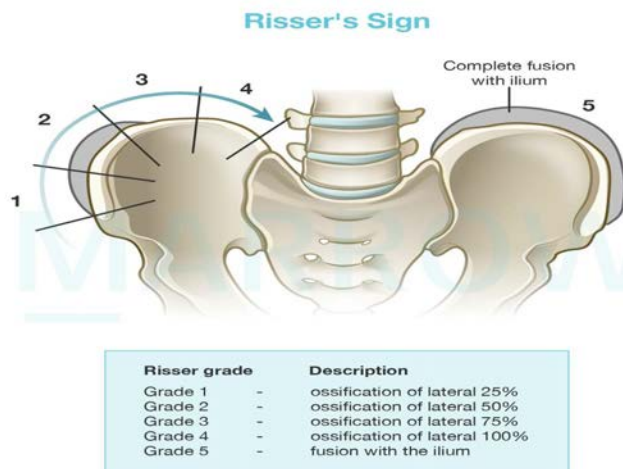
Risser's sign evaluates skeletal maturation using the ossification of the iliac apophysis.

Risser's sign is used to predict the worsening of scoliosis and in the planning of corrective surgery.

The iliac apophysis is divided into four quadrants. The ossification of iliac apophyses normally proceeds from lateral to the medial side i.e., from the anterior superior iliac spine to the posterior superior iliac spine.

The Risser sign progresses from grade 0 (no ossification) to grade 4 (all four quadrants have ossified). When the apophysis has fused completely with the ilium, it is Risser grade 5 and the patient is considered skeletally mature.

Risser's grade 5 (fusion with the ilium) coincides with the fusion of the apophysis in the vertebral ring. After this, there is no possibility of further progression of the scoliosis curve.



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Solution to Question 9:

Females are most commonly affected with idiopathic scoliosis, and female gender is a poor prognostic factor.

Unfavorable prognostic factors in scoliosis include:

- Congenital or juvenile or paralytic type
- Curve greater than 20-40 degrees
- Thoracic curve
- 2-4 degrees of rotation
- Immature skeleton (Risser's sign 0)
- Female gender
- Presentation before menarche
- Osteoporosis
- Rapid increase in the size of curves
- Single short curve
- Previous discectomy, laminectomy

Solution to Question 10:

The image shows the Boston brace that is used in scoliosis.

Boston brace is a type of thoraco-lumbo-sacral-orthosis (TLSO brace). It has a hard polypropylene outer shell with a soft foam lining inside. It is used in patients whose scoliosis curve apex is at T7 or lower.

Braces are used to prevent progression and avoid surgery in scoliotic curves between 20 and 30 degrees. A variety of braces are available, some are created as cast and some are prefabricated.

They usually extend from the thoracic and lumbar spine to the pelvis and have pads to push the spine into correct alignment.

Braces used in scoliosis:

- Milwaukee brace :
- Originally designed cervico-thoracic-lumbar-sacral orthosis (CTLSO) introduced in the 1940s
- Less commonly used nowadays due to the convenience of modern braces
- Still used for scoliosis with curves in the high thoracic and cervical spine
- Boston brace
- Risser's cast :
- Body cast that extends up to the cervical spine and touches the chin and skull
- A hole is cut in the abdominal region to make breathing easy
- Charleston bending brace & Providence brace:
- Used while laying down and sleeping at night for 8 to 10 hours
- Best suited for single thoracolumbar or lumbar curves

Milwaukee brace



Risser's cast for scoliosis



Solution to Question 11:

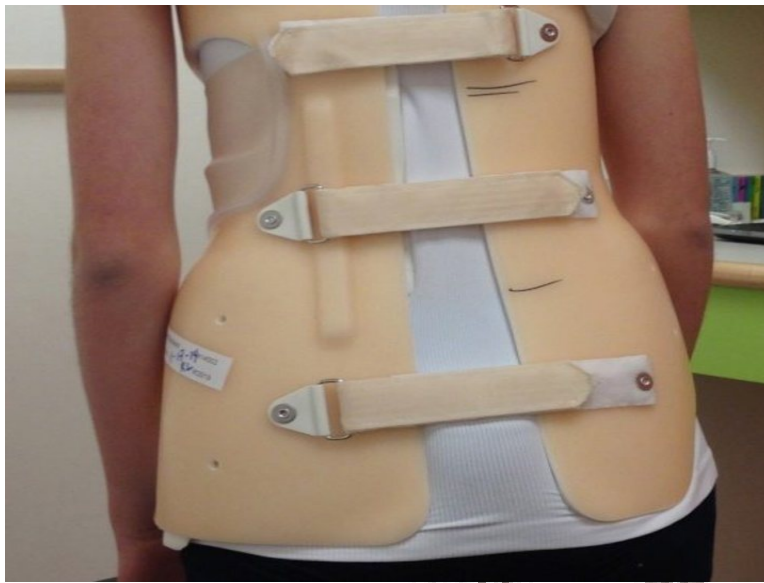
The brace shown in the image is the Milwaukee brace.

The Milwaukee brace is an active corrective spinal orthosis primarily used in the ambulatory treatment of structural scoliosis. Designed as a cervico-thoracic-lumbar-sacral orthosis (CTLSO), the main objective of the Milwaukee brace is to delay or eliminate the need for surgery. However, in recent years, the use of the Milwaukee brace has declined due to the availability and convenience of modern braces. Nonetheless, it is still employed for scoliosis cases characterized by high thoracic and cervical spine curves.

Milwaukee brace



Option A: Boston brace is a type of thoraco-lumbo-sacral-orthosis (TLSO brace). It has a hard polypropylene outer shell with a soft foam lining inside. It is used in patients whose scoliosis curve apex is at T7 or lower. The below image shows a Boston brace.



Option C: Taylor brace is designed to control the upper and lower regions of the spinal column and support your spine whilst standing, sitting, and walking after spinal surgery.

Taylor brace



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Option D: ASHE brace (Anterior spinal hyperextension brace) is used in dorso lumbar spinal injury.

Solution to Question 12:

Poor compliance due to discomfort and poor appearance is the most common complication of bracing.

Other complications of bracing include:

- Skin breakdown

- Excessive sweating
- Allergic skin reaction
- Increased gastric pressure
- Spontaneous sternum fracture

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If you purchased this from someone else,
you may have been scammed.

Spondylolisthesis & IVDP

Question 1:

What is the most common site for spondylolisthesis?

- a) L2 - L3
- b) L4 - L5
- c) L5 - S1
- d) L3 - L4

Question 2:

In which age group is type III spondylolisthesis usually seen?

- a) Children
- b) Early adulthood
- c) Middle age
- d) Adolescents

Question 3:

A 62-year-old woman presented with lower back pain and numbness in the right foot. An X-ray spine was done which is given below. Which classification system is used for radiologic grading of this condition?



- a) Quebec Task Force
- b) Allen & Ferguson
- c) Miyazaki
- d) Meyerding

Question 4:

A 74-year-old man presented with low back pain that was radiating to his legs. On examination of the spine, a palpable step was felt in the lumbosacral region. What is the likely diagnosis?

- a) Spondylolysis
- b) Spondylolisthesis
- c) Disk prolapse
- d) Spondylosis

Question 5:

The oblique spinal X-ray of a patient having chronic low-back ache is given below. What is the sign seen here called?



- a) Spur sign
- b) Beheaded Scottish terrier sign
- c) Corduroy sign
- d) Polka dot sign

Question 6:

A 60 year old lady presented with back pain that radiates to both of her legs for the past 6 months. X-ray spine was done which is given below. What is your diagnosis?



- a) Stage I of spondylolisthesis

- b) Stage III of spondylolisthesis
- c) Stage IV of spondylolisthesis
- d) Stage V of spondylolisthesis

Question 7:

A patient complaining of sharp radiating pain in his legs is diagnosed with sciatica. What is the most common cause for this condition?

- a) Spondylolisthesis
- b) Sacroiliitis
- c) Disc prolapse
- d) Ankylosing spondylitis

Question 8:

Which is the most common level at which lumbar disc prolapse occurs?

- a) L5-S1
- b) L4-L5
- c) L2-L3
- d) L3-L4

Question 9:

A 52-year-old lady has been experiencing low back pain that radiates to her right thigh for the last 3 weeks. She realised that tilting her torso to the left side relieved the pain and hence she has started maintaining a tilted posture. What is this known as?

- a) Degenerative scoliosis
- b) Compensatory scoliosis
- c) Sciatic scoliosis
- d) Postural scoliosis

Question 10:

Which of the following statements is false regarding the pain seen in patients with intervertebral disc prolapse?

- a) It is increased by sitting
- b) It is increased by flexion
- c) It is increased in the semi-Fowler position
- d) Leg pain more than back pain indicates root involvement

Question 11:

A patient with low back pain is diagnosed to have intervertebral disc prolapse between L3 and L4. Which of the following findings is least likely to be seen in this patient?

- a) Sensory loss on the medial shin
- b) Diminished ankle jerk
- c) Pain along anterior thigh
- d) Diminished knee jerk

Question 12:

A clinician is performing the following test on a patient with sciatic pain. Which sign is being elicited here?



- a) Lasègue sign
- b) Mackiewicz sign

- c) Fajersztajn sign
- d) Bowstring sign

Question 13:

What is the gold standard investigation for evaluation of low backache in a patient?

- a) CT
- b) Technetium 99m bone scan
- c) MRI
- d) DEXA scan

Question 14:

Which of the following patients with disc prolapse have an absolute indication for surgery?

- a) Patient experiencing debilitating sciatica
- b) Patient with sciatica not improving with epidural steroid injection
- c) Patient that is diagnosed with cauda equina syndrome
- d) Patient with progressive loss of sensation in the lower limbs

Question 15:

In spine fusion surgery, the screws are fixed to which part of the vertebra?

- a) Spinous process
- b) Lamina
- c) Pedicle
- d) Facet joint

Answer Key

Question No.	Correct Option
1	c
2	c

3	d
4	b
5	b
6	d
7	c
8	b
9	c
10	c
11	b
12	d
13	c
14	c
15	c

Detailed Explanations

Solution to Question 1:

The most common site for spondylolisthesis is L5 - S1 (82%), followed by L4 - L5 (11%).

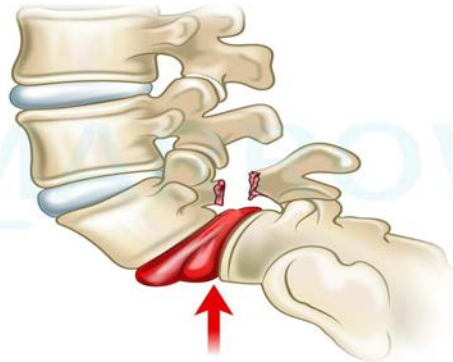
Spondylolisthesis is the anterior displacement of one segment of the spine upon another. It is caused as an end result of spondylolysis.

Spondylolysis refers to defects or stress fractures in the pars interarticularis of the vertebral arch. The most common site for spondylolysis is L5.

The last stage (stage V) of spondylolisthesis is known as spondyloptosis. There is complete displacement of one vertebra over the next vertebra in this stage.

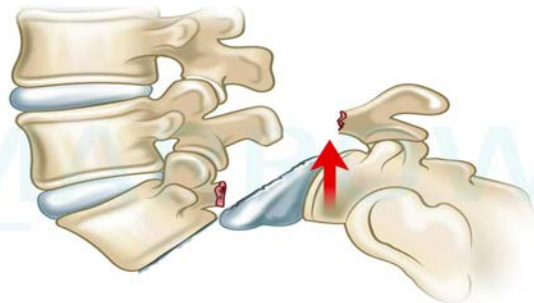
Note: Spondylosis is used to describe degenerative findings in the adjacent vertebral endplates due to age-related skeletal changes or osteophyte formation. Spondylitis is inflammation of the vertebrae.

Spondylolisthesis



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Spondyloptosis



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Spondylolysis



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Spondylosis



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Spondylitis



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Solution to Question 2:

Type III spondylolisthesis is of degenerative origin and presents mostly during middle-age or later. It occurs most commonly at the L4-L5 level.

Wiltse-Newman classification of spondylolisthesis is based on the cause. It is as follows:

- I (Dysplastic) - Congenital abnormalities of the lumbosacral junction
- II (Isthmic or lytic) - Due to defects in the pars interarticularis
- III (Degenerative) - Degenerative changes in the disc and incompetence of facet joints
- IV (Traumatic) - Posterior arch fractures causing destabilization of the spine
- V (Pathologic) - Due to destructive diseases such as tuberculosis or neoplasm

- VI (Iatrogenic) - After facetectomy surgery and pars fracture during laminectomies

Types I and II are commonly seen in childhood and adolescence. These occur most commonly at the L5-S1 level.

Solution to Question 3:

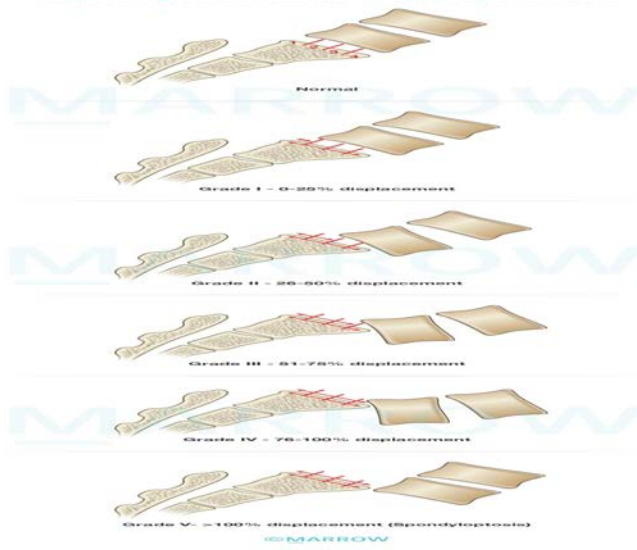
In the above clinical scenario, the history and X-ray are suggestive of spondylolisthesis. The radiological grading of this condition is done using Meyerding classification.

Spondylolisthesis is graded into 5 types based on the percentage of slippage of one vertebra over the vertebra below.

The Meyerding classification of spondylolisthesis is given below.

Grade	Displacement
I	0-25%
II	26-50%
III	51-75%
IV	76-100%
V (Spondyloptosis)	>100%

Meyerding Classification of Spondylolisthesis



Solution to Question 4:

In the above clinical scenario, the patient most likely has spondylolisthesis. A palpable step in the lumbosacral spine is a classic clinical feature of this condition. It is known as step sign.

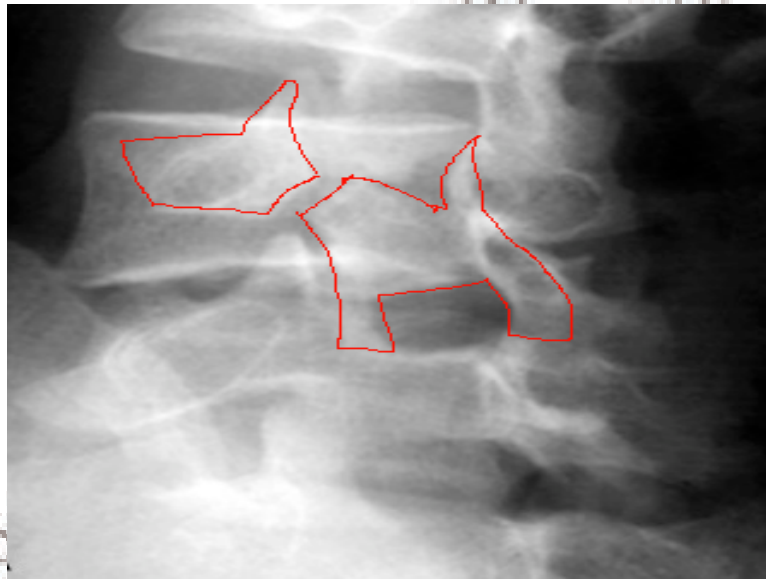
Normally, the spinous processes of the adjacent vertebrae are aligned with each other. They can be palpated on the back in a smooth way.

In spondylolisthesis, one vertebra has moved over the other. Therefore, a step-off or step sign can be felt over the spinous process at the affected level.

Note: The step-off sign is also used to describe the radiographic appearance of Lisfranc injury of the foot. There is a dorsal displacement of the tarsal bones with respect to the metatarsal bones.

Solution to Question 5:

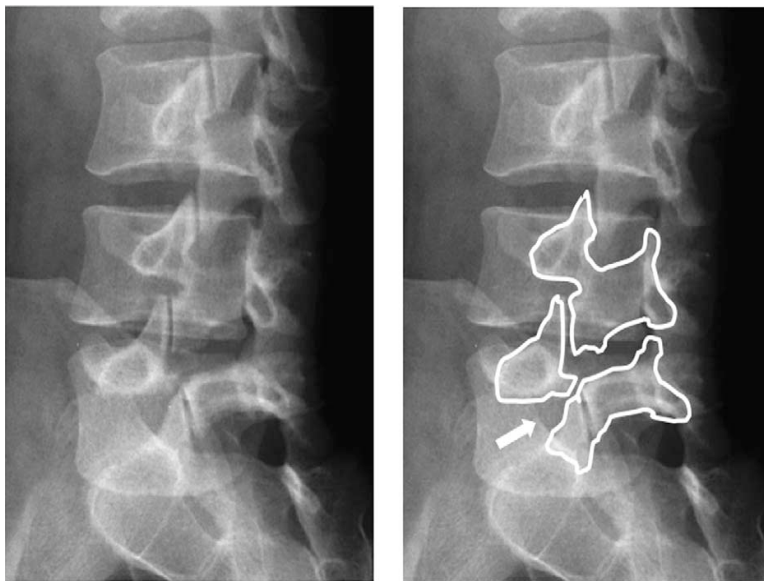
In the X-ray given, there is a break in the pars interarticularis of the L4 vertebra, which appears like a beheaded Scottish terrier. Hence, it is known as beheaded Scottish terrier sign and it is diagnostic of spondylolisthesis.



The investigation of choice in the case of spondylolysis and spondylolisthesis is an oblique view X-ray of the lumbar spine.

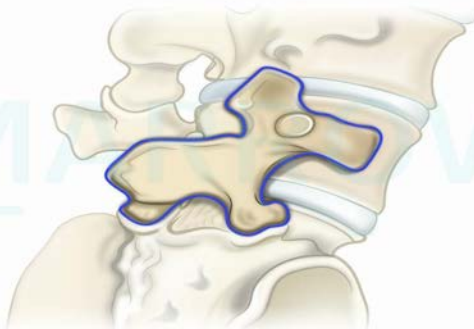
Normally, the posterior elements of the normal vertebra appear like a 'Scottish terrier dog' and this is known as Scottie dog sign.

The X-ray spine below shows Scottie dog sign and beheaded Scottish terrier sign.



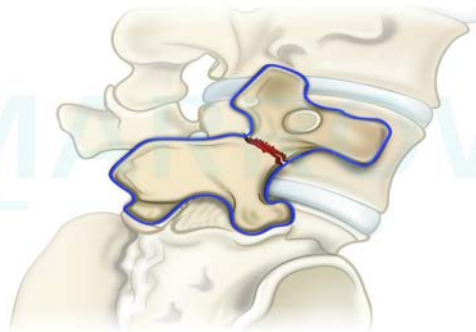
In spondylolysis, there is a defect or break in the pars without dislocation. This gives the appearance of Scottish terrier with collar sign as shown in the image below.

Normal spine
(Scottie dog sign)



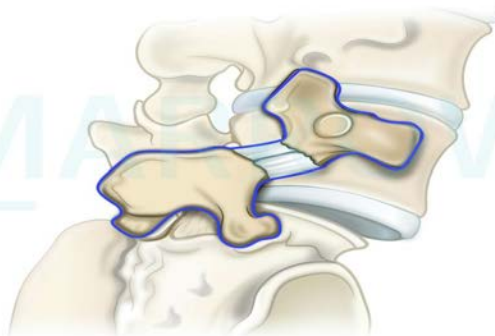
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Spondylolysis
(Scottish terrier with collar sign)



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Spondylolisthesis
(Beheaded Scottish terrier sign)



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Solution to Question 6:

The given AP radiograph of spine depicts the inverted Napoleon hat sign, which is seen in stage V of spondylolisthesis.

In such cases, there is bilateral spondylolysis and significant spondylolisthesis of L5 over S1. The vertebra appears like an inverted Napoleon hat in the AP-view X-ray of the lumbar spine as shown below.



Solution to Question 7:

The most common cause of sciatica is intervertebral disc prolapse.

Sciatica is defined as a radiating pain along the course of the sciatic nerve. It is felt in the back, buttocks, posterior aspect of the thigh and legs, and the foot.

Common causes for sciatica include:

- Intervertebral disc prolapse
- Spondylolisthesis
- Sacroiliitis
- Herpes simplex virus
- Tuberculoma
- Cyst of the sacral nerve root
- Diabetic neuropathy

Solution to Question 8:

Lumbar disc prolapse most commonly occurs at the level of L4-L5.

Most common sites of disc prolapse are: L4-L5 & L5-S1 & L3-L4 & L2-L3 & L1-L2.

Acute disc herniation occurs due to underlying disc degeneration. It is most commonly seen in the fourth to fifth decades of life and is more common in men than in women (3:1 ratio).

Risk factors include:

- Smoking

- Heavy lifting, especially with torsional stress
- Strenuous physical activity
- Occupational driving

Some terms related to disc prolapse are:

- Protrusion - posteriorly bulging disc with the outer annulus intact.
- Extrusion - expulsion of fibrocartilaginous disc material after rupture occurs through the posterior longitudinal ligament.
- Sequestration - disc material breaks free to lie in the spinal canal.

Solution to Question 9:

In the given scenario the patient most likely has sciatic scoliosis. This refers to the patient tilting to the unaffected side to relieve the pain of intervertebral disc prolapse (IVDP).

Compensatory scoliosis is seen in those with a short leg or a contracture of the hip. It disappears when the patient is made to sit.

Postural scoliosis occurs due to incorrect posture being maintained by the patient. It disappears when the patient is made to bend forwards.

Degenerative scoliosis occurs due to degeneration of the spine with ageing.

Solution to Question 10:

The pain of intervertebral disc prolapse decreases in semi-Fowler position. In this position, the patient lies on a bed supine with the head of the bed raised by 30 to 45 degrees.

Characteristics of pain in IVDP:

- Pain is increased by flexion, sneezing, coughing, straining, and sitting
- Pain is decreased by rest and in the semi-Fowler position
- Leg pain equal to or more than the back pain in IVDP cases is evidence of involvement of the nerve root due to herniated disc

Solution to Question 11:

Diminished ankle jerk corresponds to S1 nerve root involvement, which is suggestive of disc prolapse between L5-S1.

When there is an L3-L4 prolapse, the L4 nerve root is involved. Pain is felt in the lumbar region and radiates along the anteromedial aspect of the thigh.

There is a sensory loss on the posterolateral thigh, anterior knee, medial malleolus, medial foot, and medial shin. There is weakness of the quadriceps muscles leading to reduced to absent knee jerk. This is known as Westphal's sign.

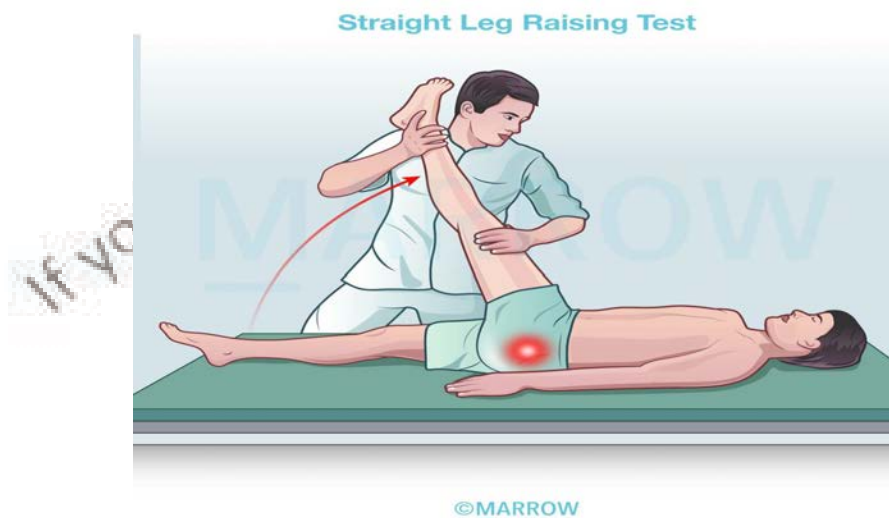
Solution to Question 12:

The image shows the examiner pressing the popliteal fossa of the patient to elicit sciatic pain. This is known as the Bowstring sign.

Important tests for intervertebral disc prolapse:

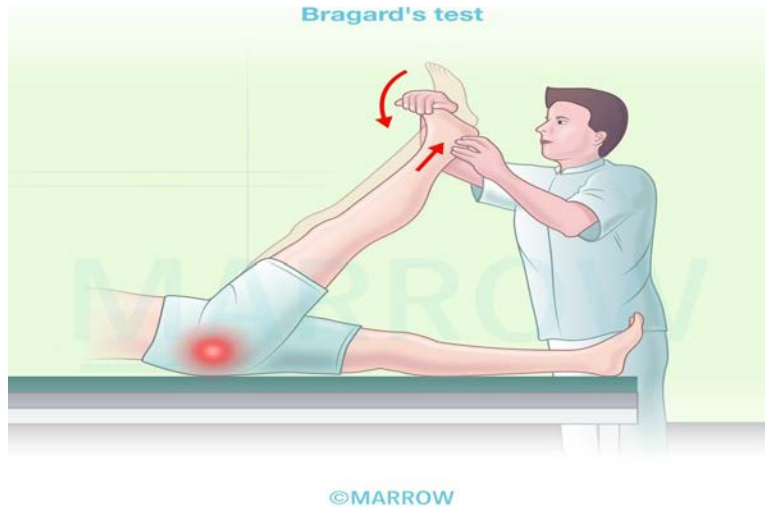
1. Straight Leg Raising Test (SLRT) or Lasegue sign:

- Done to assess nerve root irritation in the lumbosacral area.
- Patient is made to lie on the back with the head extended, with hips and legs in the neutral position.
- Affected leg passively and slowly raised by the ankle with the knee fully extended
- SLRT test negative if leg can be raised 80–90 degrees without pain
- SLRT test positive if pain elicited between 30-60 or 70 degrees from horizontal
- Pain should be radicular type and radiating to the back of the thigh or to the calf



2. Bragard test (sciatic stretch test or flip test):

- Perform SLRT
- When the patient experiences discomfort, the leg is lowered a little till the pain disappears
- At this angle, the ankle is passively dorsiflexed
- If pain is felt again at the back of the thigh or in the calf, the test is positive
- Also called reinforcement positive or Bragard's sign positive



3. Crossed SLRT (well-leg raising test or Fajersztajn sign):

- SLRT is performed on the unaffected side
- Pain felt on the affected side
- Termed a contralateral positive SLRT or crossed SLRT positive
- Very specific sign of root compression
- Usually positive when there is severe compression due to a centrally located prolapse

4. Popliteal compression test or Bowstring sign:

- Bowstring sign is more specific for disc prolapse than SLRT
- Perform SLRT until the patient experiences sciatic pain
- Without reducing the amount of lift, bend the knee to relax the sciatic nerve
- Buttock pain is immediately relieved
- The examiner then presses popliteal fossa to stretch the lateral popliteal nerve behind the lateral tibial condyle
- Tightening of the nerve like a bowstring re-induces the pain

Popliteal Compression Test



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5. Femoral stretch (reverse Lasegue test or Mackiewicz sign):

- Patient lies prone
- Examiner flexes the knee and the hip is passively extended
- Test is positive if patient experiences anterior thigh pain
- This test is usually positive for L2-L3 and L3-L4 (high lumbar) protrusions

Femoral stretch test



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Solution to Question 13:

MRI is the gold standard investigation of the spine for evaluation of a case of low backache.

MRI spine can help rule out impingement of the spinal cord. It is superior to CT for the identification of infections, tumours, and degenerative changes within the discs.

Other investigations done for low backache include:

- X-rays have limited value in detecting disc prolapse. They are useful in diagnosing metabolic, degenerative, inflammatory and malignant conditions affecting the spine.
- Myelography is used for demonstrating blocks due to disc prolapse.
- CT scan helps to identify bone and soft tissue problems with greater accuracy.

Solution to Question 14:

Cauda equina syndrome is the only absolute and urgent indication for surgery in disc prolapse.

The relative indications for elective surgery in disc prolapse include:

- Failed conservative management
- Progressive neurological deficit
- Recurrent episodes of incapacitating sciatica
- Pain not relieved by complete rest from activities

The aim of the surgery is to relieve the pressure on the nerve root. The prolapsed disc is removed (discectomy), followed by stabilization of the spine.

In most cases of disc prolapse, conservative treatment is given. Conservative therapy for this condition includes:

- Bed rest
- Heat
- Ice
- Analgesics
- Non-steroidal anti-inflammatory drugs (NSAIDs)
- Antidepressants
- Muscle relaxants
- Epidural steroids

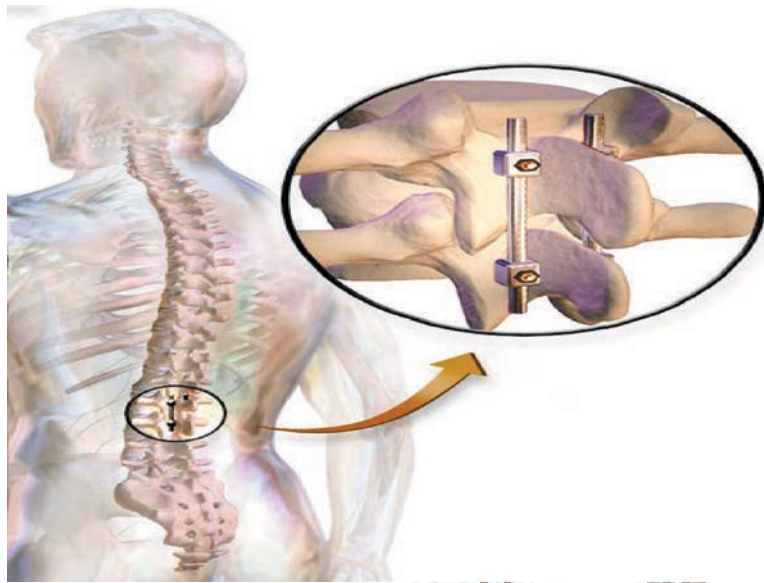
Solution to Question 15:

In spine fusion surgeries, screws are placed in the pedicle of the vertebrae.

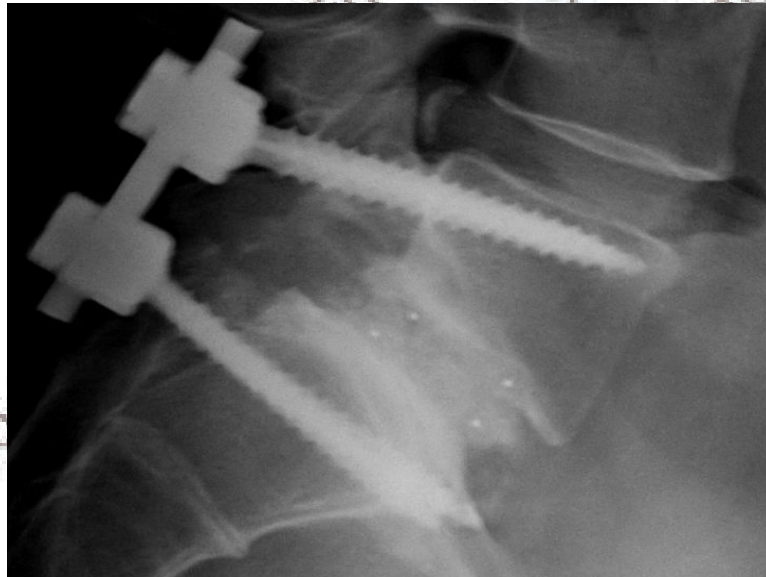
Spinal fusion or spondylodesis is a surgical technique that joins two or more vertebrae. This procedure prevents any movement between the fused vertebrae.

Pedicle screws are placed above and below the vertebrae that are to be fused. These are used in a spinal fusion to add extra support and strength to the fusion while it heals.

Rods are used to connect the screws as shown below. These prevent movement and allow the bone to heal.



The post-operative X-ray given below shows fusion of L5 and S1 vertebrae.



Injuries of Pelvis

Question 1:

What are rotationally unstable, but vertically stable pelvic ring fractures classified as?

- a) Tile type B
- b) Tile type C
- c) Neer type 1
- d) Neer type 2

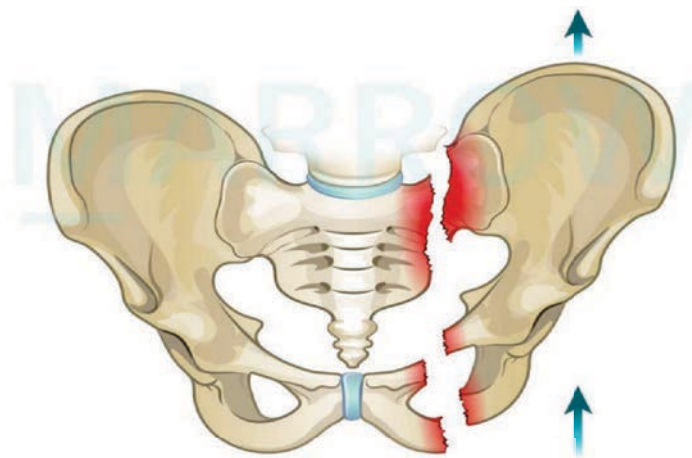
Question 2:

Which of the following is not included in the criteria of unstable pelvic injury?

- a) Sacroiliac complex disruption more than 1cm
- b) Avulsion fracture of sacral or ischial end of sacrospinous ligament
- c) Avulsion fracture of L5 transverse process
- d) Isolated pubic diastasis of 2 cm

Question 3:

A patient sustained a fracture as depicted in the image, following a fall from height. What is this fracture known as?



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- a) Malgaigne fracture
- b) Chauffeur fracture
- c) Open book fracture
- d) Bucket handle fracture

Question 4:

A young lady who had jumped from the fourth floor of her apartment building was brought to the casualty. CT pelvis revealed jumper's fracture. Which of the following best describes the fracture?

- a) Fracture of the dome of the acetabulum
- b) Combination fracture of pubis and ilium
- c) Bilateral fracture of both pubic rami
- d) H or U shaped sacral fractures

Question 5:

Which of the following best describes a straddle fracture?

- a) Unilateral SI joint disruption
- b) Pelvic fracture with urethral injury
- c) Unilateral Iliac bone fracture
- d) Bilateral superior and inferior pubic rami fracture

Question 6:

What is the most common complication of pelvic fractures?

- a) Deep vein thrombosis
- b) Neurogenic shock
- c) Hypovolemic shock
- d) Fat embolism

Question 7:

An elderly man was accidentally dragged down the stairs when he was taking his dog for a walk. He is suspected to have sustained a pelvic fracture. On examination, a closed degloving injury is noted in the proximal part of his right thigh. What is this lesion characteristically known as?

- a) Malgaigne's lesions
- b) Morel-Lavallee lesions
- c) Judet-Letournel lesions
- d) Kocher-Langenback lesions

Question 8:

A middle aged man complains of left-sided hip pain after he sustained an injury in a game of squash. X-ray pelvis reveals the spur sign. What is the likely diagnosis in this patient?

- a) Posterior wall acetabular fracture
- b) Anterior column acetabular fracture
- c) Transverse acetabular fracture
- d) Bicolumnar acetabular fracture

Question 9:

An orthopaedic surgeon uses a posterior approach while operating on a patient with acetabular fracture. What is this approach known as?

- a) Iliofemoral approach
- b) Ilioinguinal approach
- c) Kocher-Langenbeck approach
- d) Stoppa approach

Answer Key

Question No.	Correct Option
1	a
2	d
3	a

4	d
5	d
6	c
7	b
8	d
9	c

Detailed Explanations

Solution to Question 1:

Rotationally unstable, but vertically stable pelvic ring fractures are classified as Tile type B.

Two classification systems are used in the evaluation of pelvic ring fractures:

1. The Tile classification provides an assessment of the stability of the pelvis. It helps the surgeon predict the need for surgery. Pelvic ring fractures are classified into 3 types:
2. The Young and Burgess classification is based on the mechanism of injury. It helps the surgeon predict the severity of the injury, blood loss, and deformity or displacement.

Note: Neer classification is used for proximal humerus fractures.

Tile classification	Stability	Management
Type A	Rotationally and vertically stable	Conservative
Type B	Rotationally unstable and vertically stable	External fixation is used for definitive management. Anterior fixation is additionally done if pubic bones have separated by more than 2.5 cm.
Type C	Rotationally and vertically unstable	Posterior fixation is done for vertical stability along with external fixation.

Solution to Question 2:

Isolated pubic diastasis is not a criterion for unstable pelvic injury. For the pubic diastasis to be considered unstable, it must be accompanied with posterior ring injury or injury of sacro-tuberous or sacro-spinous ligaments.

Radiographic factors indicating unstable pelvic injury include:

- Sacroiliac joint disruption >1 cm.
- Gap in posterior pelvic ring.

- Avulsion fracture of L5 transverse process or sacrotuberous or sacrospinous ligament.
- Pubic diastasis of > 2 cm along with posterior ring injury or sacro-tuberous ligament or sacrospinous ligament.

Solution to Question 3:

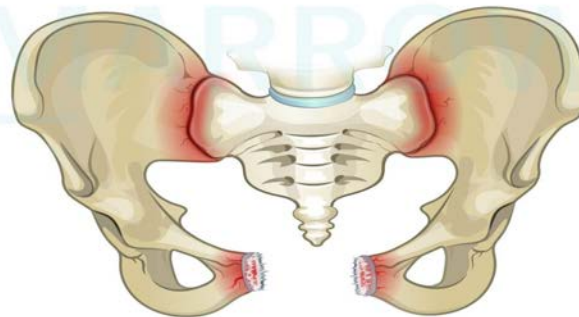
The fracture shown in the image is known as Malgaigne's fracture.

This fracture involves the pubic rami anteriorly and the sacroiliac joint (SI joint) or ilium near the SI joint on the same side posteriorly.

Chauffeur's fracture refers to fracture of the radial styloid process in the forearm.

Open book fracture are associated with pubic diastasis and/or a fracture of the pubic rami with a posterior pelvic disruption of the sacro-iliac joint.

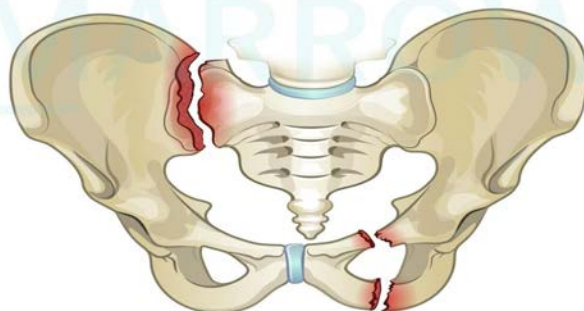
Open book fracture



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Bucket handle fracture refers to a vertically orientated fracture through ipsilateral superior and inferior pubic rami with contralateral sacroiliac joint disruption.

Bucket handle fracture



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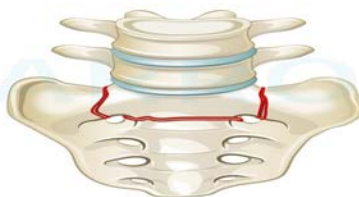
Solution to Question 4:

Jumper's fracture is H or U-shaped fracture of the sacrum.

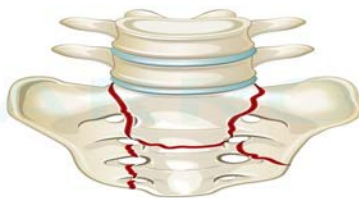
These are called jumper's or suicide jumper's fracture as they are seen in falls from height. There are two longitudinal fractures that run through the sacral foramina and a transverse fracture. The level of the transverse fracture line determines if it is H or U shaped.

As these fractures pass through the sacral foramina, they can cause injury to the spinal cord and result in cauda equina syndrome.

Jumper's fracture



U-Shaped Fracture

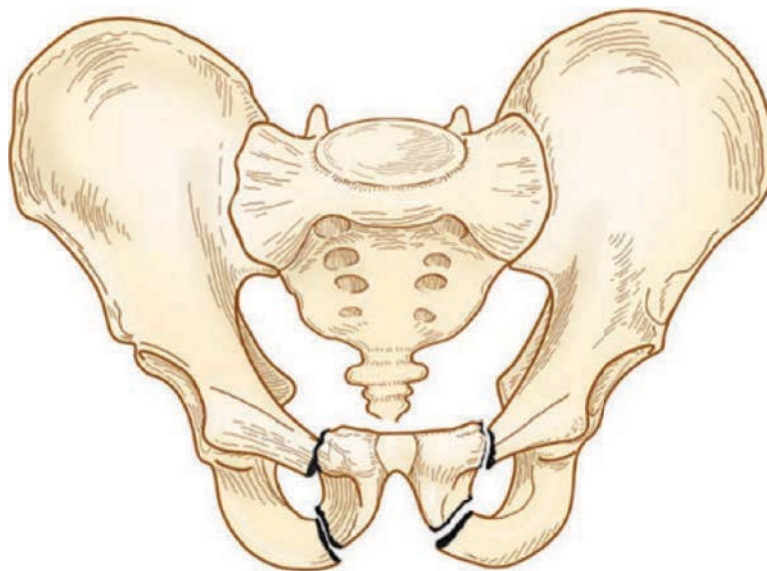


H-Shaped Fracture

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Solution to Question 5:

Bilateral superior and inferior pubic rami fracture is called straddle fracture.



Solution to Question 6:

Acute haemorrhage leading to hypovolemic shock is the most common complication of pelvic fractures.

In fractures of the pelvic ring, there is a risk of injury to the major vessels (internal iliac and external iliac vessels) and to the venous plexus around the sacroiliac joint. Bleeding from the venous plexus is the major cause of pelvic haemorrhage.

Potential blood loss in fractures is given below:

Pelvic fractures have a high mortality rate ranging from 10% to 50% in some open pelvic fractures. Early mortality is mostly the result of haemorrhage. Late mortality occurs from sepsis or multiple system organ failure.

Fracture site	Potential blood loss
Pelvis	> 2 litres
Femur	1 - 2 litres
Tibia or fibula	0.5 - 1.5 litres

Solution to Question 7:

Closed degloving soft tissue injuries associated with pelvic and acetabular fractures are known as Morel-Lavallee lesions.

Morel-Lavallee lesion involves separation of skin from the underlying fascia. They are frequently seen in pelvic fractures due to motor vehicle accidents and other crush injuries. The shearing force in these injuries creates a pocket between skin and fascia where a considerable amount of blood can collect.

MRI and ultrasonography are recommended to confirm the diagnosis.

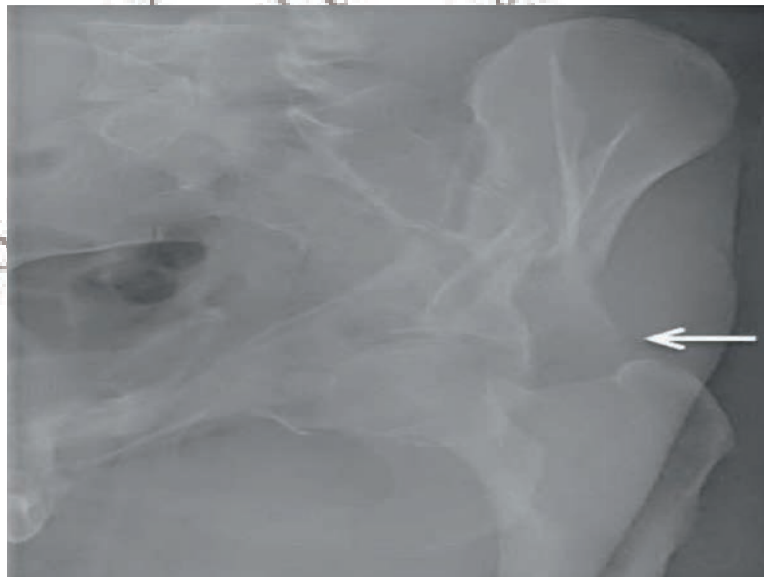
Complications of Morel-Lavallee lesions include infection, subcutaneous fat necrosis, and necrosis of the overlying skin. These lesions are managed through incisional drainage, debridement, and irrigation of the wound.

Solution to Question 8:

Spur sign is seen in bicolumnar acetabular fractures.

Bicolumnar fractures cause disruption of both the anterior and posterior columns on the acetabulum. Due to the fracture in the acetabulum, the femoral head migrates medially. The unsupported triangular area of the ilium is then seen laterally as the spur sign. It is best seen on obturator oblique view radiographs.

The obturator oblique X-ray image of pelvis shows a comminuted left acetabular fracture affecting both the columns (disruption of both the iliopectineal and ilioischial lines). The left ilium is seen pointing laterally (spur sign).



Posterior wall fractures are the most common type of acetabular fractures. Letournel and Judet classification is used to classify acetabular fractures.

Judet view (45-degree oblique) and AP views are used to radiographically evaluate acetabular fractures.

Solution to Question 9:

The posterior approach used in acetabular fractures is known as the Kocher-Langenbeck approach.

The surgical approaches used in the management of acetabular fractures include:

- Kocher-Langenbeck approach is the posterior approach that provides access to the posterior wall, posterior column, and to transverse fractures. It is also used for handling sciatic nerve injuries.
- The ilioinguinal approach provides access to the entire anterior column, symphysis pubis, ilium, and sacroiliac joint. The Stoppa approach is a modification of the ilioinguinal approach.
- The iliofemoral approach is a lateral approach that is rarely used nowadays due to the high rate of complication.

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Infections of the bone

Question 1:

Which is the earliest site of infection in acute hematogenous osteomyelitis?

- a) Epiphysis
- b) Diaphysis
- c) Metaphysis
- d) Periosteum

Question 2:

A 4-year old girl is brought with high-grade fever, malaise, and severe pain over her left knee. Examination reveals tenderness over the medial aspect of the left knee joint. What is the most likely cause of this condition?

- a) *Pseudomonas aeruginosa*
- b) *Haemophilus influenzae*
- c) *Staphylococcus aureus*
- d) *Streptococcus pyogenes*

Question 3:

Which of the following patients with acute osteomyelitis is most likely to develop limb shortening and deformity?

- a) A 36-year-old HIV positive woman not on treatment
- b) A 68-year-old man with diabetes and hypertension
- c) A 1-year-old male infant who is otherwise healthy
- d) A 6-year-old girl with a history of sickle cell disease

Question 4:

A 6-year-old boy was referred for fever and chills for 2 days. His mother says that he has been refusing to walk and screams when his left leg is touched. Examination revealed point

tenderness over the medial tibia. Investigations revealed the following. Which of the following will not be useful in the management of this child?

- a) Empirical antibiotics
- b) Surgical drainage
- c) Vacuum assisted closure
- d) Splinting of the limb

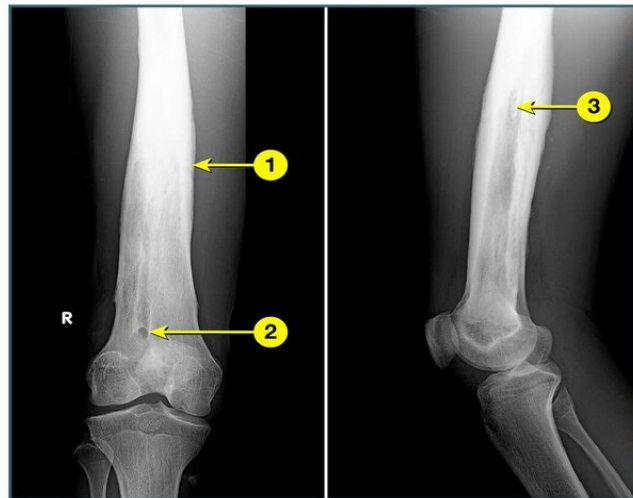
Question 5:

When does the first bony lesion of osteomyelitis appear on an X-ray?

- a) Within 24 hours
- b) Within 48 hours
- c) During 1st week
- d) During 2nd week

Question 6:

Identify the following marked structures.



- a) 1 - Sequestrum, 2 - Involucrum, 3 - Cloacae
- b) 1 - Sequestrum, 2 - Cloacae, 3 - Involucrum
- c) 1 - Involucrum, 2 - Cloacae, 3 - Sequestrum
- d) 1- Cloacae, 2 - Sequestrum, 3 - Involucrum

Question 7:

A patient has a history of a road traffic accident 2 years back, and has developed pain and swelling now at the same site. His X-ray image is shown in the image given below. What is the probable diagnosis?



- a) Osteogenic sarcoma
- b) Ewing's sarcoma
- c) Chronic osteomyelitis
- d) Multiple myeloma

Question 8:

A 52-year-old man is being evaluated for chronic pain and purulent discharge from a wound over his left thigh. He had suffered a fracture of his left femur 7 years ago in an accident and has had these complaints ever since. Examination reveals the following. Which of the following is likely responsible for the recurrent nature of this condition?



- a) Sequestrum
- b) Involucrum
- c) Cloacae
- d) Sinus tract

Question 9:

In patients with chronic osteomyelitis, the paprika sign is seen on which of the following?

- a) Curettage of the bone
- b) Drainage of abscess
- c) MRI scan
- d) CT scan

Question 10:

A 50-year-old woman with chronic osteomyelitis of the tibia is planned for surgical debridement. The orthopedic surgeon explains to her that this procedure will result in a bony defect that will need to be corrected. All of the following can be used for the correction of this defect except:

- a) Metal plate
- b) PMMA Beads
- c) Muscle graft

d) Bone graft

Question 11:

In patients with chronic osteomyelitis, which of the following complications would you not expect?

- a) Pathological fractures
- b) Squamous cell carcinoma
- c) Amyloidosis
- d) Brodie's abscess

Question 12:

Which of the following is true regarding sclerosing osteomyelitis of Garre?

- a) There is no pus formation
- b) It is a highly virulent infection
- c) It occurs in immunocompromised hosts
- d) There is presence of sequestrum

Question 13:

What is the most common cause of septic arthritis in sexually active young adults?

- a) Chlamydia trachomatis
- b) Staphylococcus aureus
- c) Neisseria gonorrhoeae
- d) Enterobacter cloacae

Question 14:

A 7-year-old boy presents with complaints of acute pain and swelling of the knee joint. He is reluctant to move the limb. Ultrasonography shows joint effusion. What is the next best step in management?

- a) Blood culture
- b) MRI

- c) Empirical antibiotics
- d) Joint aspiration

Question 15:

A 52-year-old woman with rheumatoid arthritis develops septic arthritis of her left knee. She needs to be treated immediately to prevent the destruction of which of the following?

- a) Articular cartilage
- b) Joint capsule
- c) Subchondral bone
- d) Synovial membrane

Question 16:

An 11-month-old baby is brought with high-grade fever and persistent crying for the past 2 days. She has been refusing to stand or eat anything. Examination reveals erythema and swelling of the right hip. Joint arthrocentesis reveals purulent fluid and the presence of bacteria. What is the likely diagnosis?

- a) Holstein-Lewis arthritis
- b) Hawkin-Kennedy arthritis
- c) Tillaux-Chaput arthritis
- d) Tom Smith arthritis

Question 17:

In patients with transient synovitis of the hip joint, which of the following is true regarding the attitude of the affected limb?

- a) Extended, adducted, and internally rotated
- b) Flexed, adducted, and internally rotated
- c) Extended, abducted, and externally rotated
- d) Flexed, abducted, and externally rotated

Question 18:

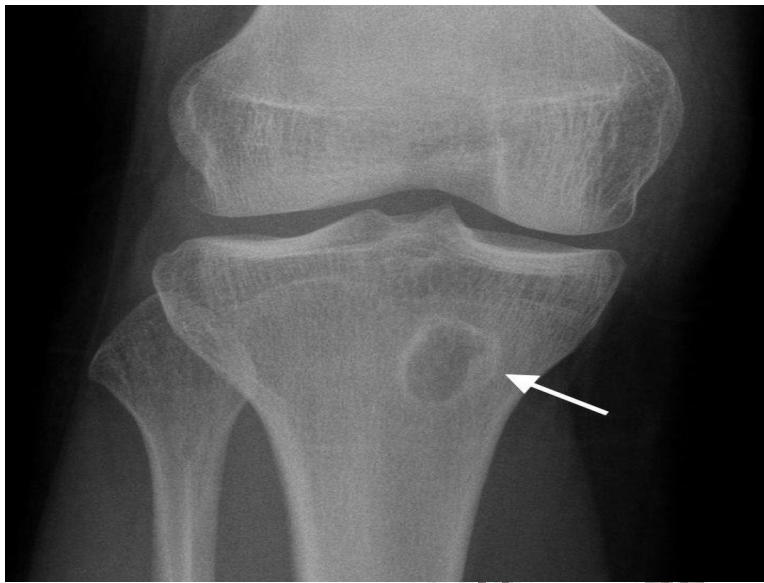
A 24-year-old woman presented with severe pain and swelling of her right index finger for 2 days. Last week, she had sustained a cut on her finger with a pair of rusty gardening shears. On examination, the following finding is seen. She cries out in pain when you try to passively extend the finger and palpate the palmar aspect. What is the likely diagnosis?



- a) Tenosynovitis
- b) Osteomyelitis
- c) Septic arthritis
- d) Necrotizing fasciitis

Question 19:

A 12-year-old boy presents with swelling and pain for 6 months over the upper tibia. His radiographic image is shown below. The most likely diagnosis is:



- a) Osteosarcoma
- b) Osteoclastoma
- c) Brodie's abscess
- d) Ewing's sarcoma

Answer Key

Question No.	Correct Option
1	c
2	c
3	c
4	c
5	d
6	c
7	c
8	a
9	a
10	a
11	d
12	a
13	c
14	d

15	a
16	d
17	d
18	a
19	c

Detailed Explanations

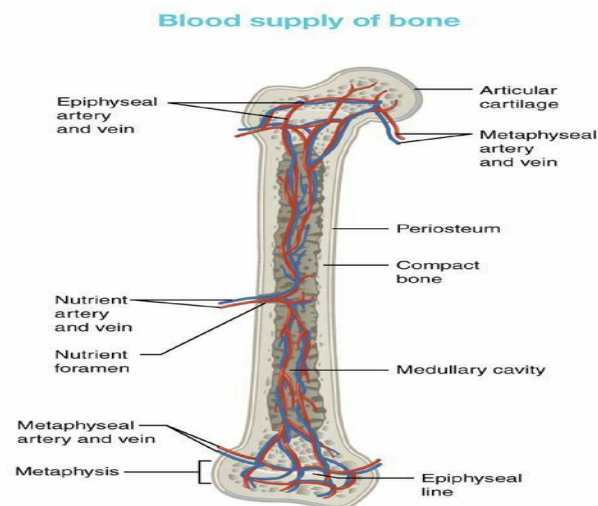
Solution to Question 1:

The earliest site of infection in acute hematogenous osteomyelitis is the metaphysis. It is also the most common site of infection.

The infection reaches metaphysis via the hematogenous route. The metaphysis is susceptible due to the following factors:

- Hairpin loop arrangement of terminal blood vessels - leads to vascular stasis that favors bacterial colonization
- Fewer phagocytes in this area

Apart from the hematogenous route, acute osteomyelitis can also occur by the exogenous route. This includes open fractures, iatrogenic intervention, or spread from local infection.



Solution to Question 2:

The given clinical scenario is suggestive of acute osteomyelitis. The most common organism causing osteomyelitis is *Staphylococcus aureus*.

The other common causative organisms include:

- Pseudomonas aeruginosa - most common cause in IV drug abusers
- Salmonella - patients with sickle cell anemia are prone
- Haemophilus influenzae - was a common causative organism in children, less common now due to vaccination
- Streptococcus pyogenes
- Escherichia coli

It presents with acute onset fever, pain, and tenderness of the affected site. Redness, warmth, swelling, and edema are late features. It most commonly involves the proximal tibia or proximal and distal ends of the femur.

It commonly occurs by hematogenous spread following toe infections, ear discharge, tooth infection, sore throat, or a boil. In infants, the source of infection may be umbilical cord infection, heel prick, or IV cannula.

Solution to Question 3:

Acute osteomyelitis is most likely to cause limb shortening and deformity in infants because of the involvement of the growth plate, epiphysis, and the adjacent joint.

This occurs because the metaphyseal infection spreads via the blood vessels of the physis (growth plate) to the epiphysis and the adjacent joint. Hence, septic arthritis is frequently associated with acute osteomyelitis in infancy. The resulting damage to the growth plate and septic arthritis of the adjacent joint lead to limb shortening and deformity.

Beyond 2 years of age, the physis acts as a barrier preventing the direct spread of metaphyseal infection into the epiphysis. Hence, the metaphyseal infection more commonly spreads to the diaphysis.

Solution to Question 4:

The given clinical scenario is suggestive of acute osteomyelitis. Vacuum-assisted closure is not used in the management of acute osteomyelitis. It is used in the management of chronic osteomyelitis following extensive debridement.

Management of acute osteomyelitis includes the following:

- Immediate empirical antibiotic therapy (after taking blood samples for culture and sensitivity)
- Surgical drainage - if patient does not respond to antibiotics or if abscess is detected on imaging
- Supportive therapy - analgesics, IV fluids, and splinting of the limb

The complications of inadequately treated acute osteomyelitis include:

- Septicemia
- Chronic osteomyelitis

- Septic arthritis
- Altered bone growth

Solution to Question 5:

The first bony lesion of osteomyelitis is seen on an x-ray during the 2nd week of infection. It is due to periosteal new bone formation and appears as a faint extracortical outline.

When osteomyelitis is suspected on clinical grounds, early x-rays show only soft tissue swelling with no bony abnormality. Hence, the following imaging modalities are highly sensitive and are used to aid the diagnosis within 24-48 hours:

- MRI - shows marrow edema within 24-48 hours
- Technetium-99 bone scan - shows increased osseous uptake of the tracer

Solution to Question 6:

In the given radiographs showing features of chronic osteomyelitis, the marked structures are as follows:

- Involucrum is the thick sheath of periosteal new bone that surrounds the sequestrum.
- Cloacae are openings in the involucrum that allow drainage of purulent and necrotic material out of the dead bone.
- Sequestrum is a piece of devitalized bone that has been separated from its surrounding bone during the process of necrosis.

Chronic Osteomyelitis



Solution to Question 7:

The given clinical scenario of a patient with a history of an accident 2 years ago, experiencing symptoms of pain and swelling at the site of injury, and an X-ray of the lower limb revealing sequestrum and involucrum in the tibia, strongly suggests a diagnosis of chronic osteomyelitis.

Chronic Osteomyelitis



Chronic osteomyelitis may occur by direct inoculation of the infective organism during trauma (like road traffic accidents). The infection continues to thrive within the bone leading to alternating quiescent and flare-up stages of chronic osteomyelitis.

Sequestrum is a piece of dead bone. It is formed when a fragment of bone gets separated from the healthy bone due to necrosis. It varies in size from a spicule to a large fragment and acts as a nidus for infection. It leads to abscess and persistent pus discharge in the bone. Sinus tracts are formed when the abscess from the infected bone drains out through the skin.

The involucrum is the dense new sclerotic bone surrounding the sequestrum. It is formed from deep layers of stripped periosteum. Cloacae are the perforations in the involucrum. Pus and tiny spicules of bone may be discharged through them.

The radiograph below shows sequestrum, involucrum and cloacae:

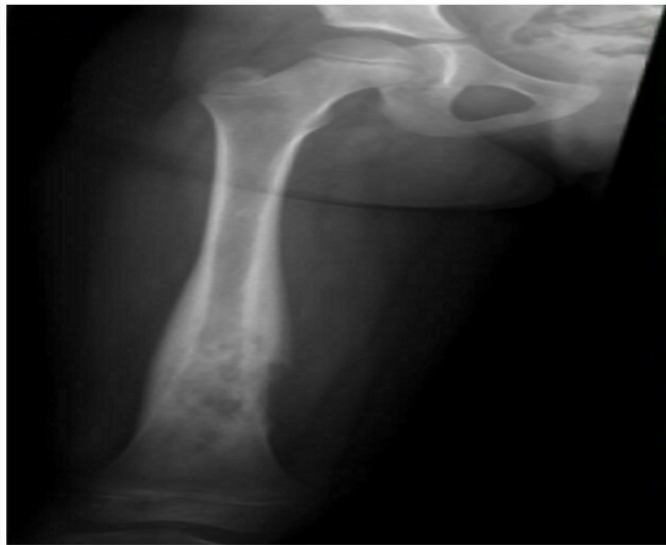
Chronic Osteomyelitis



Option A: Osteogenic sarcoma characteristically shows the sun-burst appearance and Codman's triangle, as shown below.



Option B: Ewing's sarcoma shows an onion-skin appearance of the periosteum, as shown below.



Option D: Multiple myeloma shows multiple punched-out lesions of the bone, as shown below.



Solution to Question 8:

This clinical scenario and image showing a sinus are suggestive of chronic osteomyelitis. In this condition, sequestrum acts as the nidus of infection and is the most common cause of non-healing and recurrence.

Sequestrum is a piece of dead bone. It is formed when a fragment of bone gets separated from the healthy bone due to necrosis. It varies in size from a spicule to a large fragment and acts as a nidus for infection. It leads to persistent pus discharge and abscess in the bone. Sinus tracts are formed when the abscess from the infected bone drains out through the skin.

The involucrum is the dense new sclerotic bone surrounding the sequestrum. It is formed from deep layers of stripped periosteum. Cloacae are the perforations in the involucrum. Pus and tiny spicules of bone may be discharged through them.



Solution to Question 9:

Paprika sign in chronic osteomyelitis is seen during the curettage of the bone. It refers to active punctate bleeding on debridement and indicates a healthy tissue surface.

The appearance of the paprika sign is an indication that the curettage is adequate. Effective curettage is very important as inadequate debridement is one of the reasons for high recurrence rates in chronic osteomyelitis.

MRI in chronic osteomyelitis shows rim sign which is a rim of high signal intensity surrounding the focus of disease.

Solution to Question 10:

The bony defect left behind after debridement is called dead space. Metal plates are not used in its management as they act as a nidus of infection and cause recurrent disease. If metal implants are already in place, they must be replaced by external fixators.

The dead space created after debridement in chronic osteomyelitis leads to bony instability. It is managed using the following techniques:

- PMMA beads (polymethyl methacrylate) impregnated with antibiotics - in initial stages
- Cancellous bone graft - later stages
- Muscle flap transfer

Solution to Question 11:

Brodie's abscess is not a complication of chronic osteomyelitis. It is a subacute variant of osteomyelitis.

The complications of chronic osteomyelitis include:

- Pathological fracture - most common, occurs due to devitalization of the bone and sequestrum formation
- Squamous cell carcinoma (SCC) - occurs rarely due to metaplasia in a chronic discharging sinus
- Amyloidosis - occurs rarely due to long-standing inflammation

Solution to Question 12:

Sclerosing osteomyelitis of Garre is characterized by the absence of pus.

It is a specific type of chronic osteomyelitis and is caused by a low-grade anaerobic infection that is effectively contained by the host immune system. Hence, there is no abscess or sequestrum formation.

This condition is characterized by an excessive periosteal reaction at the affected site of the bone, causing marked sclerosis and cortical thickening.

The given radiograph shows Garre's osteomyelitis:



Solution to Question 13:

Neisseria gonorrhoeae is the most common cause of septic arthritis in sexually active young adults.

Staphylococcus aureus causes septic arthritis in all ages followed by group A Streptococcus and Enterobacter.

Solution to Question 14:

The given clinical scenario is highly suggestive of septic arthritis. The next best step is the aspiration of the joint fluid to confirm the diagnosis and identify the organism.

Empirical antibiotic therapy has to be started immediately after aspiration. It is not the first step as giving antibiotics would interfere with the identification of infective organisms from the aspirated fluid. Blood culture is positive only in a few cases and has very little diagnostic value.

USG is the most reliable investigation to detect effusion at an early stage. MRI is reserved for infections in obscure sites like the sacroiliac or sternoclavicular joints.

Solution to Question 15:

Septic arthritis needs to be treated immediately to prevent the destruction of articular cartilage.

When the synovium becomes infected, there is an acute inflammatory response and effusion into the joint space. Destruction of articular cartilage begins within 2 days of infection and becomes apparent in 4-6 days.

There is depletion of ground substance and destruction of collagen due to exposure to collagenases. This is brought about by enzymes of the inflammatory response, bacterial toxins, and stimulation of T-lymphocytes. This destruction of articular cartilage finally progresses to bony ankylosis.

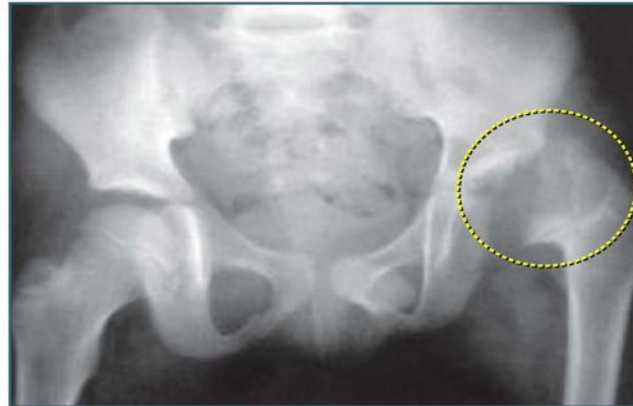
Solution to Question 16:

This clinical scenario is suggestive of septic arthritis of the hip joint in an infant. This condition is also called Tom Smith arthritis.

Septic arthritis of the hip in infancy causes severe destruction of the femoral head as it is cartilaginous at this age. This results in limb shortening and increased mobility at the hip joint leading to an unstable gait.

The following image shows destruction and deformation of the left femoral head in a child who had suffered from septic arthritis in infancy.

Septic Arthritis - Destruction of Left Femoral Head



Options A and C: Holstein-Lewis and Tillaux-Chaput are types of fractures.

Option B: The Hawkin-Kennedy test is used to diagnose supraspinatus, infraspinatus and teres minor injury as a result of impingement between coracohumeral ligament and the greater tubercle of the humerus.

Solution to Question 17:

In patients with transient synovitis of the hip, the attitude of the affected limb is flexion, abduction, and external rotation.

This attitude maximizes the capsular volume of the hip joint and, thus, minimizes the intracapsular pressure. This leads to a decrease in pain caused by joint effusion.

Transient synovitis	Septic arthritis
Reactive inflammation following a viral infection	Suppurative infection of the joint
Common in children	May occur in all age groups, especially with comorbidities (rheumatoid arthritis, immunosuppression)
Painful, but with preserved weight bearing	Inability to bear weight on the affected side
Normal WBC count and ESR	High WBC count and ESR
Self-limiting condition Analgesics and bed rest	Requires IV antibiotics and surgical drainage

Solution to Question 18:

The given clinical scenario and image showing flexed positioning of the affected finger are descriptive of Kanavel's sign. It is characteristically positive in infectious flexor tenosynovitis.

This sign has four cardinal components:

- Tenderness over the flexor sheath
- Rigid positioning of the finger in flexion
- Pain on attempts to hyperextend the fingers
- Swelling of the involved part

Solution to Question 19:

The given clinical scenario of a child with prolonged swelling and pain over the upper tibia, along with a radiograph showing a lytic lesion with a dense sclerotic rim and minimal periosteal reaction, suggests the diagnosis of Brodie's abscess.

Brodie's abscess is a localized form of subacute osteomyelitis that occurs when organisms of low virulence infect an immunocompetent host. The abscess is walled off by the thickening of the surrounding bone trabeculae. It most commonly involves the metaphysis of the proximal tibia and distal femur.

The patient is typically a child or adolescent experiencing prolonged pain near a large joint for several weeks or months. Symptoms may include a limp, slight swelling, muscle wasting, and localized tenderness.

The typical radiographic finding is a circumscribed, round or oval radiolucent cavity measuring 1-2 cm in diameter, surrounded by a halo of sclerosis, with minimal or no periosteal reaction. The radioisotope scan shows markedly increased activity. MRI may be helpful in diagnosis. Open biopsy with curettage is indicated if there is any doubt in the diagnosis.

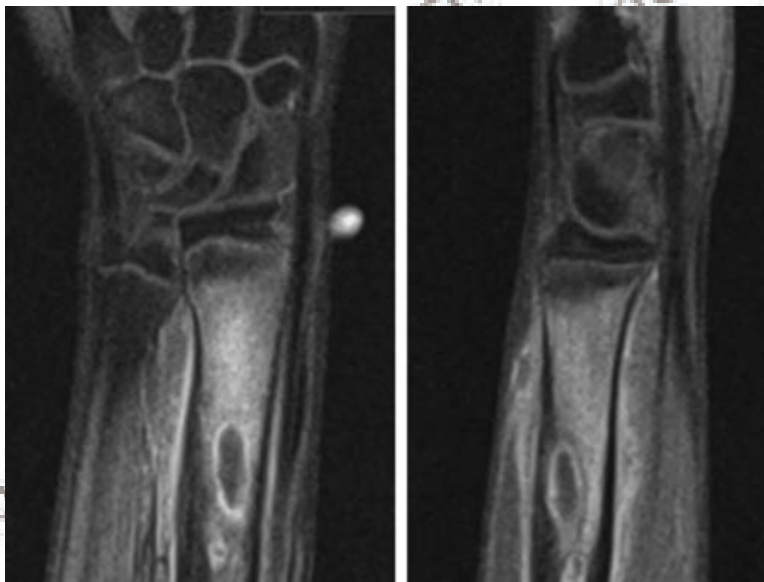
Differential diagnoses include:

- Cystic tuberculosis
- Eosinophilic granuloma
- Osteoid osteoma
- Ewing's sarcoma

Treatment:

- Immobilization and antibiotics (flucloxacillin and fusidic acid) intravenous for 4-5 days, followed by oral administration for another 6 weeks; healing may take up to 12 months
- Curettage is needed if the x-rays show no healing after conservative management.

The following X-ray and MRI images show Brodie's abscess of the radius in a patient.



The differentiating features of each of the given conditions are as follows:

Condition	Age group	Radiographic findings
Brodie's abscess	Children, adolescents	Lytic lesion with dense sclerotic rim, minimal periosteal reaction
Osteosarcoma (Option A)	Bimodal: Children and adolescents, 70-80 years Rapidly progressive tumor	Periosteal reaction leading to sunray appearance and Codman triangle
Osteoclastoma (Option B)	20-40 years (unlikely in children)	Lytic lesion with thin sclerotic rim, minimal periosteal reaction
Ewing's sarcoma (Option D)	10-20 years	Diaphyseal mass and periosteal reaction with onion-peel appearance

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Skeletal Tuberculosis

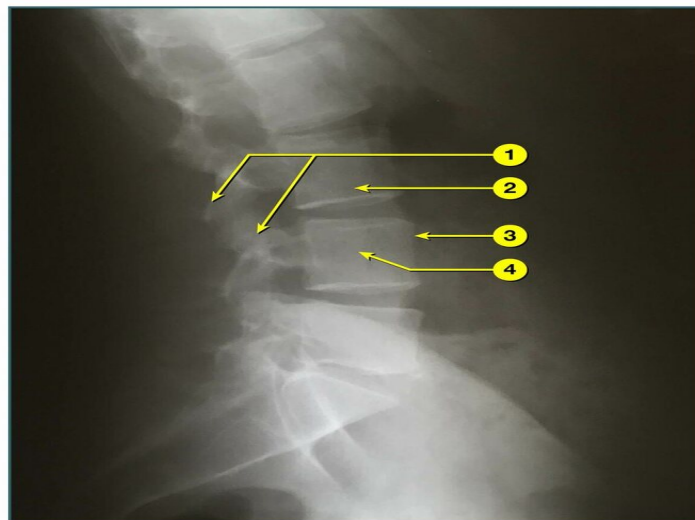
Question 1:

Which of the following is most commonly affected by skeletal tuberculosis in adults?

- a) Cervical spine
- b) Dorso-lumbar spine
- c) Hip joint
- d) Sacroiliac joint

Question 2:

A 37-year-old man on treatment for tuberculosis presented with back pain. History revealed non-compliance to ATT and you suspect the disease has disseminated to the spine. Which part of the vertebra is most likely to be involved in this condition?



- a) 4
- b) 1
- c) 2
- d) 3

Question 3:

Which of the following features is least likely to be seen in patients with spinal tuberculosis?

- a) Exaggerated lumbar lordosis
- b) Exaggerated thoracic kyphosis
- c) Decreased flexion of the vertebral column
- d) Decreased extension of the vertebral column

Question 4:

The following deformity was seen in a patient with spinal TB. What is it called?



- a) Knuckle
- b) Gibbus
- c) Kyphosis
- d) Vertebra plana

Question 5:

Which among the following is an early radiographic finding in spinal tuberculosis?

- a) Reduction of disc space
- b) Bird's nest abscess
- c) Sclerotic appearance of vertebrae
- d) Anterior wedging of vertebrae

Question 6:

A 44-year-old who had been diagnosed with spinal tuberculosis 3 years back now presents with paraplegia. What is the most likely cause for his presentation?

- a) Inflammatory edema
- b) Vertebral collapse
- c) Vertebral abscess
- d) Granulation tissue in the vertebra

Question 7:

Which of the following is seen in the final stage of Pott's paraplegia?

- a) Flaccid paralysis
- b) Spasticity
- c) Paraplegia in extension
- d) Positive Babinski's sign

Question 8:

Which of the following is a false statement regarding the management of patients with Pott's paraplegia?

- a) Bladder involvement is an indication for surgery
- b) Rapid onset paraplegia is an indication for surgery
- c) Anterolateral decompression is the surgery of choice
- d) Laminectomy is indicated when paravertebral abscess is present

Question 9:

Anterolateral decompression surgery is being performed on a patient with Pott's paraplegia. Which of the following structures will not be removed during this procedure?

- a) Transverse process
- b) Part of the vertebral body
- c) Lamina
- d) Posterior part of the rib

Question 10:

A patient presented with pain and stiffness of the right hip. On examination, apparent shortening of the right lower limb was noted. A synovial aspirate was taken which showed the presence of numerous acid-fast bacilli. Which stage of the disease has the patient presented in?

- a) Stage of synovitis
- b) Stage of early arthritis
- c) Stage of advanced arthritis
- d) Stage of arthritis with subluxation

Question 11:

Which of the following is a true statement about girdlestone arthroplasty?

- a) It is done in early arthritis
- b) It uses vastus medialis muscle
- c) It provides hip joint stability
- d) It preserves hip joint mobility

Question 12:

A patient presented with difficulty walking and a knee deformity. On examination, his knee was found to be externally rotated, flexed, and posteriorly subluxated. He was suspected to have TB of the knee. Which of the following muscles plays a role in causing the deformity seen here?

- a) Sartorius
- b) Gracilis
- c) Biceps femoris
- d) Popliteus

Question 13:

In which of the given conditions is spina ventosa seen?

- a) Spinal tuberculosis
- b) Caries sicca
- c) Tubercular arthritis
- d) Tuberculous dactylitis

Answer Key

Question No.	Correct Option
1	b
2	c
3	a
4	b
5	a
6	b
7	a
8	d
9	c
10	b
11	d
12	c
13	d

Detailed Explanations

Solution to Question 1:

Skeletal tuberculosis most commonly affects the dorso-lumbar (thoraco-lumbar) spine in adults (thoracic & lumbar).

The cervical spine is most commonly affected in children.

Skeletal TB affects the axial skeleton more than the appendicular skeleton. Hence, spinal TB is more common as compared to TB of the joints. In the appendicular skeleton, the hip and knee joints are more commonly affected.

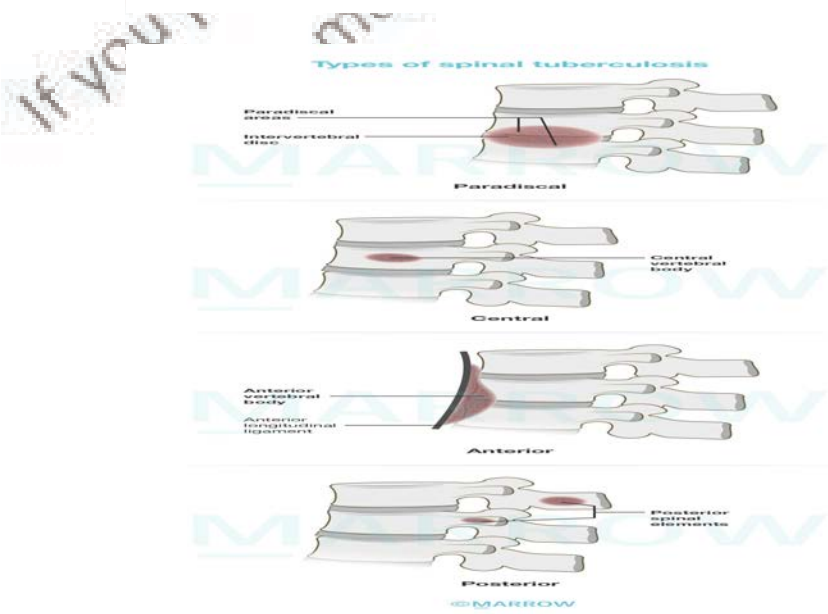
Solution to Question 2:

In cases of spinal tuberculosis, the paradiscal area (marked '2' in the image) of the vertebra is most commonly involved.

The probable reason for this is the rich blood supply of this area which favors the high oxygen requirement of the tuberculosis bacilli. Appendiceal/ posterior vertebral involvement is the least commonly seen in skeletal TB.

The structures marked in the image are as shown below:

- 1 - Posterior spinal elements
- 2 - Paradiscal area of the vertebra
- 3 - Anterior vertebral body
- 4 - Central vertebral body



Solution to Question 3:

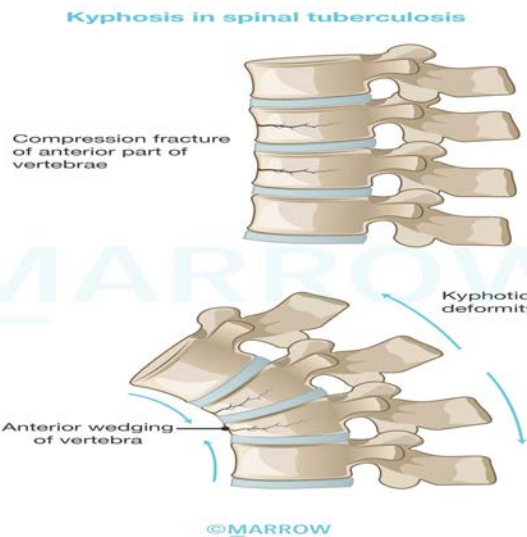
Spinal tuberculosis leads to loss of lumbar lordosis.

Spinal TB more often causes compression fracture of the anterior part of the vertebrae. This leads to anterior wedging of the vertebrae giving rise to kyphosis.

When spinal TB involves the thoracic vertebrae, it exaggerates the existing thoracic kyphosis.

Clinical features of spinal tuberculosis:

- Back pain and stiffness are the usual early complaints
- Cautious gait - a person with spinal TB will walk carefully with short steps to avoid pain resulting from movement
- Decreased flexion and extension - all the movements of the vertebral column are decreased in spinal TB due to the associated paraspinal muscle spasm, pain, and skeletal deformity



Solution to Question 4:

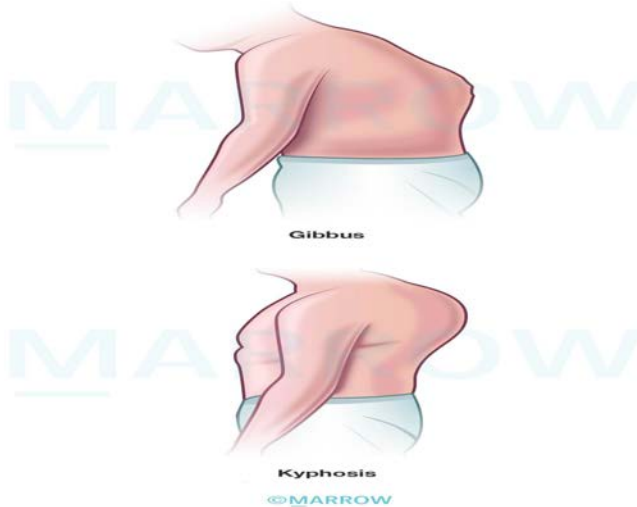
The skeletal deformity shown above is gibbus. It involves the collapse of two or three vertebral levels and presents as sharp posterior angulation.

Spinal tuberculosis may present with the following skeletal deformities:

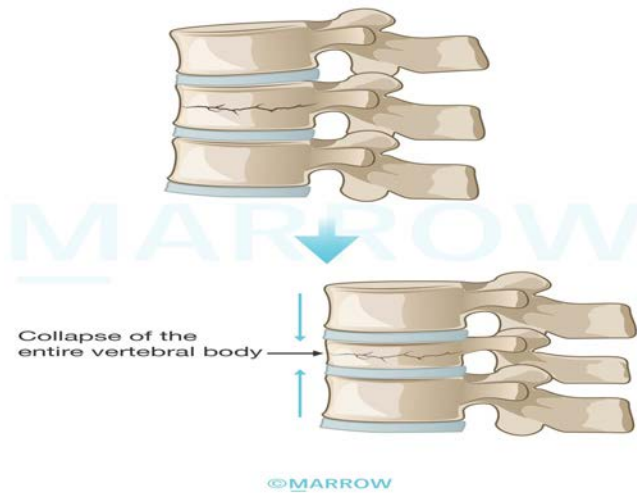
Deformity	Mechanism	Description
Knuckle	Collapse of a single vertebra	Prominence of a single spinous process
Gibbus/Kyphus	Collapse of 2-3 vertebral levels	Sharp posterior angulation
Kyphosis	Collapse of anterior vertebral bodies	Exaggerated curvature of the vertebral column

Deformity	Mechanism	Description
Concertina collapse / vertebral plana	Collapse of the entire vertebral body	Seen in tuberculosis of the central vertebral body

Skeletal deformities in Tuberculosis



Concertina collapse



Solution to Question 5:

The reduction of disc space between the vertebrae is an early radiographic finding in spinal tuberculosis. This indicates the destruction of the intervertebral disc due to spinal tuberculosis.

The infection first involves the vertebral bodies and the intervertebral disc. Hence, the early radiographic features include rarefaction/osteopenic appearance of the involved vertebrae and reduction of disc space between the vertebrae.

In later stages, the infection leads to para-vertebral abscess formation and vertebral destruction. These features can be seen on a radiograph as bird's nest abscess and anterior wedging of vertebrae respectively.

When the disease is in the healing phase, the sclerotic appearance of vertebrae can be seen.

Solution to Question 6:

The above scenario is suggestive of late-onset paraplegia in spinal tuberculosis. It is because of vertebral collapse which causes injury to the spinal cord.

Spinal tuberculosis with neurological involvement is known as Pott's paraplegia. It is classified as early-onset and late-onset paraplegia:

- Early-onset paraplegia occurs within 2 years of disease onset. It is due to edema, abscess, or granulation tissue that causes spinal cord compression.
- Late-onset paraplegia in spinal tuberculosis is because of vertebral collapse which causes injury to the spinal cord.

Prognosis is better in early-onset paresis because it can subside when the active infection is treated or when the drainage of the abscess relieves compression of the cord.

Solution to Question 7:

Flaccid paralysis is seen in the final stage of Pott's paraplegia.

Pott's paraplegia begins as a UMN lesion. So initially, the patient is asymptomatic but ankle clonus, increased deep tendon reflexes, and extensor plantar can be detected on clinical examination.

It then progresses to spastic paraplegia of the extensors and the flexors. In later stages, it presents as an LMN lesion causing flaccid paralysis.

Solution to Question 8:

Laminectomy is indicated when the posterior parts of the vertebrae are involved.

Management of Pott's paraplegia includes conservative management (with antitubercular therapy) or surgery.

The "middle path regimen" combines both the approaches and includes the following:

- Antitubercular therapy
- Immobilization using spinal braces
- Draining of abscess/surgery if required

Surgery is indicated in the following conditions:

- Failed conservative management
- Recurrence of the disease after treatment
- Rapid onset paraplegia
- Bladder and bowel involvement

Surgeries for Pott's paraplegia include:

- Antero-lateral decompression - it helps in the removal of both solid and liquid debris and so it's the surgery of choice for Pott's paraplegia
- Costotransversectomy - surgery indicated for paravertebral abscess
- Laminectomy - indicated when the posterior parts of vertebrae are involved

Solution to Question 9:

The lamina process of the vertebra is not removed in anterolateral decompression surgery.

Anterolateral decompression surgery is the preferred surgery for Pott's paraplegia.

The structures removed in this procedure are :

- Posterior part of the rib
- Transverse process
- Pedicle
- Part of the vertebral body anterior to the spinal cord

Solution to Question 10:

The above scenario is suggestive of tuberculosis of the hip. An apparent shortening of the limb is seen in the stage of early arthritis.

Clinical features seen in the four stages of TB hip:

- Stage of synovitis presents with apparent lengthening of the limb due to abduction deformity.
- Stage of early arthritis presents with apparent shortening of the limb due to adduction deformity.
- Stage of advanced arthritis leads to true shortening of the limb because of the destruction of the articular cartilage of the femur and the acetabulum.
- Stage of arthritis with subluxation leads to true shortening of the limb. The destruction of acetabulum leads to dislocation of the femur head. This is also known as wandering acetabulum/ mortar and pestle hip because of the widened acetabulum and diminished size of femur head.

The TB of the hip finally results in fibrous ankylosis of the hip joint.

Note: The apparent length of the lower limb is measured from the umbilicus to the medial malleolus and the true length of the limb is measured from the anterior superior iliac spine to the

medial malleolus. The apparent length is increased when there is abduction deformity of the hip and decreased when there is adduction deformity of the hip.

Solution to Question 11:

Girdlestone arthroplasty preserves the mobility of the hip joint. It is done for the management of TB of hip.

Early stages of TB hip can be conservatively managed by antitubercular therapy, traction, and immobilization. Later stages need surgical management.

Surgeries for TB hip include:

- Synovectomy and joint debridement is the preferred surgery in early arthritis.
- Girdlestone arthroplasty refers to the modification of the articular surface of the joint. It involves excision of the affected portion of the joint and reconstruction of the joint with vastus lateralis muscle. It gives a painless, mobile joint but it results in an unstable hip.
- Arthrodesis refers to the fusion of the joint. It is indicated in painful fibrous ankylosis. It gives a painless stable hip joint.

Solution to Question 12:

The above scenario is suggestive of the triple deformity characteristically seen in TB knee. It occurs due to the spasm of biceps femoris.

Tuberculosis of the knee presents with triple deformity, which includes:

- Posterior (and lateral) subluxation - due to ligament laxity/ degeneration
- External/lateral rotation - due to spasm of biceps femoris
- Flexion - due to spasm of the hamstrings (semimembranosus, semitendinosus, biceps femoris)

Sartorius, gracilis, and popliteus are responsible for medial rotation at the knee joint and do not contribute to triple deformity.

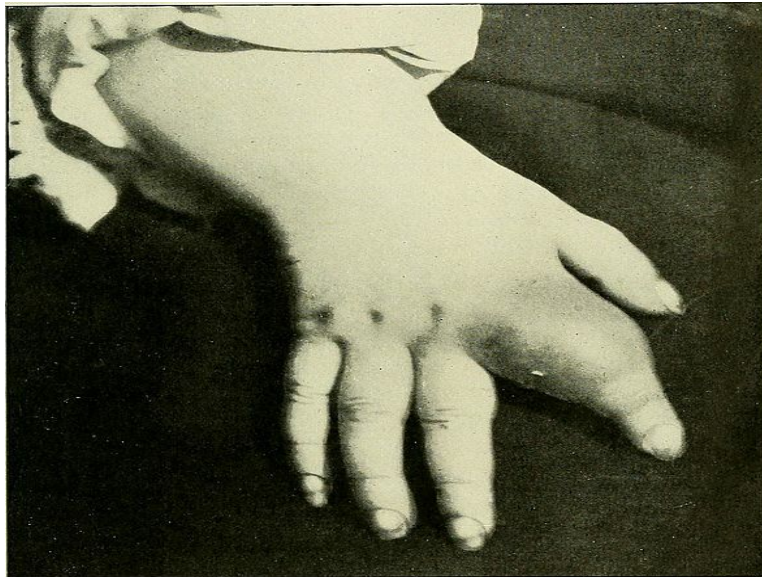
Solution to Question 13:

Spina ventosa is a feature of tuberculous dactylitis. This refers to the tuberculosis of short tubular bones i.e. metacarpals, metatarsals, and phalanges.

The infection is lodged in the marrow cavity leading to spindle-shaped expansion/ ballooned-out appearance of the bone known as spina ventosa. Periosteal reaction, abscess, and sinus formation are seen.

TB sicca or caries sicca is the tuberculosis of the shoulder joint. It usually does not have any effusion of joint, hence it is known as sicca which is a Latin word for 'dry'.

The image below shows tuberculous dactylitis. Note the swelling in the affected phalanx.



else,
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you may have been scammed.

Fractures in children

Question 1:

What is the most common bone to be fractured in children?

- a) Distal forearm bones
- b) Humerus
- c) Clavicle
- d) Carpals

Question 2:

Which of the following is false about supracondylar fracture of the humerus?

- a) It is the most common pediatric elbow fracture
- b) Flexion type is the most common
- c) The Gartland classification is commonly used
- d) Anterior interosseous nerve is most commonly injured

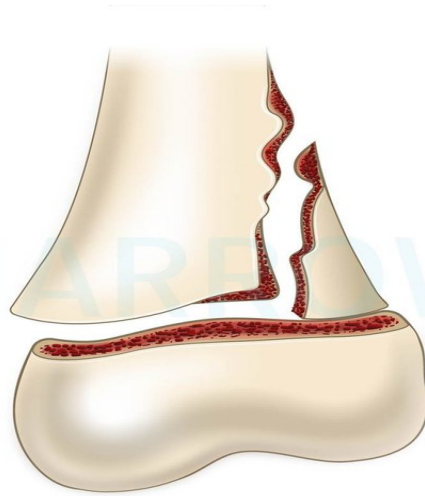
Question 3:

A 4-year-old girl was brought to the emergency following a fall in the playground. On examination, her right arm was swollen, pink, and pulseless. An x-ray revealed a supracondylar fracture of the right humerus. What is the most appropriate management?

- a) Observation
- b) Reduction and pinning
- c) Fasciotomy
- d) Vascular repair

Question 4:

How would you classify the following injury?



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- a) Salter-Harris type III
- b) Salter-Harris type II
- c) Salter-Harris type V
- d) Salter-Harris type IV

Question 5:

A 13-year-old boy is brought to the ED two hours after falling from his bicycle. He complains of progressive pain and swelling in his left arm. On examination, the pointing index sign is noted. Which of the following will you suspect?

- a) Fracture of lateral condyle humerus
- b) Fracture of supracondylar humerus
- c) Fracture of medial condyle humerus
- d) Fracture of neck of radius

Question 6:

Which of the following is the first ossification center to appear around the elbow?

- a) Radial head
- b) Olecranon
- c) Lateral epicondyle
- d) Capitellum

Question 7:

In which of the following patients would you suspect child abuse?

- a) An 8-year-old boy with a torus fracture of the left distal radius
- b) A 7-year-old girl with a fracture of the left lateral epicondyle of humerus
- c) A 3-year-old boy with a greenstick fracture of the right tibia
- d) A 9-month-old infant with a spiral fracture of the right femur

Question 8:

An 8-year-old child was brought to the casualty with a history of a fall from the stairs. On examination, varying degrees of ecchymosis are noted over the buttocks and upper limbs. X-ray reveals a metaphyseal corner fracture of the right femur. What is the likely diagnosis?

- a) Albers-Schönberg disease
- b) Battered baby syndrome
- c) Vitamin D deficiency
- d) Osteogenesis imperfecta

Question 9:

A toddler was brought to the pediatrician with forearm swelling and inconsolable crying. An x-ray revealed the following. What is your diagnosis?



- a) Torus fracture
- b) Nightstick fracture
- c) Monteggia fracture
- d) Greenstick fracture

Question 10:

In patients with Madelung deformity, which of the following bones is involved?

- a) Distal ulna
- b) Distal radius
- c) Trapezoid
- d) Triquetrum

Question 11:

A 7-year-old boy is being evaluated for the following deformity of his left elbow. 3 years ago, he had suffered a fracture of his left elbow following a fall on his outstretched hand. During that period, his arm was put in a cast for 6 weeks. Which of the following can be performed to correct this deformity?



- a) 1, 3, 4
- b) 2, 5

c) 1, 4

d) 2, 3, 5

Question 12:

An orthopedic resident is applying a cast for a 6-year-old child with the following fracture. What should be the position of the child's forearm during the procedure?



- a) Mid-pronation with elbow flexed
- b) Full supination with elbow extended
- c) Mid-pronation with elbow extended
- d) Full pronation with elbow flexed

Answer Key

Question No.	Correct Option
1	a
2	b
3	b
4	b
5	b
6	d

7	d
8	b
9	d
10	b
11	c
12	a

Detailed Explanations

Solution to Question 1:

The most common bones to be fractured in children are the distal forearm bones.

The distal radius is the most commonly fractured bone in childhood. It is more commonly fractured than the clavicle.

The clavicle is most commonly fractured during birth.

Solution to Question 2:

Most supracondylar fractures (98%) are extension-type injuries. They are usually caused by a fall onto an outstretched hand.

Supracondylar humeral fractures are the most common type of pediatric elbow fracture. They most commonly lead to the following nerve injuries:

- Extension-type: Anterior interosseous nerve
- Flexion-type: Ulnar nerve

According to the Gartland classification, there are 3 types of fractures:

- Type I: Undisplaced
- Type II: Some degree of displacement
- Type III: Complete displacement

The following x-ray shows a type III supracondylar fracture of the humerus:

Supracondylar fracture of humerus



Solution to Question 3:

This clinical scenario with a pink and pulseless arm is suggestive of a supracondylar fracture with adequate perfusion. The treatment of choice is reduction and pinning, followed by observation.

On the other hand, if there is poor perfusion due to vascular compromise, the affected arm is pale and cool to the touch. In this case, the urgent reduction must be performed in the operating room. After reduction, the vascular status of the hand is reassessed. If the hand remains pale, exploration of the brachial artery, the release of entrapped structures, and direct repair with vein grafting may be required.

Solution to Question 4:

The physal injury depicted in the given diagram is classified as Salter-Harris type II.

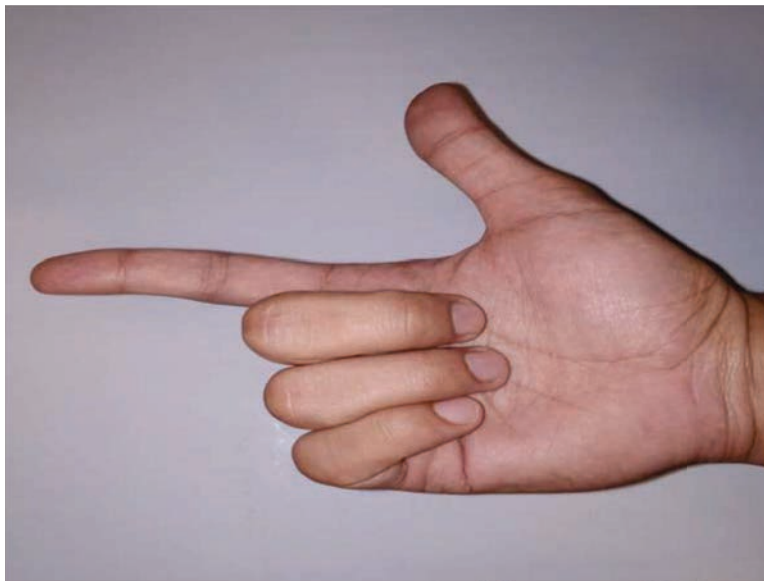
In a type II fracture, the fracture line passes through the metaphysis into the epiphyseal plate. This results in a metaphyseal fragment called the Thurston-Holland fragment. The epiphysis is spared.

Solution to Question 5:

The pointing index sign is seen in supracondylar fractures of the humerus.

This finding occurs as a result of injury to the median nerve. It results in loss of function of both flexor digitorum profundus (FDP) and flexor digitorum superficialis (FDS). Hence, the index finger sticks out when the patient is asked to clasp their hand.

The image shows the pointing index sign:



Solution to Question 6:

The capitellum is the first ossification center to appear around the elbow.

The order of appearance of ossification centers can be remembered using the mnemonic CRITOE:

- Capitellum: 2 years
- Radial head: 4 years
- Internal epicondyle: 6 years
- Trochlea: 8 years
- Olecranon: 10 years
- External (lateral) epicondyle: 12 years

Solution to Question 7:

Long bone fractures, particularly spiral fractures, in non-ambulatory infants < 1 year should raise the suspicion of child abuse.

Accidental fractures of long bones (humerus, tibia, radius) are common in toddlers and older children once they start walking.

Solution to Question 8:

This clinical scenario is suggestive of battered baby syndrome.

Non-accidental trauma must be suspected when there are ecchymoses and fractures in various stages of healing. This indicates that the trauma has occurred over a period of time. Metaphyseal corner or bucket handle fractures are typically seen on x-ray. Sub-epiphyseal micro-fracture is also a feature of child abuse that is seen on MRI.

In such cases, a radiological assessment of the entire skeleton is indicated. The minimum x-ray views required in a case of suspected child abuse are:

- AP views of the entire skeleton
- Dedicated views of hands and feet
- Lateral views of the axial and appendicular skeleton

Solution to Question 9:

The given image shows a fracture with a broken cortex on one side and an intact cortex on the other side. This is called a greenstick fracture and is common in children.

Option A: Torus fracture or buckle fracture occurs due to buckling of the cortex. It most commonly occurs at the transition between metaphysis and diaphysis.



Greenstick and torus fractures



Greenstick fracture



Torus fracture

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Option B: Nightstick fracture refers to a fracture of the shaft of the ulna.

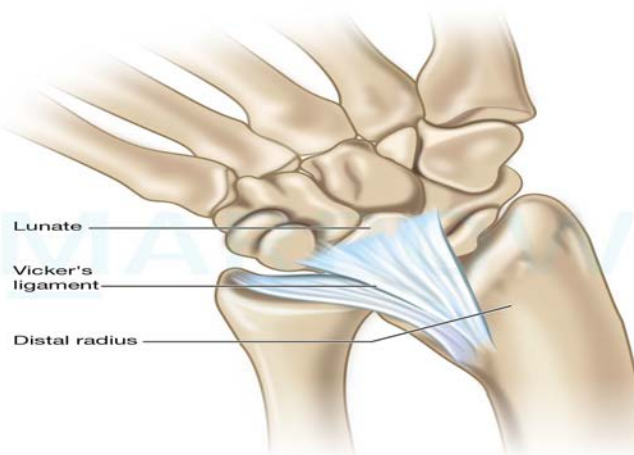
Option C: Monteggia fracture refers to a fracture of the proximal ulna with an associated radial head dislocation.

Solution to Question 10:

The distal radius is involved in Madelung deformity.

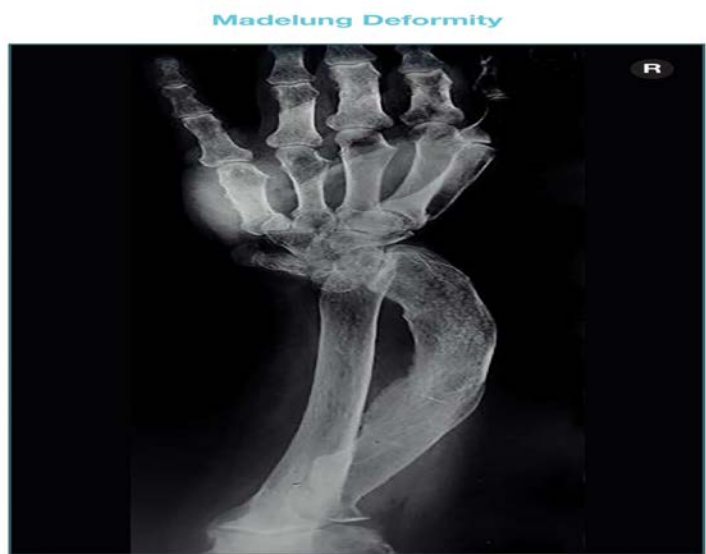
This is a congenital or post-traumatic deformity in children due to disruption of the ulnar and volar aspect of the growth plate of the distal radius. This disruption is believed to be caused by the Vicker's ligament. This ligament normally tethers the lunate to the distal radius proximal to the physis.

Ligament of Vickers



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Disruption of the growth plate causes a ventral curvature of the distal radius. However, the ulna continues to grow and the distal ulna appears more prominent may stick out as a lump on the back of the wrist. This is known as a positive ulnar variance. There is volar subluxation of the hand.

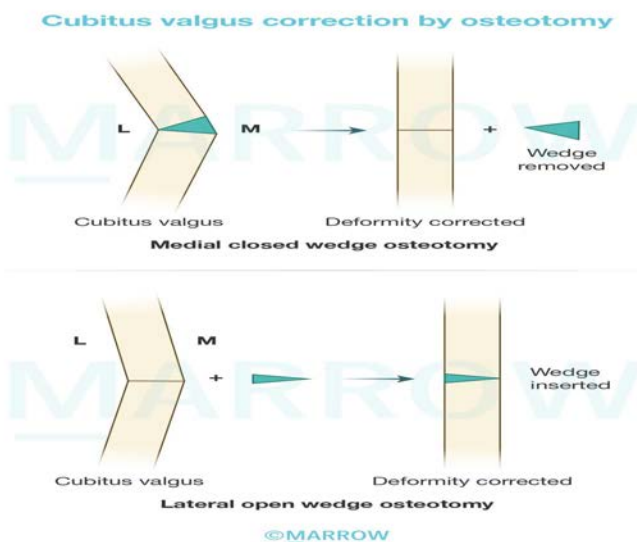


Solution to Question 11:

The image shows the cubitus valgus deformity of the left elbow, which is usually a complication of lateral condyle fracture of the humerus. It can be corrected by medial closed wedge osteotomy or lateral open wedge osteotomy.

Cubitus varus can be corrected by a lateral closed wedge osteotomy or medial open wedge osteotomy.

Derotation osteotomies are commonly used for the correction of lower limb deformities.



Solution to Question 12:

The x-ray shows a fracture at the junction of the middle and distal 1/3 of both radius and ulna. The elbow should be flexed at 90° and the forearm should be in mid-pronation position while applying the cast.

Forearm fractures in children are managed conservatively by applying a POP cast. In adults, surgery is preferred (open reduction and internal fixation).

Fracture site on the forearm	Position of forearm(with elbow flexed)
Upper one-third	Full supination
Middle one-third	Mid pronation (neutral)
Lower one-third fracture	Full pronation

CTEV, Genu varum and valgum

Question 1:

A 3-month-old infant was brought to the clinic with the given malformation present since birth. What is the primary deformity in this condition?



- a) Convex lateral border
- b) Abduction
- c) Concave medial border
- d) Adduction

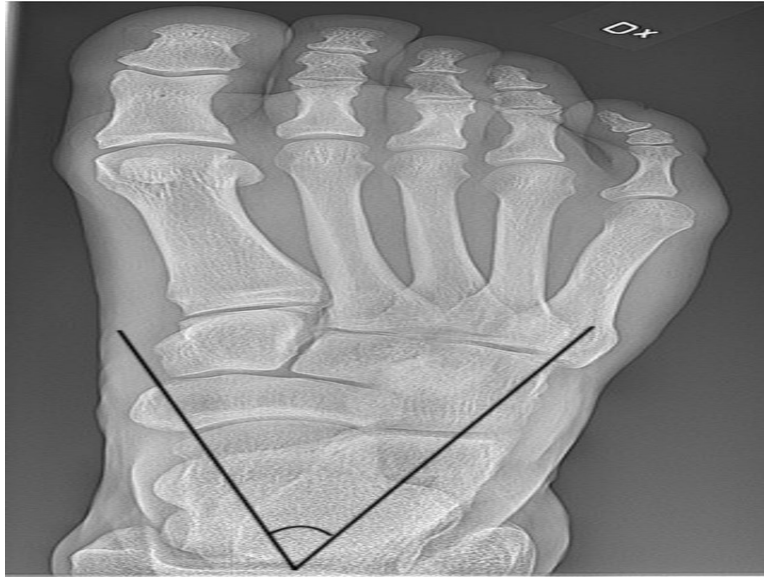
Question 2:

Which of the following tests can be performed in a child with CTEV to detect tibial torsion?

- a) Dorsiflexion test
- b) Ortolani's test
- c) Plumb line test
- d) Barlow's test

Question 3:

Which angle is depicted in the radiograph below?



- a) Gissane angle
- b) Meary's angle
- c) Bohler's angle
- d) Kite's angle

Question 4:

What is the right order of correction of deformities in an infant with CTEV?

- a) Cavus, adduction, varus, equinus
- b) Valgus, abduction, equinus, cavus
- c) Cavus, abduction, varus, equinus
- d) Cavus, adduction, valgus, equinus

Question 5:

A pediatrician referred a newborn with the given deformity to the orthopedics department. Ponseti's method was planned for correction. Which of the following is incorrect regarding this technique?



- a) Equinus is corrected last
- b) Below knee cast is applied
- c) Head of the talus acts as the fulcrum
- d) Treatment should be started within first 2 weeks of life

Question 6:

A 1-year-old boy was undergoing treatment for CTEV with a POP cast for the past 6 months. However, his deformities have not improved. What is the next best step in management?

- a) CTEV shoes
- b) Dillwyn Evans procedure
- c) Turco's procedure
- d) Triple arthrodesis

Question 7:

An infant undergoing treatment for CTEV has just started walking. Which of the following is false regarding the shoes that he will be prescribed to wear?

- a) The straight inner border prevents cavus
- b) Outer shoe raise prevents foot inversion
- c) Absence of heel prevents equinus
- d) These shoes can be used until 5 years

Question 8:

A 12-year-old with neglected CTEV and muscle wasting is brought to the hospital. A triple arthrodesis is planned. Which of the following joints will not be fused?

- a) Talocrural
- b) Calcaneocuboid
- c) Talonavicular
- d) Talocalcaneal

Question 9:

Which of the following methods can be used for external fixation in a patient with resistant CTEV?

- a) Dwyer's procedure
- b) Davis procedure
- c) Joshi's method
- d) Dillwyn Evan's procedure

Question 10:

A child was brought to the orthopaedic OPD for evaluation of the given knee deformity. What is it known as?



- a) Genu recurvatum
- b) Genu varus
- c) Genu valgum
- d) Windswept deformity

Question 11:

A 7-year-old boy fractured the lateral condyle of his femur. He developed malunion as a complication. Which deformity is he most likely to develop?

- a) Genu recurvatum
- b) Genu varus
- c) Genu valgus
- d) Windswept deformity

Question 12:

What is the most common cause of acquired genu recurvatum?

- a) Rickets
- b) Cerebral palsy
- c) Poliomyelitis
- d) Malunited fractures around the knee

Question 13:

Which of the following is a feature of Blount's disease?

- a) Coxa valgus
- b) Genu valgus
- c) Coxa varus
- d) Genu varus

Answer Key

Question No.	Correct Option
1	d
2	c
3	d
4	a
5	b
6	c
7	a
8	a
9	c
10	c
11	c
12	c
13	d

Detailed Explanations

Solution to Question 1:

Adduction of the forefoot is a primary deformity in congenital talipes equinus varus (CTEV).

The five primary deformities in CTEV are:

- Cavus- excessive arching of the foot
- Adduction of forefoot
- Varus- inversion and adduction of foot
- Equinus- increased plantar flexion
- Internal tibial torsion- medial rotation of the tibia

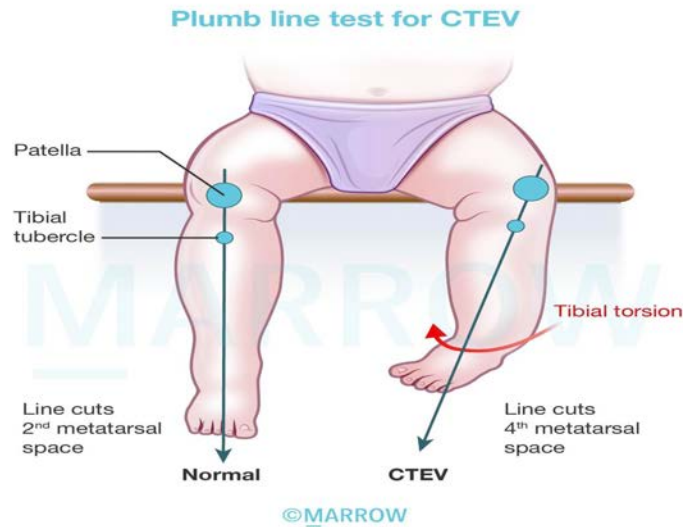
Solution to Question 2:

The plumb line test helps to detect tibial torsion which is seen in congenital talipes equinus varus (CTEV).

The child is made to sit at a table with both the lower limbs hanging from the edge. A line is drawn from the center of the patella to the tibial tubercle. This is called the plumb line.

Normally, when extended down, it should cut the foot at the first or second inter-metatarsal space.

In CTEV, due to medial rotation of the tibia plumb line cuts the third or fourth inter-metatarsal space.



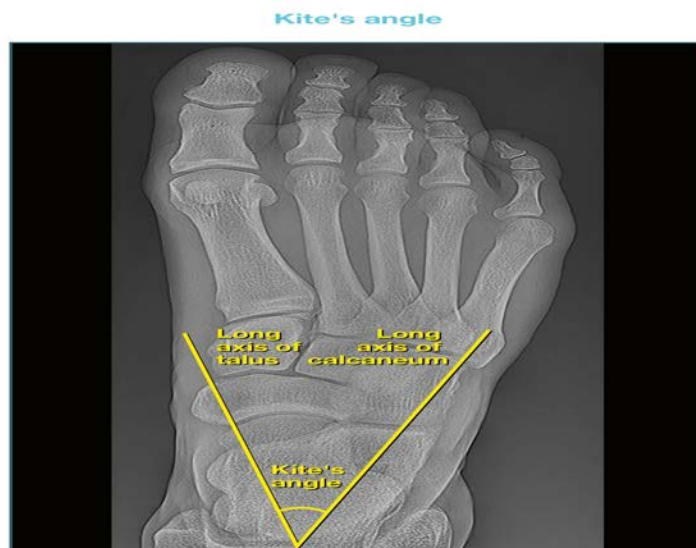
Option A: A dorsiflexion test is done in the screening of clubfoot. In a newborn, the dorsum of the foot can be brought in contact with the tibia by dorsiflexion but not in CTEV.

Options B and D: Ortolani's and Barlow's tests are performed in developmental dysplasia of the hip (DDH).

Solution to Question 3:

The given radiograph shows Kite's angle, which is the angle between the long axis of the talus and the long axis of the calcaneum.

The normal Kite's angle is 30-55 degrees. In CTEV, the Kite's angle is less than 25 degrees.



Solution to Question 4:

The right order of correction of CTEV is cavus followed by adduction, then varus, and lastly equinus (CAVE).

An incorrect sequence of correction or overtreatment of CTEV can result in the development of the rocker-bottom foot. It is characterized by a prominent heel and a convex sole.

Rocker bottom feet



Solution to Question 5:

In Ponseti's method, an above-knee cast is used to correct clubfoot.

Ponseti's method is the currently used method for conservative management of CTEV. Previously Kite's method was followed.

	Ponseti's method	Kite's method
Treatment start	<2 weeks	1 month
Order of correction	cavus° adduction° varus° equinus	adduction ° inversion ° equinus
Fulcrum	Head of the talus	Calcaneocuboid joint
POP type	Above knee cast	Below knee cast
Duration	6-8 weeks	6-9 months

Solution to Question 6:

The next best step, in this case, is posteromedial soft tissue release (PMSTR), also known as Turco's procedure.

By 1 year of age, posteromedial soft tissue gets contracted. This causes difficulty in the manipulation of the joint. Therefore, PMSTR is done and tight soft tissue structures (tendons, ligaments, capsule) on the posterior and medial side of the foot are cut.

Solution to Question 7:

When the child starts walking, CTEV shoes are prescribed for the daytime. The straight inner border in CTEV shoes prevents adduction, not cavus.

CTEV shoes are prescribed when the child starts walking and are used up to 5 years of age. The straight inner border prevents adduction, while the absence of heel prevents the equinus. An outer shoe raise is present to prevent foot inversion.

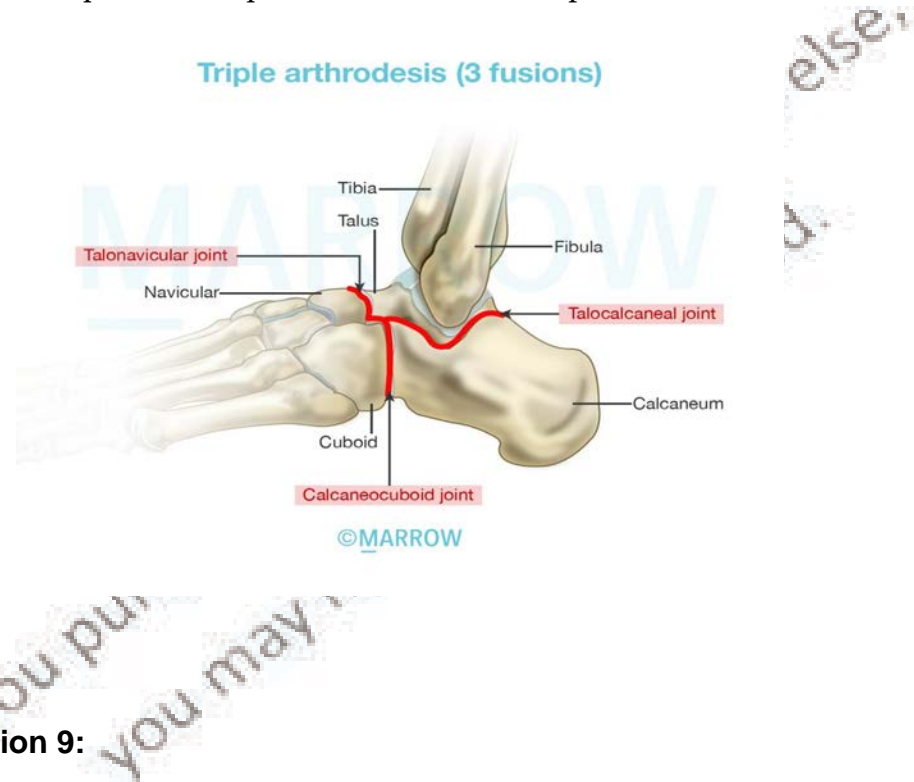


Solution to Question 8:

The talocrural joint (ankle joint) is not involved in triple arthrodesis.

Triple arthrodesis involves the fusion of talonavicular, talocalcaneal and calcaneocuboid joints.

Triple arthrodesis is done for recurrent or persistent clubfoot deformity in older children (chronic cases). It is done after 10-12 years of age as before this age bones are not fully ossified, therefore fusion may not be adequate. Inadequate fusion is known as pseudoarthrosis.



Solution to Question 9:

Joshi's method (Joshi's external stabilisation system - JESS) is a method of external fixation used in CTEV.

Treatment by external fixators is a recent concept in the management of CTEV. It is done for difficult cases.

There are two types of external fixator frames:

- Ilizarov's
- Joshi's (JESS)

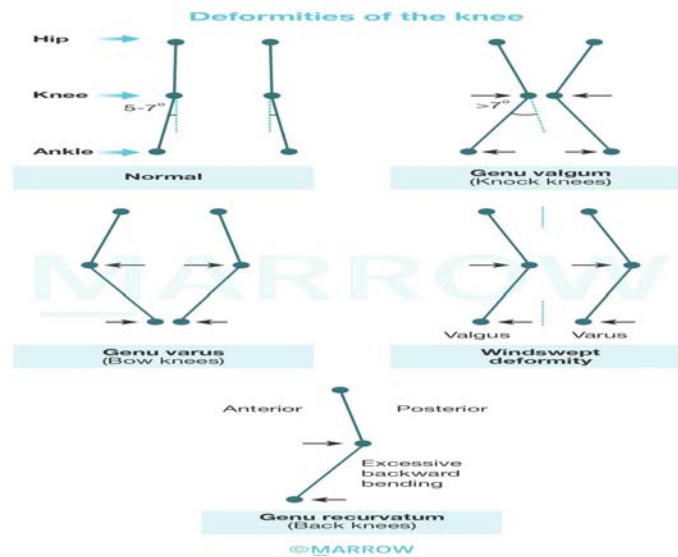
Solution to Question 10:

The deformity shown is genu valgum.

A normal knee has 5-7 degrees physiological outward deviation (valgum). Any increase or decrease in angle can result in knee deformities.

Knee deformities are:

- Genu valgus (valgum) or knock knee - Knees are abnormally approximated and the ankles are divergent.
- Genu varus (varum) or bow knee - Knees are abnormally divergent and the ankles are approximated.
- Windswept deformity - Abnormal valgus deformity of one knee with varus of the other.
- Genu recurvatum - Hyperextension at the knee joint with backwards bending.



Solution to Question 11:

The boy is most likely to develop genu valgus subsequent to lateral condyle fracture of the femur.

Fracture of lateral condyle femur will result in injury to the lateral growth plate of the femur, and thus only the medial condyle will continue to grow with age resulting in genu valgus.

Similarly, injury to the medial growth plate of the femur will cause the lateral condyle to grow only with age, resulting in genu varus.

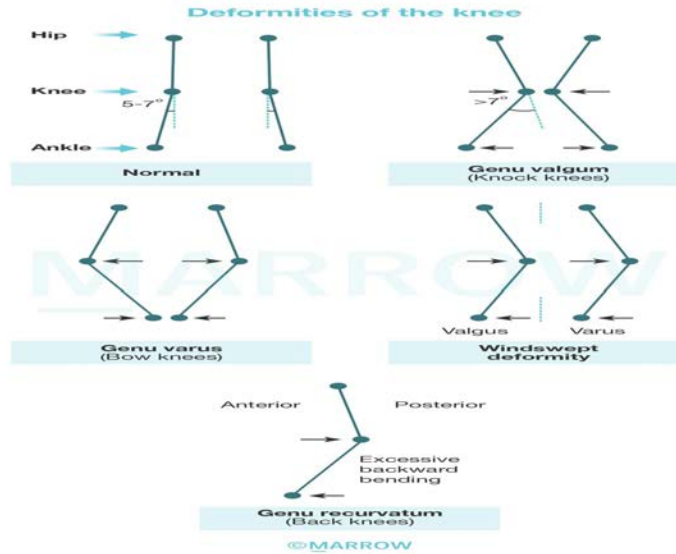
Solution to Question 12:

The most common cause of acquired genu recurvatum is poliomyelitis.

Causes of genu recurvatum:

- Congenital (due to abnormal intrauterine position)
- Acquired

- Neurological disorders like polio, cerebral palsy
- Rickets
- Malunion
- Knee fractures



Solution to Question 13:

Genu varus is a feature of Blount's disease.

Blount's disease, is a growth disorder of proximal tibial physis that causes the lower leg to angle inwards resulting in genu varus.

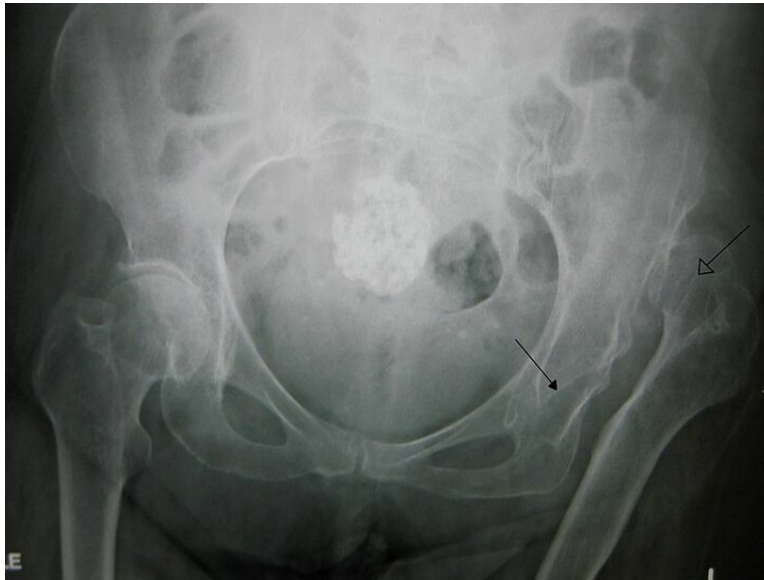
Triad seen in Blount's disease:

- Bilateral idiopathic genu varus
- Genu recurvatum
- Internal rotation of tibia

Congenital malformations, Perthes disease and SCFE

Question 1:

The radiograph of an infant with a hip deformity is given below. There is no history of trauma. Which of the following is not a risk factor for developing this condition?



- a) Positive family history
- b) Breech presentation
- c) Male gender
- d) First born child

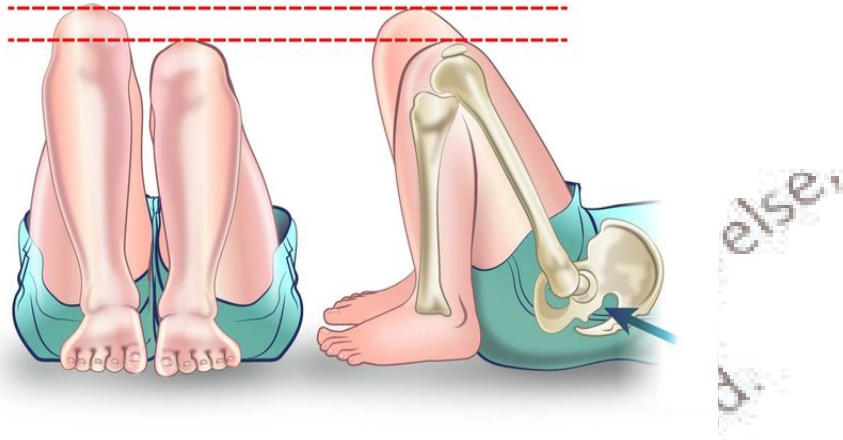
Question 2:

What is the vertical line drawn at the outer border of the acetabulum called as?

- a) Hilgenreiner's line
- b) Perkin's line
- c) Shenton's line
- d) Klein's line

Question 3:

A 3-month-old baby is brought to the OPD by her mother as she noticed some deformity in the hip and lower limbs of the child. On examination, asymmetry of groin crease is seen and the following test in the image is positive. What is the name of the test being performed?



- a) Barlow's test
- b) Ortolani's test
- c) Galeazzi's test
- d) Durkan's test

Question 4:

Which of the following is unlikely to be seen in patients with DDH?

- a) Altered gait
- b) Limb shortening
- c) Decreased lumbar lordosis
- d) Decreased abduction

Question 5:

A mother with a history of breech delivery brings her 1-month-old baby to the OPD. On examination, the child has asymmetric thigh folds and Ortolani's test is positive. What should be the immediate management?

- a) Closed reduction only

- b) Pavlik harness
- c) Hip spica
- d) Pemberton osteotomy

Question 6:

A 1-year-old child is diagnosed with DDH. Closed reduction is attempted but fails. What is the next step?

- a) Total hip replacement
- b) Pelvic osteotomy
- c) Manipulation under anesthesia
- d) Open reduction

Question 7:

A 12-year-old boy is diagnosed with DDH with secondary arthritic changes. What is the treatment of choice?

- a) Open reduction
- b) Salter osteotomy
- c) Total hip replacement
- d) Femoral osteotomy

Question 8:

What is the most common type of osteochondrosis?

- a) Frieberg's disease
- b) Kienbock's disease
- c) Kohler's disease
- d) Perthes disease

Question 9:

Which statement is true about Perthes disease?

- a) Limitation of external rotation
- b) More common in females
- c) The bone age is lower than the chronological age
- d) Patients present during adolescence

Question 10:

Which of the following statements is true about coxa vara?

- a) The neck shaft angle is increased
- b) The greater trochanter is displaced upwards
- c) Lengthening of limb is seen
- d) Limitation of adduction and internal rotation

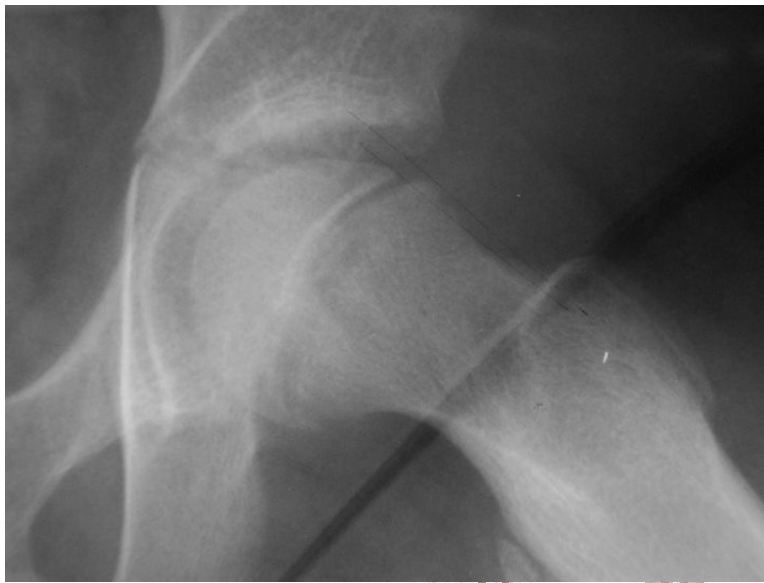
Question 11:

Which of the following movements is not affected to a great extent in slipped capital femoral epiphysis?

- a) Extension
- b) Internal rotation
- c) Flexion
- d) Abduction

Question 12:

A 15-year old boy presents to you with limitation of abduction and internal rotation of the left hip. An X-ray of his left hip joint is shown below. What is the sign seen?



- a) Trethowan's sign
- b) Catterall's sign
- c) Alli's sign
- d) Dagger sign

Question 13:

In which position is the hip held in transient synovitis?

- a) Adduction and external rotation
- b) Adduction and internal rotation
- c) Abduction and external rotation
- d) Abduction and internal rotation

Question 14:

Which mutation is seen in patients with achondroplasia?

- a) FGFR-3
- b) RANK
- c) COL1A1
- d) Fibrillin-1

Question 15:

The following finding is seen in a patient. Which condition is this associated with?



- a) Osteogenesis imperfecta
- b) Cleido cranial dysplasia
- c) Achondroplasia
- d) Edward's syndrome

Question 16:

In which of the following conditions is ring-shaped epiphysis seen?

- a) Osteopetrosis
- b) Osteogenesis imperfecta
- c) Osteoporosis
- d) Osteomalacia

Question 17:

A male neonate was admitted to the NICU due to multiple birth deformities. He had blue-grey sclera with a high arched palate. The radiograph revealed fractures of the right humerus, ulna, and femur with osteopenia. Which of the following is true about this condition?

- a) Defective mineralisation
- b) Defective osteoclast activity
- c) Defective osteoblast activity
- d) Defective osteoid formation

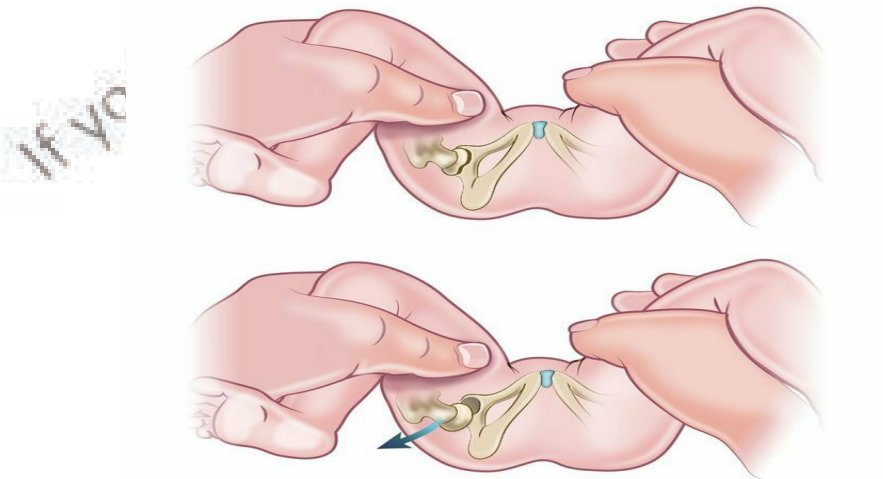
Question 18:

A 13-year-old boy developed sudden pain and tenderness over his left hip following a minor fall. There is restricted abduction and internal rotation. He is a known case of hypothyroidism and weighs 80kg. What is the likely diagnosis?

- a) Perthes disease
- b) DDH
- c) Fracture femur neck
- d) SCFE

Question 19:

Name the following test being performed on a newborn baby.



- a) Varus stress test
- b) Ortolani's test
- c) Barlow's test
- d) Ober's test

Answer Key

Question No.	Correct Option
1	c
2	b
3	c
4	c
5	b
6	d
7	c
8	d
9	c
10	b
11	a
12	a
13	c
14	a
15	c
16	b
17	d
18	d
19	c

Detailed Explanations

Solution to Question 1:

The above X-ray shows developmental dysplasia of the hip (DDH) on the left side. Female gender is a risk factor for DDH.

The risk factors for DDH are remembered by 4Fs:

- Females
- Firstborn
- Faulty intrauterine position (breech)
- Familial

Solution to Question 2:

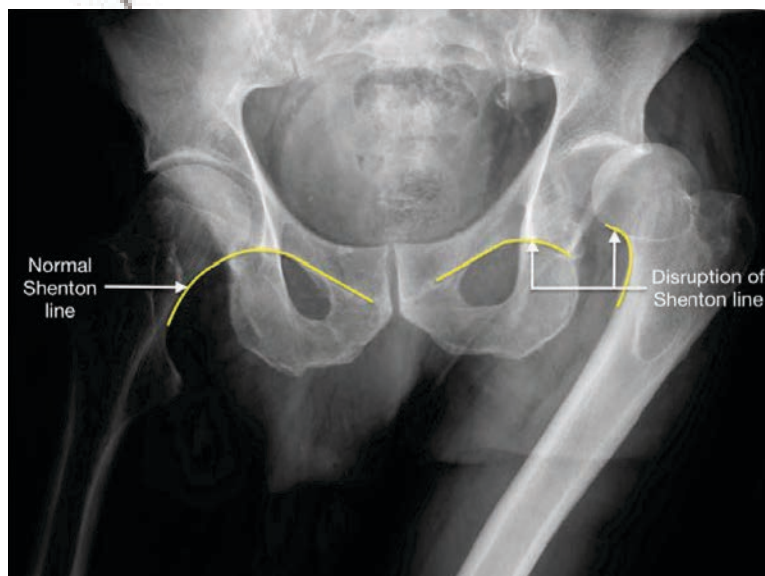
Perkin's line is a vertical line drawn at the outer border of the acetabulum.

Option A: Hilgenreiner's line is a horizontal line through the tri-radiate cartilages. Perkin's line is perpendicular to Hilgenreiner's line.

The image below shows the vertical Perkin's line and the horizontal Hilgenreiner's line. Normally the femoral head lies in the inner and lower quadrant formed by these lines. But in DDH the femoral head is in the upper and outer quadrant.

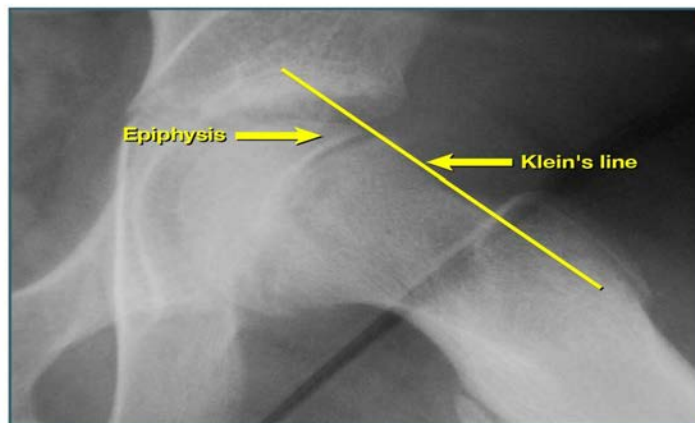


Option C: Shenton's line is a smooth curve formed by the inferior border of the neck of the femur with superior margin of the obturator foramen. It is broken in DDH and fractured neck of the femur.



Option D: Klein's line is a line along the superior aspect of the femoral neck which normally intersects the epiphysis. In slipped capital femoral epiphysis, Klein's line does not intersect the epiphysis and passes superior to it.

Trethowan's sign
- slipped capital femoral epiphysis (SCFE)



Solution to Question 3:

Galeazzi's test is shown in the above image.

It is done in children with unilateral cases of developmental dysplasia of the hip (DDH) between 3 to 8 months of age.

The child is placed supine with the hip and knee in flexion. The level of both the knee joints is noted with respect to a horizontal line. Normally both knees should be at the same level. In DDH, the affected knee is seen to be at a lower level indicating femoral shortening. This is also known as Allis's sign.

Tests for DDH are:

- Barlow's test
- Ortolani's test
- Galeazzi's test
- Asymmetric skin fold test

Durkan's test is the most specific test for the diagnosis of carpal tunnel syndrome. In this test, direct median nerve compression elicits paresthesias and pain.

Solution to Question 4:

Increased lumbar lordosis is seen in developmental dysplasia of the hip (DDH).

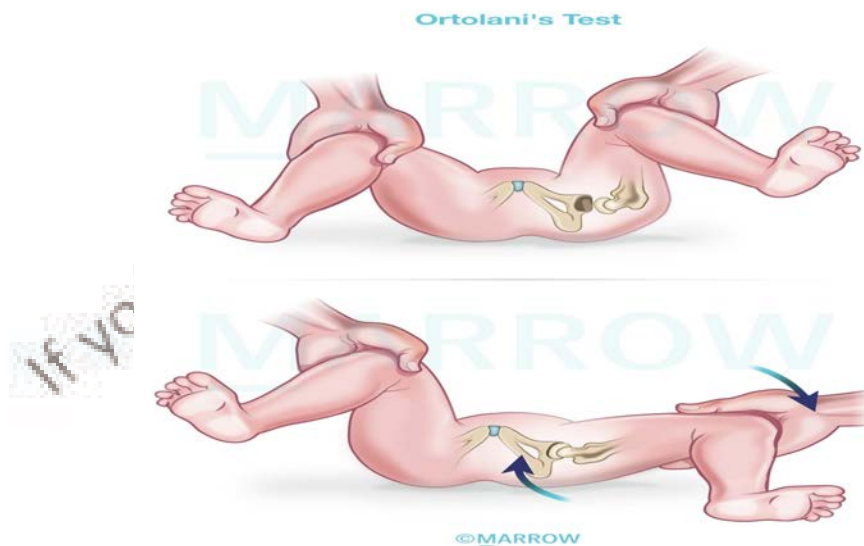
Other features include:

- Limb shortening
- Decreased abduction and lateral rotation of the hip
- Altered gait
- If unilateral - Trendelenburg's gait (body lurches to the affected side as the child bears weight on it)
- If bilateral - waddling gait (alternate lurching on both sides)

Solution to Question 5:

The above scenario is suggestive of developmental or congenital dysplasia of the hip (DDH). In a child of age ≤ 6 months, closed reduction with Pavlik harness or Von Rosen splint is done.

The Ortolani's test is a relocation manoeuvre. It is done by placing the infant supine, with the hip and knee flexed. With the thumb placed over the medial thigh and the index finger on the greater trochanter, the hip is gently abducted. This reduces the femoral head into the acetabulum producing a palpable "clunk".



Solution to Question 6:

The next step for a 1-year-child diagnosed with DDH, with failed closed reduction is open reduction.

Solution to Question 7:

The treatment of choice for a case of DDH with secondary arthritic changes in a 12-year-old child is total hip replacement.

Solution to Question 8:

The most common type of osteochondrosis is Perthes disease. It is also called coxa plana or osteochondritis deformans juvenilis.

It is a disorder causing avascular necrosis of the capital femoral epiphysis.

Solution to Question 9:

The bone age is lower than the chronological age by 1–3 years.

Since the blood supply of the femoral capital epiphysis is affected, it is characterized by avascular necrosis and disordered enchondral ossification of the primary and secondary centers of ossification.

Perthes disease typically affects boys aged 4–8 years. Patients have short stature and limitation of abduction and internal rotation.

When the hip is flexed it may go into obligatory external rotation called Catterall's sign.

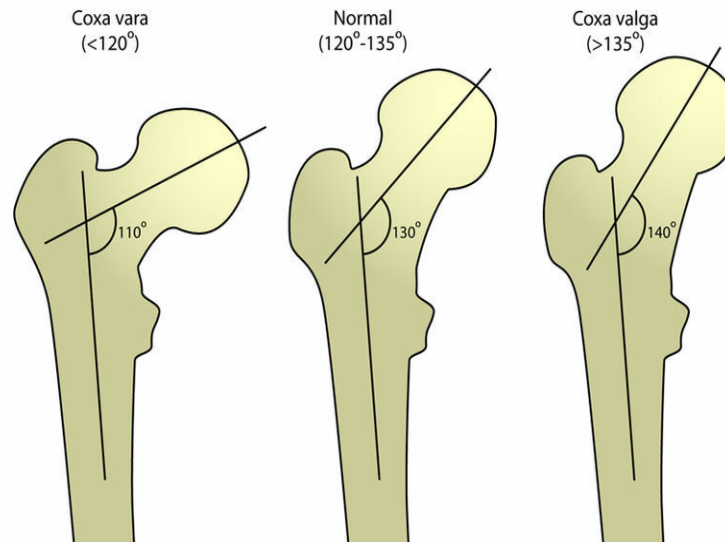
Solution to Question 10:

The greater trochanter is displaced upwards in coxa vara.

In coxa vara, there is a limitation of abduction and internal rotation. Trendelenburg's gait is seen.

The normal femur neck-shaft angle (Mikulicz angle) is from 120-135 degrees.

Increases or decreases in the neck-shaft angle result in deformities. An angle <120 degrees is called coxa vara. An angle >135 degrees is called coxa valga.



The radiograph below shows the reduced angle between the head and shaft of the femur in coxa vara.



Solution to Question 11:

Decreased flexion is seen in slipped capital femoral epiphysis (SCFE).

SCFE refers to the split fracture at the growth plate of epiphysis causing the neck of the femur to slip. The head remains in the acetabulum.

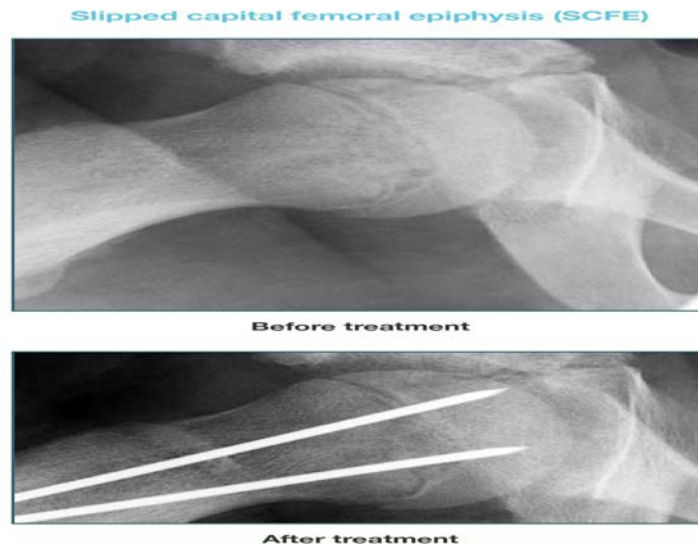
SCFE occurs during the adolescent rapid growth period when the epiphyseal plate is weak. It is associated with endocrinopathies. It is more common in adolescent boys.

It is characterized by:

- Decreased flexion

- Restricted abduction and internal rotation of the hip presenting with difficulty in sitting cross-legged and squatting
- Positive knee axilla sign

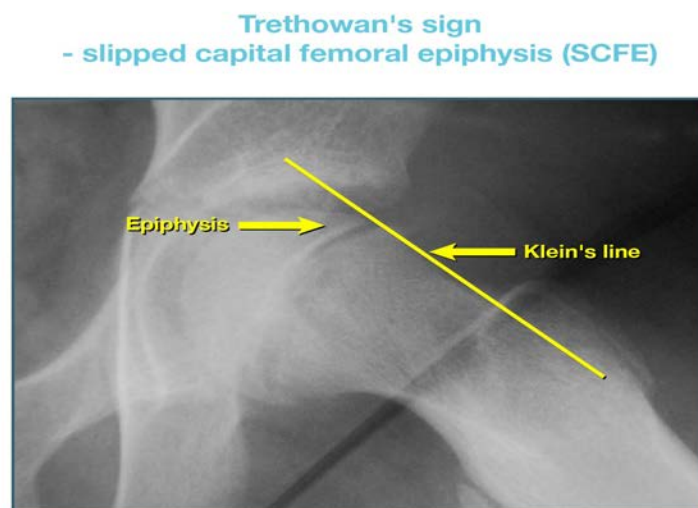
The following image shows SCFE before and after treatment.



Solution to Question 12:

The above scenario is suggestive of slipped capital femoral epiphysis (SCFE). The radiograph shows the Trethowan's sign.

The Klein line is a line drawn along the superior aspect of the femoral neck which normally intersects the epiphysis. In SCFE, Klein's line does not intersect the epiphysis and passes superior to it. This is known as Trethowan's sign.



Option B: Catterall's sign is seen in Perthes disease.

Option C: Allis's sign is seen in DDH.

Option D: Dagger sign is seen in ankylosing spondylitis.

Solution to Question 13:

Hip is held in abduction and external rotation in transient synovitis.

In any type of synovitis, the hip joint is held in abduction and external rotation because in this position the joint capacity is maximum, to accommodate the effusion. Hence, the stretching due to effusion is minimal, thus causing less pain.

Solution to Question 14:

Achondroplasia is caused by a mutation of the fibroblast growth factor receptor-3 (FGFR-3) gene.

The primary defect is abnormal chondrocyte proliferation at the growth plate that causes the development of short and thick bones.

Clinical features include:

- Short limbs
- Normal trunk
- Large head
- Saddle nose
- Exaggerated lumbar lordosis
- Severe spinal deformity may lead to cord compression

The radiograph below shows champagne glass pelvis in achondroplasia. Bone softening leads to lateral indentation of acetabula.

Champagne Glass Appearance



Solution to Question 15:

The above picture depicts a starfish hand seen in achondroplasia.

In these patients, the middle finger is shorter than usual resulting in all digits being of equal length (starfish hand). There is a separation between the middle and ring fingers and this is described as trident hands.

Achondroplasia is the most common form of disproportionate dwarfism. Inheritance is autosomal dominant. Intelligence and sexual development are usually normal. Hands are short and broad and there is posterior scalloping of the vertebrae.

Solution to Question 16:

Ring-shaped epiphysis is seen in osteogenesis imperfecta.

Osteogenesis imperfecta, also known as brittle bone disease, is mostly inherited as autosomal dominant. There is a defect in the type I collagen COL1A1 gene

It is associated with the following features:

- Wormian bones
- Multiple fractures
- Deafness
- Blue sclera

Solution to Question 17:

The above scenario is suggestive of osteogenesis imperfecta. Defective osteoid formation is seen in osteogenesis imperfecta.

Mutation in COL1A1 or COL1A2 results in defective collagen I synthesis and defective osteoid formation.

Solution to Question 18:

The most likely diagnosis is slipped capital femoral epiphysis (SCFE).

Adolescent age group, hypothyroidism, obesity, sudden onset of pain after trauma with restricted abduction, internal rotation are suggestive of SCFE.

Option A: The age of presentation in Perthes disease is 4-8 years.

Option B: DDH is present since birth.

Option C: Fracture neck of femur is usually seen in the 6th-7th decade of life.

Solution to Question 19:

The image shows Barlow's test.

It is done to test for Developmental dysplasia of hip (DDH).

The Barlow's manoeuvre is a provocation test. This test is done within 2-3 days of birth. To perform this test, the infant is supine with the knees fully flexed and the hip at 90° of flexion. The thigh is grasped and the hip is gently adducted to 45 degrees while applying downward and lateral pressure. This results in a posterior subluxation or dislocation of an easily dislocatable femoral head, producing a palpable "clunk".

This test is positive when the joint can be dislocated and a clunk is heard.

Metabolic Bone Diseases in Children

Question 1:

Which of the following occur due to nutritional deficiency?

- a) 1, 2, and 3
- b) 1, 3, and 4
- c) 2, 3, and 5
- d) 1, 4, and 5

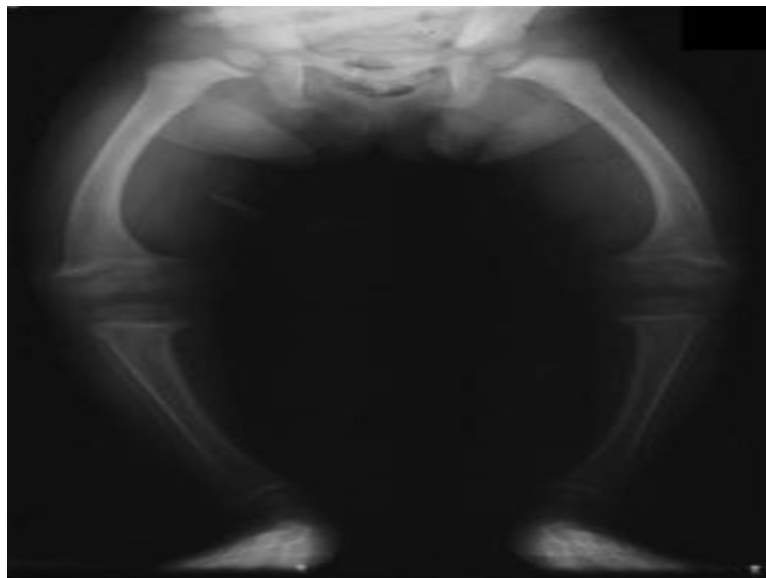
Question 2:

Laboratory findings of a patient are given below. What is the most likely diagnosis?

- a) Primary hyperparathyroidism
- b) Rickets
- c) Paget's disease of bone
- d) Osteoporosis

Question 3:

A 4-year-old child was brought to the OPD with a painless deformity. A radiograph of the child's legs is shown below. The most common cause of this deformity is _____.



- a) Skeletal dysplasia
- b) Rickets
- c) Scurvy
- d) Blount disease

Question 4:

The X-ray of a child with rickets shows widening of the metaphyseal ends. What is this known as?

- a) Fraying
- b) Splaying
- c) Cupping
- d) Pelkan spur

Question 5:

A 4-year-old child with perifollicular hemorrhages is diagnosed with scurvy. X-ray of the child is done. Which of the following radiological features is incorrectly matched?

- a) White line of Frankel- dense zone of provisional calcification
- b) Wimberger's ring sign- ring shaped epiphysis
- c) Trummerfeld zone- radiopaque zone
- d) Pelkan spur- small portion of detached bone

Question 6:

A child presents with pinpoint ecchymoses around hair follicles and is not allowing anyone to move his limbs because of pain. He also has tender nodules over the chest, as seen in the image given below. What is the most likely diagnosis in this child?



- a) Acute osteomyelitis
- b) Osteogenesis imperfecta
- c) Rickets
- d) Scurvy

Question 7:

A child presents with multiple painless swellings over the costochondral junction. Which of the following conditions is least likely in this child?

- a) Rickets
- b) Primary hyperparathyroidism
- c) Hypophosphatemia
- d) Hemangiopericytoma

Question 8:

A 7-month-old child was brought with frontal bossing and craniotabes. X-ray of the child showed widening of the wrist joint. Which of the following is least likely to be seen in this child?

- a) Widening of joint space
- b) Widely open fontanelles
- c) Convulsions

d) Bowing of legs

Question 9:

A 3-year-old child was brought to OPD with history of multiple bone fractures. Examination showed blue sclera, deformed legs and deformed teeth. What is the pathophysiology behind this condition?

- a) Defect in bone mineralisation
- b) Defect in osteoclastic activity
- c) Defect in enchondral ossification
- d) Defect in collagenous matrix of bone

Question 10:

A 5-year-old boy with pathological fracture is diagnosed with marble bone disease. What is the pathophysiology behind this condition?

- a) Decreased osteoblastic activity
- b) Decreased collagen production
- c) Decreased osteoclastic activity
- d) Increased collagen production

Question 11:

An infant with hydrocephalus is found to have pancytopenia and hepatosplenomegaly. On further investigations, he is also found to have ruggar-jersey spine on X-ray. What is the most probable diagnosis?

- a) Osteopetrosis
- b) Renal osteodystrophy
- c) Paget's disease
- d) Osteogenesis imperfecta

Answer Key

Question No.	Correct Option
1	b
2	b
3	b
4	b
5	c
6	d
7	b
8	d
9	d
10	c
11	a

Detailed Explanations

Solution to Question 1:

Osteomalacia, secondary hyperparathyroidism, and rickets occur due to nutritional deficiency.

Metabolic bone disorders due to nutritional deficiencies include:

- Vitamin D deficiency may lead to:
 - Rickets- in children
 - Osteomalacia- in adults
 - secondary hyperparathyroidism
- Vitamin C deficiency may lead to scurvy

Primary hyperparathyroidism occurs due to an adenoma or hyperplasia of the parathyroid gland. This leads to the unregulated production of parathyroid hormone.

Osteopetrosis occurs due to decreased osteoclastic activity.

Solution to Question 2:

Raised parathormone level and raised alkaline phosphatase along with low serum calcium and low serum phosphate level is suggestive of rickets.

Nutritional rickets occurs due to deficiency of vitamin D. This leads to low calcium levels in the blood. To raise the serum calcium, the secretion of the parathyroid hormone rises. The parathyroid hormone tries to raise the calcium levels by :

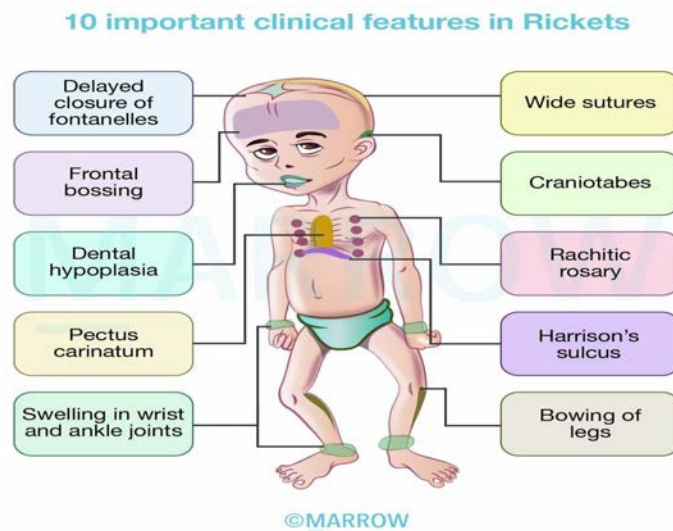
- Reabsorbing calcium in the kidneys and secreting phosphate in exchange leading to low phosphate levels
- Increasing bone resorption

Solution to Question 3:

The given X-ray shows bow legs or genu varum which is most commonly seen in rickets.

Rickets is a bone mineralization disorder that primarily affects children with open growth plates, resulting from a deficiency of vitamin D, calcium, or phosphate.

In toddlers, genu varum is one of the most common initial sign of rickets. In older children, genu valgum or coxa vara might be present.

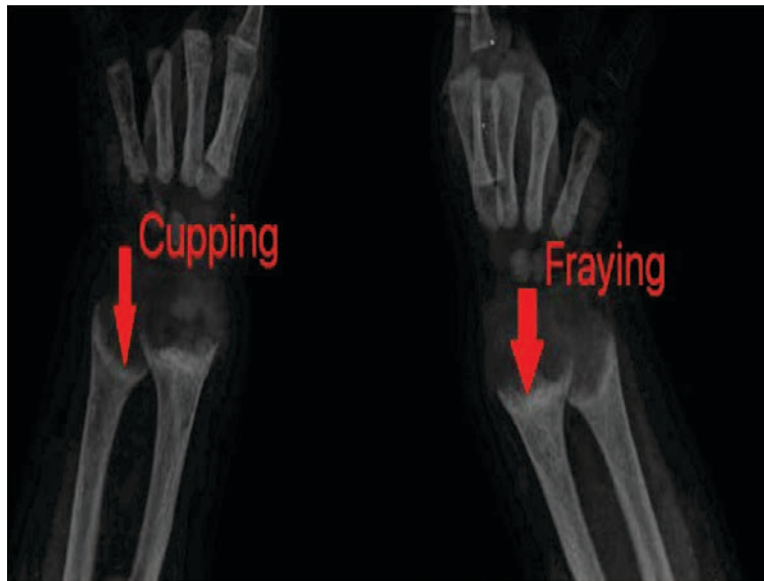


Solution to Question 4:

Widening of the metaphyseal ends is known as splaying. It occurs because of the accumulation of non-mineralized osteoid at the metaphyseal ends.

Defective mineralization of osteoid also results in fraying and cupping. Fraying is the worn-out appearance of the metaphyseal margins. Cupping is the concave appearance of the metaphysis. Bowing is seen in the diaphysis of the long bones affected by rickets.

The given radiograph shows splaying, fraying and cupping.



Solution to Question 5:

Trummerfeld zone is a radiolucent zone beneath the Frankel's line due to lack of mineralized osteoid.

Solution to Question 6:

The given clinical scenario and the image showing scorbutic rosary are suggestive of scurvy.

Scurvy results from the deficiency of vitamin C. Vitamin C is required for the hydroxylation of lysine and proline that are used in the synthesis of collagen. Hence, deficiency of vitamin C leads to the formation of defective collagen.

Defective collagen results in capillary hemorrhages which may present as generalized bleeding tendency. It also results in defective osteoid formation. Subperiosteal hemorrhages cause acute pain and swelling mimicking acute osteomyelitis.

Costo-chondral separation leads to the formation of tender nodules, also known as scorbutic rosary. Rickets also presents with similar nodules at the costochondral junctions known as rachitic rosary. They can be differentiated as scorbutic rosary is more sharply angulated and are painful.

Solution to Question 7:

Multiple painless swellings at the costochondral junction is suggestive of rachitic rosary in this child. It is not seen in primary hyperparathyroidism.

Rachitic rosary is seen in rickets and all the conditions leading to hypocalcemia and hypophosphatemia. Hemangiopericytoma causes hypophosphataemic vitamin D-resistant rickets.

Solution to Question 8:

The given clinical scenario is suggestive of rickets. Lower limb deformities appear when the child starts to walk. Hence, bowing of legs will be less commonly seen in infants.

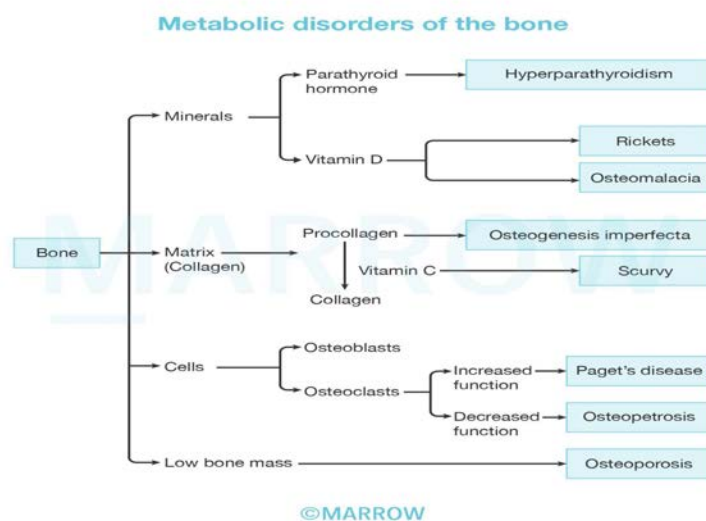
Clinical features of rickets:

- Lassitude
- Muscle weakness
- Convulsions
- Hyperparathyroidism secondary to hypocalcemia

Solution to Question 9:

The given clinical scenario is suggestive of osteogenesis imperfecta. It occurs due to defect in the collagenous matrix of the bone.

Mutations in COL1A1 / COL1A2 results in defective collagen I synthesis. There are 12 types of osteogenesis imperfecta with type 1 being the most common. Triad of fragile bones, blue sclera and deafness is known as Van der Hoeve's syndrome. Treatment includes bisphosphonate therapy and orthopedic rehabilitation.

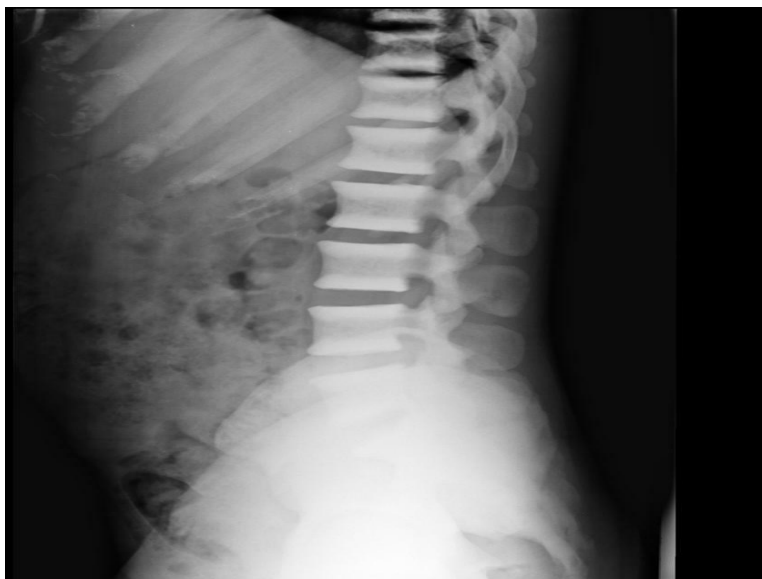


Solution to Question 10:

Marble bone disease is characterised by decreased osteoclastic activity. It is also known as osteopetrosis / Albers-Schönberg disease.

It is an inherited disorder which may present either in infancy or adulthood. There is continuous new bone formation without bone remodeling. This leads to increased bone density. They are prone to pathological fractures.

X-ray spine of a patient with osteopetrosis showing endobone (bone within a bone) appearance is given below.



Solution to Question 11:

The given clinical scenario is suggestive of the infantile form of osteopetrosis. It is characterised by decreased osteoclastic activity due to defect in carbonic anhydrase II proton pump.

The excessive new bone formation with defective resorption leads to abnormal development of the skull, especially causing narrowing of the foramina of the skull. This leads to various complications like hydrocephalus, cranial nerve compression leading to deafness and facial palsy, sinus blockage, etc.

Failure of bone resorption results in poorly formed medullary cavity. This leads to defective hematopoiesis in the medullary cavity and stimulation of extramedullary hematopoiesis. Hence, the infant presents with pancytopenia and hepatosplenomegaly.

Abnormal bone density may also lead to altered vasculature causing complications like osteitis of the mandible.

Excess bone density also leads to endobone appearance and rugger jersey appearance of vertebrae on radiograph. X-ray spine of a patient with osteopetrosis is given below.

Renal osteodystrophy also shows rugger jersey appearance of vertebrae on x-ray. However, renal osteodystrophy is a complication of chronic kidney disease and the patient is an infant. So the likely answer in the patient in the given scenario is osteopetrosis (Option B).



Osteoporosis and Osteomalacia

Question 1:

Following a fall in the bathroom, an elderly lady is diagnosed with a fractured neck of the femur. Which of the following coexisting conditions is most likely to have predisposed to this injury?

- a) Osteoporosis
- b) Osteopetrosis
- c) Osteoarthritis
- d) Osteomalacia

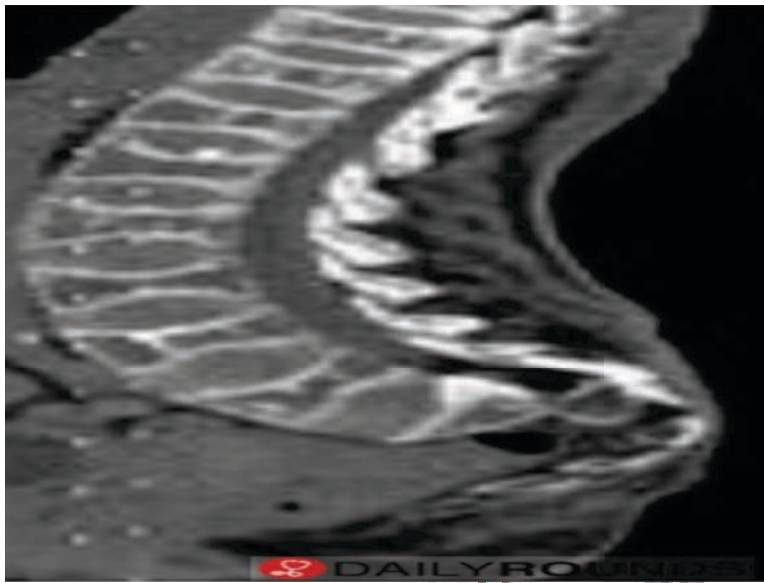
Question 2:

A 65-year-old lady comes to you with a DEXA report showing T-score of -2.8 SD. Which of the following best describes the pathophysiology of the underlying condition in this lady?

- a) Decreased bone mineralization
- b) Decreased bone mass
- c) Increased bone turnover
- d) Decreased bone quality

Question 3:

A 70-year-old lady with complaints of chronic back pain is noted to have kyphosis of the spine. MRI of the spine is shown below. Identify the given appearance.



- a) Lincoln log vertebrae
- b) Picture frame vertebrae
- c) Vertebrae plana
- d) Cod fish vertebrae

Question 4:

Which of the following conditions does not cause osteoporosis?

- a) Hyperprolactinemia
- b) Hyperparathyroidism
- c) Systemic sclerosis
- d) Thalassemia

Question 5:

X-ray spine of a patient with chronic back pain shows characteristic appearance of cod fish vertebrae. What is the investigation of choice to diagnose the underlying condition?

- a) DEXA
- b) Serum calcium, ALP levels
- c) Bone scan
- d) Quantitative CT

Question 6:

At what age in women is a DEXA scan done routinely?

- a) At 50 years
- b) At 55 years
- c) At 60 years
- d) At 65 years

Question 7:

An elderly lady diagnosed with osteoporosis was advised to start treatment with bisphosphonates. Since the patient refused to come to hospital frequently, she was prescribed a drug that is given on yearly basis. Which among the following is given to this lady?

- a) Risedronate
- b) Zoledronate
- c) Ibandronate
- d) Alendronate

Question 8:

A patient diagnosed with osteoporosis having a T-score of -4.5 SD is treated with synthetic parathyroid hormone. Which of the following drugs is given to this patient?

- a) Teriparatide
- b) Romosozumab
- c) Cinacalcet
- d) Salcatonin

Question 9:

Which of the following drugs decreases the bone resorption and increases bone formation?

- a) Teriparatide
- b) Alendronate
- c) Calcitonin
- d) Strontium ranelate

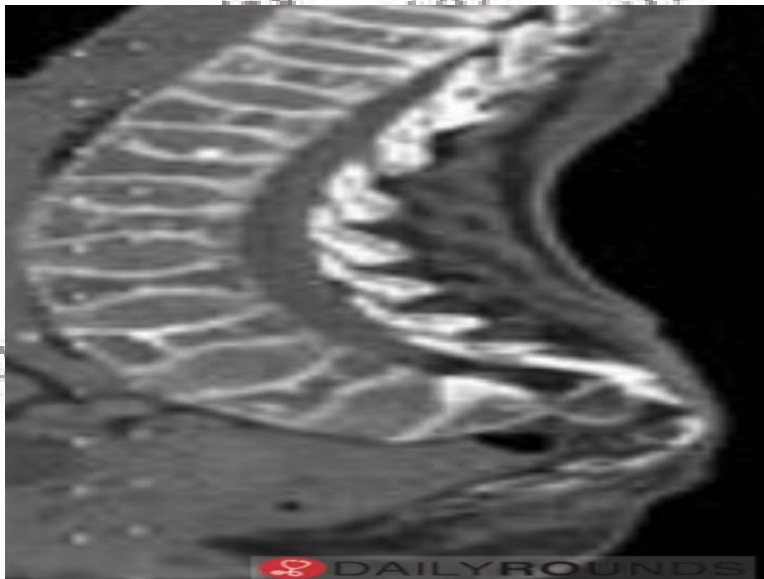
Question 10:

An elderly lady who is on bisphosphonate therapy for 4 years comes with complaints of hip pain. What is the next investigation to be done in this patient?

- a) Plain radiograph
- b) Vitamin D levels
- c) Serum ALP levels
- d) DEXA scan

Question 11:

A 55 year old female complains of lower backache. The radiographic image of her lumbosacral spine is given below. What is the probable diagnosis?



- a) Osteoporosis
- b) Ankylosing spondylitis
- c) Diffuse idiopathic skeletal hyperostosis
- d) Renal osteodystrophy

Question 12:

Which of the following tests are not commonly used in osteoporosis?

- a) 1, 2 & 3
- b) 2 & 4
- c) 2 & 3
- d) 1, 3, 4 & 5

Question 13:

Which of the following is a disorder of bone mineralization?

- a) Osteopetrosis
- b) Osteomalacia
- c) Osteogenesis imperfecta
- d) Osteoporosis

Question 14:

Which of the following conditions shows looser zones, codfish vertebrae, and champagne glass pelvis in radiographic images?

- a) Osteoporosis
- b) Osteomalacia
- c) Osteopetrosis
- d) Paget's disease

Question 15:

Which tumor does not cause osteomalacia and phosphaturia?

- a) Osteosarcoma
- b) Hemangiopericytoma
- c) Fibrosarcoma
- d) Breast carcinoma

Answer Key

Question No.	Correct Option
1	a
2	b
3	d
4	c
5	a
6	d
7	b
8	a
9	d
10	a
11	a
12	c
13	b
14	b
15	d

Detailed Explanations

Solution to Question 1:

Given the clinical history of an elderly woman experiencing a fracture following a trivial fall, which indicates a pathological fracture, the most probable predisposing condition would be osteoporosis.

Osteoporosis is the most common metabolic bone disorder characterized by abnormally low bone mass, which makes the bone unusually fragile and increases the risk of fractures.

A DEXA scan is performed in the following patients to assess bone mineral density and screen for osteoporosis, and the results are reported in terms of T-score or Z-score:

- Females aged 65 years or more
- Males aged 70 years or more
- Post-menopausal females under the age of 65 years with risk factors
- Fracture after the age of 50 years
- Males aged 50-69 with risk factors

Solution to Question 2:

The DEXA report showing a T-score of -2.8 SD is suggestive of osteoporosis. Osteoporosis is characterized by decreased bone mass.

T-score of -2.5 SD or lower is suggestive of osteoporosis. In this condition, the degree of mineralization remains the same. It is characterized by increased bone resorption, decreased bone formation or both. There is also a loss of structural connectivity in the trabecular bones.

Serum calcium, phosphates and alkaline phosphatase levels are normal in osteoporosis.

Solution to Question 3:

The MRI of the spine shows decreased bone density with biconcave appearance of vertebrae known as codfish vertebrae. The given clinical scenario and the MRI findings are suggestive of osteoporosis.

A patient with osteoporosis most commonly presents with chronic back pain or pathological fractures. The most common osteoporotic fractures are compression fractures of vertebrae which lead to the development of kyphosis. Fractures are also seen in the distal radius (colles' fracture) and proximal femur.

Option A: Lincoln log vertebrae, also called as H-shaped vertebrae are seen in patients of sickle cell anemia. The following image shows the lincoln log vertebrae.



Option B: Picture frame vertebrae in which the cortex of the vertebrae is thickened is seen in Paget's disease.

Option C: Vertebrae plana is seen in a number of conditions such as:

- Osteoporosis
- Osteogenesis imperfecta
- Osteomyelitis
- Trauma

This occurs in advanced compression fractures when the vertebral body has entirely lost its height both anteriorly and posteriorly.

Solution to Question 4:

Osteoporosis is not seen in systemic sclerosis.

Osteoporosis most commonly occurs in postmenopausal women and in elderly individuals.

The secondary causes of osteoporosis are:

- Hypogonadal states -
- Turner's syndrome
- Klinefelter's syndrome
- Hyperprolactinemia
- Endocrine disorders -
- Cushing's syndrome
- Hyperparathyroidism
- Hyperthyroidism
- Diabetes mellitus
- Hematological disorder -
- Multiple myeloma
- Lymphoma
- Leukemia
- Hemophilia
- Thalassemia
- Nutritional and gastrointestinal disorders -
- Malnutrition
- Parenteral nutrition
- Malabsorption syndrome
- Gastrectomy
- Pernicious anemia
- Rheumatologic disorder -
- Rheumatoid arthritis
- Ankylosing spondylitis
- Inherited disorders -
- Osteogenesis imperfecta

- Marfan's syndrome
- Ehler's Danlos syndrome
- Hypophosphatasia
- Prolonged immobilization
- Pregnancy and lactation

Solution to Question 5:

Cod fish vertebrae in X-ray spine is suggestive of osteoporosis. The investigation of choice for the diagnosis of osteoporosis is dual energy X-ray absorptiometry(DEXA).

It measures the bone mineral density of an individual. These measurements are made at the lumbar spine or the hip. These measured values are compared using T scores. A T score ≤ -2.5 SD is suggestive of osteoporosis.

Solution to Question 6:

Dual-energy x-ray absorptiometry (DEXA scan) is routinely done in women at 65 years of age to screen for osteoporosis.

Osteoporosis is the most common metabolic bone disorder characterized by abnormally low bone mass, which makes the bone unusually fragile and increases the risk of fractures.

The criteria to screen for osteoporosis according to the national osteoporosis foundation is as follows:

- Females aged 65 years or more
- Males aged 70 years or more
- Post-menopausal females under the age of 65 years with risk factors
- Fracture after the age of 50 years
- Males aged 50-69 with risk factors

A DEXA scan is performed in the above patients to assess bone mineral density, and the results are reported in terms of T-score or Z-score.

Solution to Question 7:

Zoledronate is bisphosphonate that is administered once a year.

The drugs used in the treatment of osteoporosis which decrease bone resorption include bisphosphonates, denosumab, and SERMs (selective estrogen receptor modulators).

Bisphosphonates decrease bone resorption by impairing osteoclast function. The bisphosphonates approved for the treatment of osteoporosis are alendronate, risedronate, ibandronate, and zoledronate.

- Alendronate and risedronate can be administered daily or weekly with different dosages.
- Ibandronate can be administered daily, weekly or quarterly.
- Zoledronate is administered annually.

Denosumab is a monoclonal antibody with an affinity for RANKL. RANKL stimulates osteoclast that results in bone resorption. By inhibiting the RANKL, denosumab prevents activation of osteoclast and decreases bone resorption.

SERMs: Raloxifene and tamoxifen are approved for the treatment of osteoporosis. Estrogen decreases bone resorption. Thus decrease in estrogen in postmenopausal females results in increased bone resorption leading to osteoporosis.

Solution to Question 8:

Synthetic parathyroid hormone given to a patient with osteoporosis is teriparatide. In low and intermittent doses, it leads to bone formation. In high and continuous doses, it leads to bone resorption.

Option B: Romosozumab is an anti-sclerostin antibody. Sclerostin inhibition increases bone formation and, to a lesser extent, decreases bone resorption.

Option C: Cinacalcet inhibits the parathyroid hormone secretion by activating the calcium-sensing receptors (CaSR).

Option D: Salcatonin inhibits osteoclastic bone resorption. It is used in the treatment of Paget's disease and osteoporosis.

Solution to Question 9:

Strontium ranelate decreases bone resorption and increases bone formation.

Strontium resembles calcium and moves into bone matrix resulting in increased bone formation. Osteoclasts cannot remove strontium, thus decreasing bone resorption.

Solution to Question 10:

The next investigation to be done in a patient with complaints of hip pain following prolonged bisphosphonate therapy is plain radiograph to rule out atypical femur fracture.

Prolonged use of bisphosphonates is associated with two potential side effects:

- Osteonecrosis of the jaw usually following a dental procedure

- Atypical femur fracture - occurs in the subtrochanteric femoral region or along the shaft distal to the lesser trochanter

Solution to Question 11:

The radiographic image of an elderly female's lumbosacral spine shows ballooning of disc spaces, resulting in the characteristic biconcave appearance of vertebral bodies known as the 'codfish' appearance, typically seen in osteoporosis.

Osteoporosis is a common metabolic bone disease characterised by a diffuse reduction in bone density due to a decrease in bone mass.

Risk factors for osteoporosis include:

- Increasing age
- Female sex
- Alcohol
- Smoking
- Previous history of fragility fractures
- Family history of hip fracture
- Low body mass index- less than 18.5 kg/m²
- Excessive usage of glucocorticoids

Osteoporosis presents with fractures that occur without any trauma or as a result of low-impact trauma. The commonly associated fractures are fractures of the distal part of the radius (Colle's fracture), fractures of the hip, and fractures of the vertebrae. In severe cases, the fracture of vertebrae can cause kyphosis.

Radiological findings:

- A decreased vertical height of the vertebra due to collapse
- Ground glass appearance - especially in bones like pelvis
- Codfish appearance - it occurs due to bulging of the disc into the adjacent vertebral bodies so that it becomes biconcave.

DEXA (dual-energy X-ray absorptiometry) is the investigation of choice for the diagnosis of osteoporosis. T-score less than -2.5 in the lumbar spine, femoral neck, or total hip indicates osteoporosis.

Solution to Question 12:

Bone scan and quantitative CT are not commonly used in the diagnosis of osteoporosis.

Bone Scan is obsolete whereas QCT measures volumetric bone density. However, this QCT is expensive and has higher risk of exposure to radiation when compared to DEXA, hence it is not

much in use

The investigation of choice for the diagnosis of osteoporosis is dual-energy X-ray absorptiometry (DEXA). A T-score ≤ -2.5 is defined as osteoporosis. DEXA measures the bone mineral density of an individual. These measurements are made at the lumbar spine, femoral neck, or hip.

Radiological features of osteoporosis:

- Ballooning of disc spaces leading to the biconcave shape of the vertebral body, known as codfish appearance (classically seen in osteoporosis but also seen in osteomalacia and hyperparathyroidism)
- Loss of vertical height of vertebra due to collapse
- Ground glass appearance of bones especially in the bones like the pelvis
- Loss of cortical bone (picture frame vertebrae) and trabecular bone (ghost vertebrae)
- Loss of trabeculae in proximal femur area.

Chemical tests like serum calcium, phosphorus and alkaline phosphatase levels are usually normal. But, osteoblastic and osteoclastic markers in urine & blood can help in diagnosing and monitoring treatment.

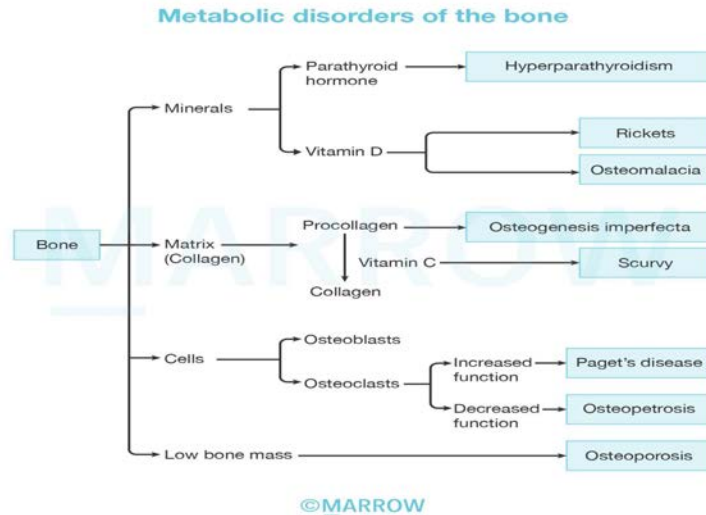
Solution to Question 13:

Osteomalacia is a disorder of bone mineralization. Osteomalacia means softening of the bone. There is incomplete calcification of osteoid throughout the skeleton.

The disorders of bone mineralization include:

- Rickets
- Osteomalacia
- Hyperparathyroidism.

Rickets and osteomalacia are different expressions of the same disease resulting from deficient mineralization of the bone. Defective mineralization of the epiphyseal growth plates in children causes rickets and defective mineralization of the bone matrix in adults causes osteomalacia. It leads to fragile bones with a high risk of fractures.



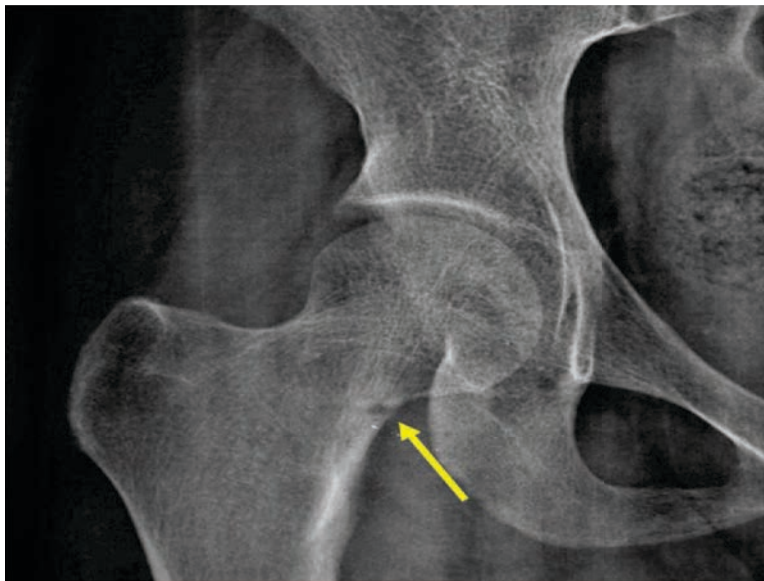
Solution to Question 14:

Looser zones, codfish vertebrae, and champagne glass pelvis are seen in osteomalacia.

Loosers zones are the classical lesions of osteomalacia. These are due to incomplete stress fractures caused by the arterial pulsations which heal with callus-lacking in calcium. They are thin transverse bands of rarefaction especially seen in the pelvis, the shaft of long bones such as femur neck and the axillary edge of the scapula. They are seen in:

- Osteomalacia (characteristic)
- Renal osteodystrophy
- Fibrous dysplasia
- Hyperthyroidism
- Paget's disease
- Osteogenesis Imperfecta

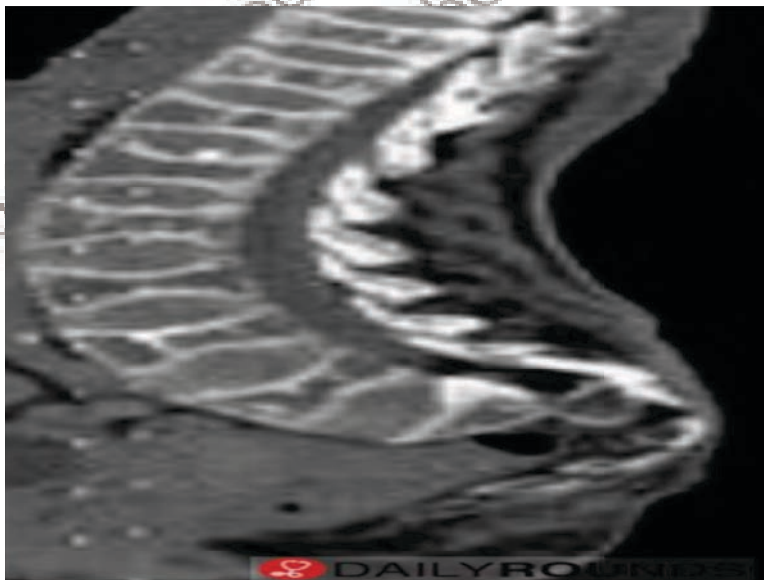
The image below shows Looser's zone.



Codfish vertebrae are the biconcave vertebral bodies seen in osteomalacia. They are seen in:

- Hyperparathyroidism
- Osteomalacia
- Osteoporosis

The image below shows the codfish vertebrae.



Champagne glass pelvis is due to bone softening leading to lateral indentation of acetabula. It is seen in:

- Osteomalacia
- Achondroplasia



Solution to Question 15:

Breast carcinoma does not cause osteomalacia and phosphaturia.

Tumor-induced osteomalacia (TIO) is a rare paraneoplastic syndrome which presents with hypophosphatemia, osteomalacia and renal phosphate wasting. It is most commonly seen with mesenchymal tumors.

Tumors associated with osteomalacia are:

- Hemangiopericytoma (option B)
- Non-ossifying fibroma
- Osteosarcoma (option A)
- Osteoblastoma
- Fibrosarcoma (option C)

Paget's Disease and Hyperparathyroidism

Question 1:

Which of the following conditions is characterized by increased osteoclastic activity?

- a) Osteopetrosis
- b) Osteogenesis imperfecta
- c) Osteomalacia
- d) Paget's disease

Question 2:

Which of the following is characteristic of Paget's disease?

- a) Decrease in bone mineralization
- b) Decreased alkaline phosphatase
- c) Increased bone turnover
- d) Increased degradation of collagen

Question 3:

Which of the following set of findings is likely to be seen in patient's with Paget's disease?

- a) 1
- b) 2
- c) 3
- d) 4

Question 4:

A patient is diagnosed with Paget's disease. X-ray of the patient is given below. In which phase of the disease is the patient at?



- a) Osteolytic phase
- b) Phase of bone formation
- c) Sclerotic phase
- d) Osteoporotic phase

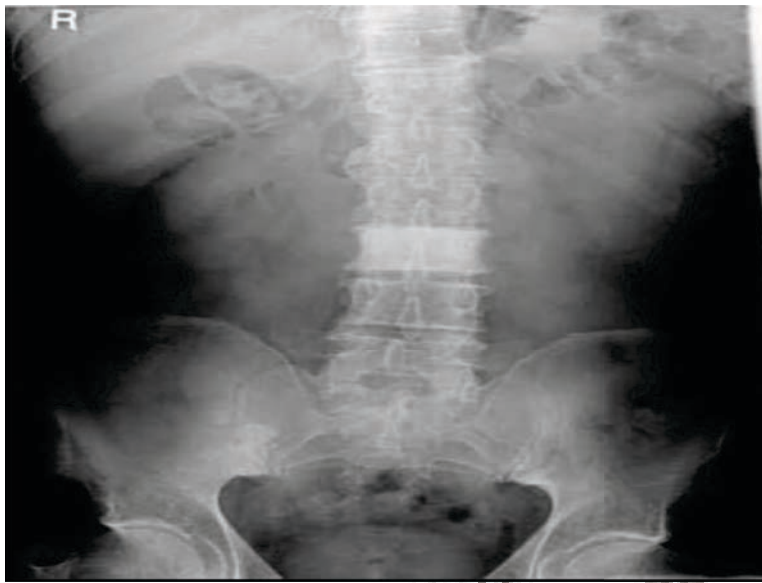
Question 5:

A 53-year-old woman is found to have raised serum alkaline phosphatase. Urinary examination reveals increased excretion of hydroxyproline in urine. X-ray skull of the patient shows cotton wool appearance. Which of the following statements is false regarding the treatment of this condition?

- a) Bisphosphonates decrease bone resorption and destruction
- b) Bisphosphonate is the drug of choice
- c) Salmon calcitonin is more effective than porcine calcitonin
- d) Etidronate is the commonly used bisphosphonate

Question 6:

A patient presents with chronic back ache and hearing loss. His X-ray spine is given below. Which of the following is not a complication of this disease?



- a) High output cardiac failure
- b) Osteoarthritis
- c) Spinal stenosis
- d) Osteochondroma

Question 7:

An elderly male patient presents with kyphosis and bowing of legs. There is increased warmth over his limbs and he is diagnosed with high frequency sensorineural hearing loss. His X-ray skull is given below. What is the most likely diagnosis?



- a) Osteopetrosis

- b) Paget's disease
- c) Multiple myeloma
- d) Eosinophilic granuloma

Question 8:

Which of the following conditions is not characterised by osteosclerosis?

- a) Paget's disease
- b) Hyperparathyroidism
- c) Fluorosis
- d) Renal osteodystrophy

Question 9:

Which of the following is not a function of parathyroid hormone?

- a) Decreases phosphate reabsorption from the kidneys
- b) Increases bone resorption
- c) Increases vitamin D formation
- d) Increases calcium absorption from the intestine

Question 10:

A patient with recurrent episodes of urinary tract infection and renal stones has the following laboratory findings. Which of the following signs may be seen in the radiograph of the skull in such a patient?

- a) Cotton wool skull
- b) Geographic skull
- c) Salt and pepper skull
- d) Punched out lytic lesion

Question 11:

An elderly woman with complains of backache, fatigue, and low mood is found to have hypercalcemia and renal stones. X-ray of her hands is shown below. What is the most

probable diagnosis?



- a) Multiple myeloma
- b) Metastatic disease
- c) Hyperparathyroidism
- d) Osteomalacia

Question 12:

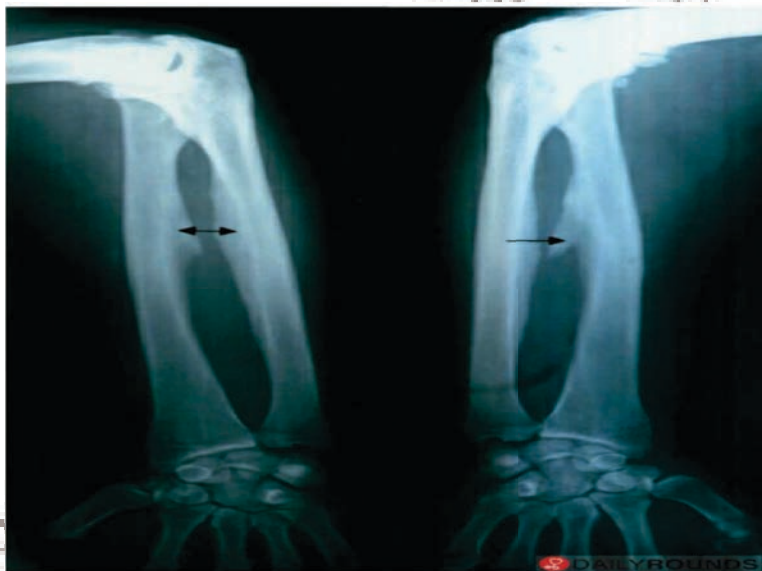
A 55-year-old man with end-stage renal disease presents with back pain. His history is significant for frequent pathological fractures. Identify the finding seen in his lumbosacral spine radiograph given below.



- a) Picture frame vertebrae
- b) Ivory vertebrae
- c) Bamboo spine
- d) Rugger jersey spine

Question 13:

A 40-year-old man presents with pain and stiffness of elbow joint. Examination shows mottled upper incisors. X-ray of the patient is given below. What is the most probable diagnosis?



- a) Hyperparathyroidism
- b) Osteopetrosis
- c) Fluorosis
- d) Hypervitaminosis D

Question 14:

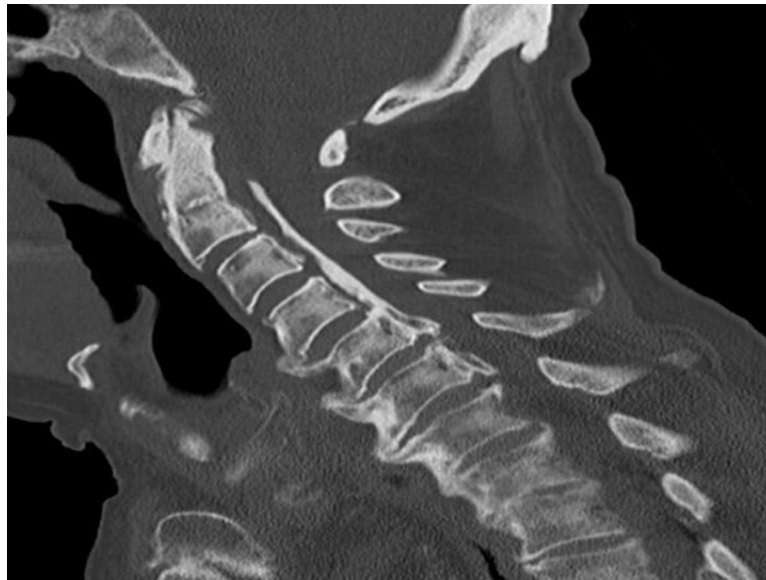
Which of the following conditions does not cause sub-periosteal new bone deposition?

- a) Hyperparathyroidism
- b) Fluorosis
- c) Caffey's disease

- d) All of the above

Question 15:

A 50-year-old man presented with spastic paraparesis. On examination, genu valgus deformity was found. CT of cervical spine showed the following finding. What is the pathophysiology behind this condition?



- a) Decreased bone mineral density
b) Decreased vitamin D levels
c) Increased resistance to osteoclasts
d) Decreased parathyroid hormone levels

Question 16:

A 50-year-old Arctic explorer presents with complaints of bone pain, headache and vomiting. There is no history of fever and you suspect elevated intracranial pressure. Radiographs of long bones reveal increased density in the metaphyseal region and subperiosteal calcification. What is your diagnosis?

- a) Hypervitaminosis A
b) Multiple myeloma
c) Secondaries
d) Hyperparathyroidism

Question 17:

A 50-year-old woman has multiple lytic lesions in the skull. Which of the following is the least likely cause of this finding?

- a) Multiple myeloma
- b) Hyperparathyroidism
- c) Metastasis
- d) Eosinophilic granuloma

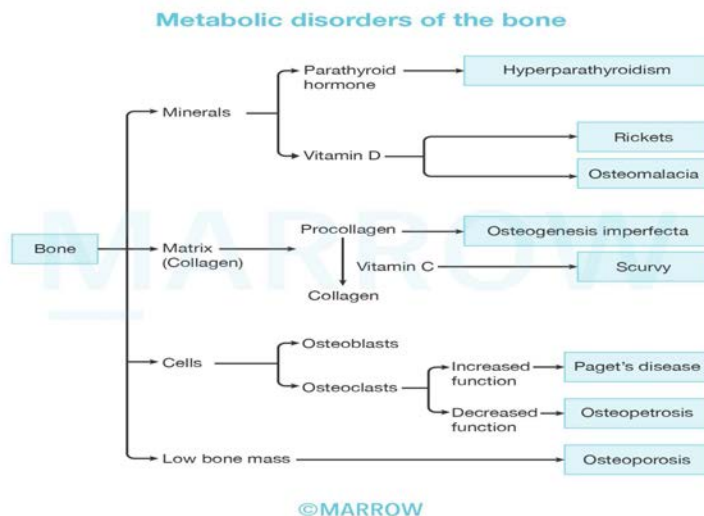
Answer Key

Question No.	Correct Option
1	d
2	c
3	b
4	a
5	d
6	d
7	b
8	b
9	d
10	c
11	c
12	d
13	c
14	a
15	c
16	a
17	d

Detailed Explanations

Solution to Question 1:

Paget's disease is characterized by increased osteoclastic activity. This is followed by a compensatory increase in osteoblastic activity. Hence, it is a disease of increased bone turnover.



Solution to Question 2:

Paget's disease is characterized by increased bone turnover with enlargement and thickening of the bone. It is also called osteitis deformans.

It manifests in 4th and 5th-decade males.

The pathologic process in Paget's disease is initiated by overactive osteoclastic bone resorption followed by a compensatory increase in osteoblastic new bone formation. This results in a structurally disorganized mosaic of woven and lamellar bone causing the bones to be unusually brittle. Plasma alkaline phosphatase is increased due to the osteoblastic activity.

Solution to Question 3:

Patients with Paget's disease have normal levels of serum calcium and raised serum ALP. It is due to increased bone formation.

Hypocalcemia can be rarely seen in patients with Paget's disease. It is due to active bone formation with insufficient calcium and vitamin D intake.

Solution to Question 4:

The given X-ray shows blade of grass deformity seen in the osteolytic phase of Paget's disease.

An initial osteolytic phase involves prominent bone resorption and marked hypervascularization. Radiographically, this manifests as an advancing lytic wedge or blade of grass or flame shaped

lesion.

The second phase is a period of very active bone formation and resorption. It is characterised by normal lamellar bone replaced with haphazard (woven) bone.

In the final sclerotic phase, bone resorption declines progressively and leads to a hard, dense, less vascular mosaic bone, which represents the so-called burned-out phase of Paget's disease.

The arrow mark in the following image indicates blade of grass appearance.

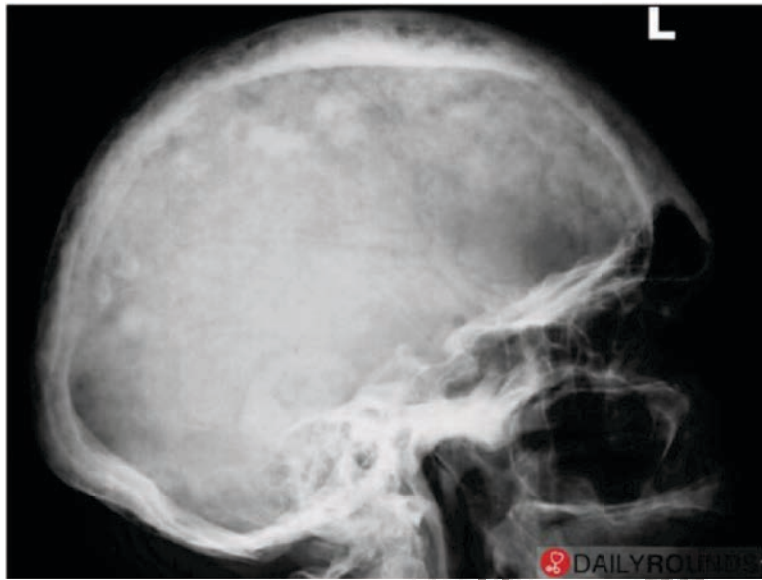


Solution to Question 5:

The given clinical scenario and X-ray showing cotton wool skull is suggestive of Paget's disease.

Pharmacological therapy includes use of bisphosphonates and calcitonin. They primarily reduce the rapid bone resorption and also increase the bone formation. Zoledronic acid is the preferred bisphosphonate.

The given below X-ray shows cotton wool skull.



Solution to Question 6:

The given clinical scenario and X-ray showing ivory vertebrae is suggestive of Paget's disease. Paget's disease of the bone increases the risk of osteosarcoma and not osteochondroma.

Complications of Paget's disease are:

- Malignancy
- Osteosarcoma (most common)
- Fibrosarcoma
- Chondrosarcoma
- Sarcoma of myeloid and mesenchymal element
- Increased risk of fractures due to decreased bone strength
- Osteoarthritis
- Bony overgrowth leading to spinal stenosis and nerve compression
- High output cardiac failure due to increased blood flow to skeletal bones
- Hypercalcemia in patients with prolonged immobilization
- 2nd, 5th, 7th, and 8th cranial nerve palsies
- Deafness due to nerve compression & otosclerosis

Solution to Question 7:

The given clinical scenario and X-ray showing cotton wool skull and Tam O'Shanter appearance is suggestive of Paget's disease.

The rapid bone formation and resorption in Paget's disease can lead to increased blood flow within the bone and the surrounding tissues. This leads to increased warmth over the limbs. They may also have kyphosis and bowing of legs. Increased bone formation in Paget's disease may lead to the narrowing of the foramina of the skull. This causes compression of the cranial nerves which may lead to deafness.

Deafness due to the narrowing of cranial nerve foramina is also seen in osteopetrosis. However, it can be differentiated from Paget's disease by the absence of lytic lesions of the bone.

Solution to Question 8:

The radiological feature of hyperparathyroidism is subperiosteal bone resorption and not osteosclerosis.

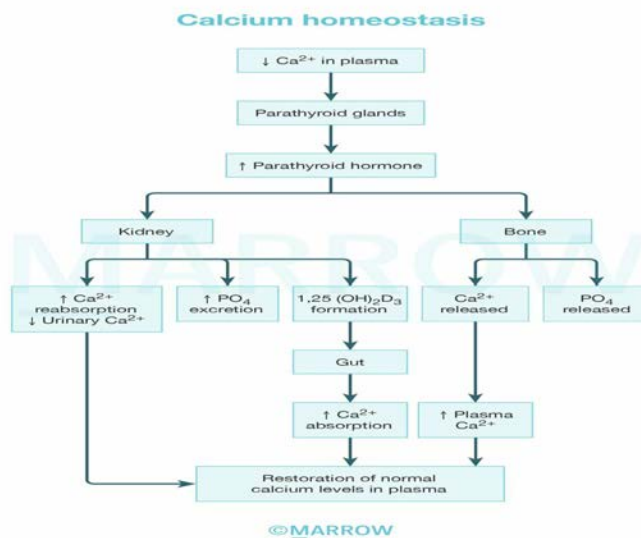
Osteosclerosis is a disorder that is characterized by abnormal hardening of bone and an elevation in bone density. It is seen in:

- Renal osteodystrophy
- Fluorosis
- Paget's disease of bone
- Osteogenic bone metastasis caused by carcinoma of prostate and breast
- Osteosclerosing types of chronic osteomyelitis
- Hypervitaminosis D

Solution to Question 9:

The parathyroid hormone does not increase calcium absorption from the intestine directly.

Parathyroid hormone (PTH) is produced by the parathyroid glands. It is regulated by the levels of serum ionized calcium. It stimulates the enzyme 1α -hydroxylase which converts 25-hydroxycholecalciferol to 1,25-dihydroxycholecalciferol (active form of vitamin D). It only increases the formation of vitamin D which increases calcium absorption from intestine.



Solution to Question 10:

The given clinical scenario is suggestive of hyperparathyroidism in which salt and pepper skull is a radiographical finding.

Option A: The cotton wool skull is seen in Paget's disease. It is due to thickened, disorganized bony trabeculae which appear as sclerosis on radiographs.

Option B: The geographic skull is seen in eosinophilic granuloma.

Option D: Multiple punched-out lesions are seen in multiple myeloma.

Note: Brown tumor in hyperparathyroidism is also known as Von Recklinghausen's disease of bone. Neurofibromatosis 1 is also known as Von Recklinghausen's disease.

Solution to Question 11:

The given clinical scenario and the X-ray showing subperiosteal bone resorption in the radial aspect of middle phalanges is suggestive of hyperparathyroidism.

Hyperparathyroidism presents with the classical findings of "bones, stones, groans, moans with fatigue overtones" which occur as a consequence of hypercalcemia.

Though multiple myeloma and metastatic disease also present with hypercalcemia, subperiosteal bone resorption is pathognomonic of hyperparathyroidism. Normal levels of PTH can help in differentiating these conditions from hyperparathyroidism.

Solution to Question 12:

The radiograph given above shows a rugger jersey spine which is a characteristic feature of renal osteodystrophy. The given clinical scenario is suggestive of renal osteodystrophy which is caused by hyperparathyroidism secondary to chronic renal disease.

Rugger jersey appearance is seen due to osteosclerosis of the superior and inferior vertebral endplates. This occurs due to excess osteoid formation by the osteoblasts to counteract increased bone resorption. The term rugger jersey appearance is used because there are alternating bands of increased and decreased bone density, similar to the jersey of a rugby player.



Solution to Question 13:

The given clinical scenario and the X-ray showing interosseous membrane ossification is suggestive of fluorosis.

Fluorosis first starts as mottling of the enamel of upper incisors. Fluorine stimulates osteoblastic activity and fluorapatite crystals are laid down in the bone. These are usually resistant to secondary osteoclastic resorption. This leads to calcium retention, osteosclerosis, and development of osteophytes. Ossification of ligaments and fascial attachments is characteristic of this condition.

Solution to Question 14:

Hyperparathyroidism is associated with sub-periosteal bone resorption and not a new bone deposition.

The subperiosteal new bone deposition is an important feature of both fluorosis and Caffey's disease.

Caffey's disease also known as infantile cortical hyperostosis is a self-limiting disorder. Classically the onset of the disease occurs before the 5th month of life. It is characterized by

- Soft tissue swelling
- Rapid sub-periosteal new bone formation
- Cortical thickening of underlying bones

Solution to Question 15:

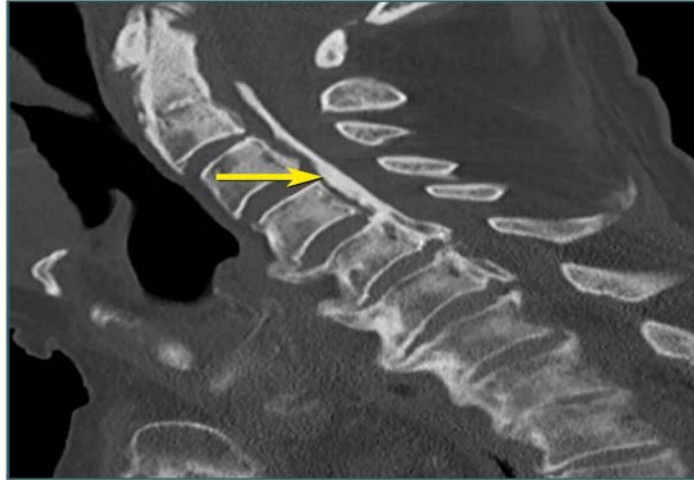
The given clinical scenario and CT of cervical spine showing ossified posterior longitudinal ligament is suggestive of fluorosis. Fluorine stimulates osteoblastic activity and fluorapatite crystals are laid down in bone. These are resistant to osteoclastic resorption.

Fluorosis is a disease where excessive deposition of calcium occurs in bone and soft tissues. This leads to calcium retention, impaired mineralization and secondary hyperparathyroidism.

The characteristic pathology involves sub-periosteal new bone formation, osteosclerosis and hyperostosis at the bony attachments of ligaments, tendons, and fascia. It is most commonly seen vertebrae, ribs and pelvis.

The CT scan given below shows ossified posterior longitudinal ligament.

Ossified posterior longitudinal ligament



Solution to Question 16:

The given clinical scenario is suggestive of hypervitaminosis A.

Hypervitaminosis A more commonly occurs in children following excessive intake. It also occurs in adults who consume polar bear livers. An increased vitamin A level in the body can manifest in the form of pseudotumor cerebri (idiopathic intracranial hypertension). X-ray shows increased density in metaphyseal region due to excessive mineralization of bone.

Note: Hypervitaminosis D also causes metabolic bone disease.

Solution to Question 17:

Eosinophilic granuloma is the least likely cause of multiple lytic lesions in the skull of an elderly woman. It is a very rare benign bone tumor which presents in the younger age group (5-15 years).

Rheumatoid Arthritis and Osteoarthritis

Question 1:

What is the most common form of arthritis?

- a) Rheumatoid arthritis
- b) Psoriatic arthritis
- c) Seronegative arthritis
- d) Osteoarthritis

Question 2:

A 35-year-old man comes with a history of musculoskeletal pain. Which of the following suggests that the pain is non-articular?

- a) Swelling
- b) Pain in both movement and at rest
- c) Painless on passive movement
- d) Presence of crepitation

Question 3:

Which is the first joint to be involved in rheumatoid arthritis?

- a) Knee joint
- b) Joints of the hands
- c) Wrist joint
- d) Ankle joint

Question 4:

Which of the following is the earliest radiological feature in rheumatoid arthritis?

- a) Erosion of articular margins
- b) Asymmetric joint space loss

- c) Juxta-articular osteopenia
- d) Subchondral cysts

Question 5:

Which of the following lesions is not seen in patients with rheumatoid arthritis?

- a) Trigger finger
- b) Ulnar deviation
- c) Heberden nodes
- d) Intrinsic plus hand

Question 6:

A middle-aged woman who is being treated for rheumatoid arthritis, presented with muscle weakness and rigidity in her upper limbs. Which of the given X-ray views should be performed to evaluate her condition?

- a) Spine in lateral flexion & extension view
- b) Open mouth view
- c) Swimmer's view
- d) Schuller's view

Question 7:

Which of the following is likely to be seen in a patient with rheumatoid arthritis of the knee?

- a) Genu valgum
- b) Osteophytes
- c) Stiff and hard joints
- d) Subchondral sclerosis

Question 8:

What is the most common pulmonary manifestation of rheumatoid arthritis?

- a) Pleuritis

- b) Pulmonary nodules
- c) Interstitial lung disease
- d) Caplan's syndrome

Question 9:

Rheumatoid arthritis management in a patient with deformity is:

- a) Steroids
- b) Methotrexate with steroids
- c) Methotrexate with anti-TNF
- d) Steroids only after NSAIDs fail

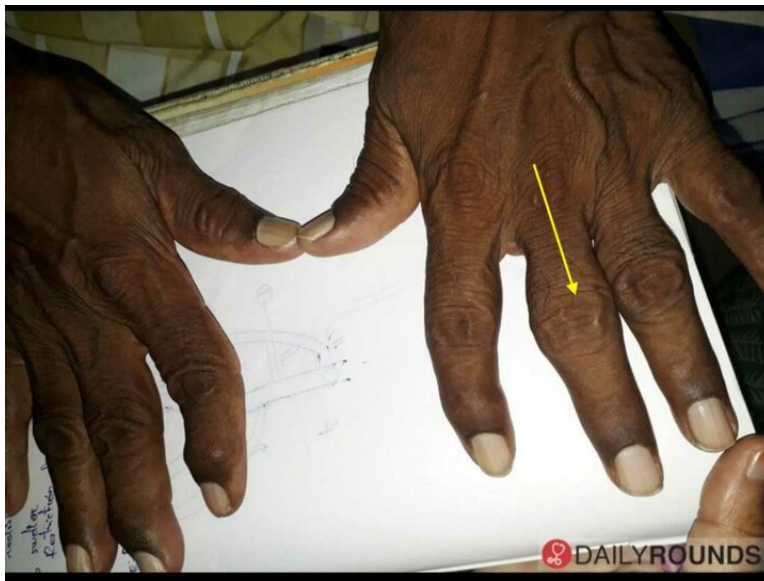
Question 10:

Where is the earliest pathological change in osteoarthritis seen?

- a) Joint capsule
- b) Synovium
- c) Subchondral bone
- d) Articular cartilage

Question 11:

A 55-year-old woman diagnosed with osteoarthritis of the knee came for a follow-up visit. On examination, the following findings were noted. Identify the marked lesion.



- a) Heberden's nodes
- b) Bouchard's nodes
- c) Osler's nodes
- d) Virchow's nodes

Question 12:

An X-ray of a patient who presented with knee pain is shown below. What is the finding depicted by black arrows?



- a) Narrowing of joint space

- b) Subchondral sclerosis
- c) Loose body
- d) Osteophyte formation

Question 13:

An 85-year-old woman presented with pain and swelling in the left shoulder for 1 month. The X-ray showed complete destruction of the humeral head. Arthrocentesis yielded a hemorrhagic noninflammatory fluid. The synovial fluid culture was negative. What is the most probable diagnosis?

- a) Septic arthritis
- b) Kashin Beck's disease
- c) Milwaukee's shoulder
- d) Diffuse idiopathic skeletal hyperostosis

Question 14:

A 62-year-old woman presented with pain and swelling over the knee joint. She also complained of stiffness of the knee after a period of rest. An X-ray was taken as shown below. Which of the following muscles is most likely to undergo atrophy in this patient?



- a) Quadriceps
- b) Hamstrings
- c) Popliteus

d) Adductor muscles

Question 15:

A patient presented with pain in the hand. The joints involved were proximal interphalangeal joint, distal interphalangeal joint and first carpometacarpal joint. The wrist and metacarpophalangeal joints were spared. What is the likely diagnosis?

- a) Osteoarthritis
- b) Rheumatoid arthritis
- c) Psoriatic arthritis
- d) Pseudogout

Answer Key

Question No.	Correct Option
1	d
2	c
3	b
4	c
5	c
6	a
7	a
8	a
9	c
10	d
11	b
12	b
13	c
14	a
15	a

Detailed Explanations

Solution to Question 1:

Osteoarthritis is the most common type of arthritis.

Osteoarthritis is strongly associated with age and is highly prevalent among older individuals. Studies suggest that over 80% of people aged 55 and above have osteoarthritis in at least one joint.

Solution to Question 2:

Non-articular disorders tend to be painless on passive movement.

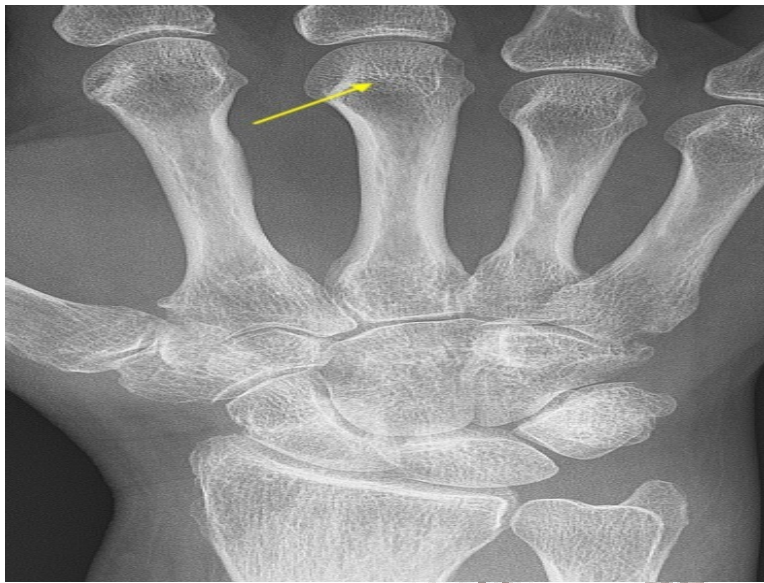
Feature	Articular	Non-articular
Structures involved	Synovium, synovial fluid, articular cartilage, intraarticular ligaments, joint capsule, and juxta-articular bone	Extraarticular ligaments, tendons, bursae, muscles, fascia, bone, nerves, and overlying skin
Pain	Deep or diffuse	Localized
Pain with movement	Both on active and passive movement	Only on active movement
Swelling	Present	Absent
Crepitation	Present	Absent
Instability	Present	Absent
Deformity	Present	Absent
Examples	Osteoarthritis, infectious arthritis, ankylosing spondylitis	Fibromyalgia, myofascial pain, acute muscle strain, myotonic dystrophy

Solution to Question 3:

The first joints to be involved in rheumatoid arthritis are the small joints of the hands and feet (MCP, PIP, and MTP).

Solution to Question 4:

The earliest feature of rheumatoid arthritis X-ray is juxta-articular osteopenia (shown below).



Other radiological features of RA:

- Erosion of articular margins
- Subchondral cyst
- Soft tissue swelling due to joint effusion
- Deformities of hand and fingers

The image below shows an X-ray of RA of the shoulder joint with the erosion of articular margins (arrows) and joint space narrowing.



Solution to Question 5:

Heberden nodes are not seen in rheumatoid arthritis, but in osteoarthritis.

They are knob like appearance of DIP due to the formation of osteophytes and tissue swelling.
The images below show the clinical and X-ray appearances of Heberden nodes in OA.



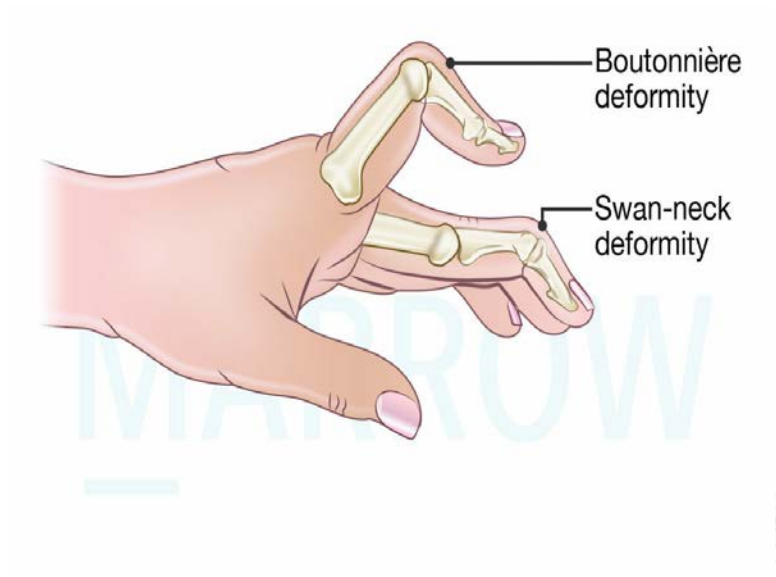
Deformities seen in RA:

The image below shows the clinical and X-ray appearance of swan-neck deformity.



The images below show the boutonniere deformity.

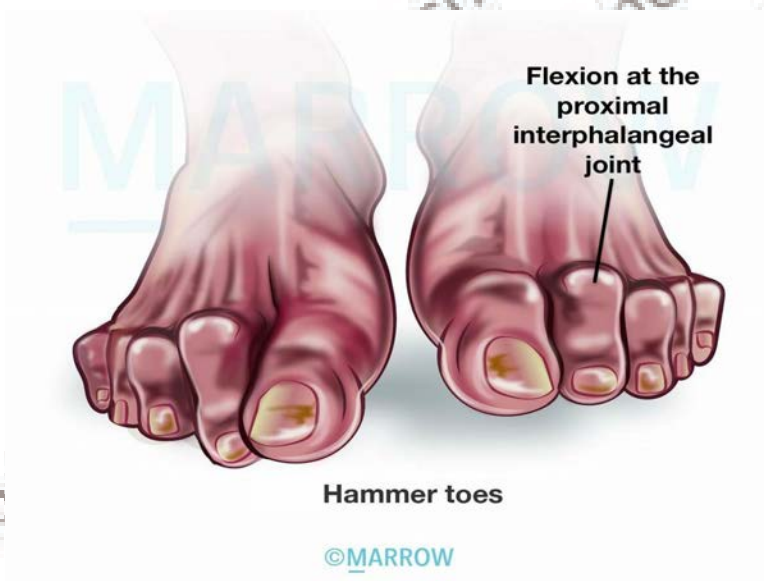




The image below shows the Z-deformity.



The images below show hammertoe.



Solution to Question 6:

The patient with rheumatoid arthritis presents with signs of UMN lesion, indicating spinal cord involvement due to atlantoaxial instability (excessive movement between C1 and C2). An X-ray of the spine in lateral flexion and extension view is required for further evaluation.

Open mouth view is also for the atlantoaxial area, but will not demonstrate instability.

Solution to Question 7:

Genu valgum is seen in rheumatoid arthritis of the knee. All other options are features of osteoarthritis of the knee.

Rheumatoid arthritis of the knee can also present as triple and quadruple deformity of the knee:

- Triple deformity of the knee - flexion + posterior subluxation + external rotation (commonly seen)
- Quadruple deformity of the knee - triple deformity + valgus

Osteoarthritis of the knee	Rheumatoid arthritis of knee
Genu varum more common	Genu valgum more common
Subchondral sclerosis	Periarticular osteopenia
No soft tissue swelling	Soft tissue swelling (pannus)
Osteophytes	No osteophytes
Hard and bony joint	Soft, warm, and tender joint
Rheumatoid factor negative	Rheumatoid factor positive

Solution to Question 8:

The most common pulmonary manifestation of rheumatoid arthritis is pleuritis.

The image below shows pleural effusion secondary to pleuritis in a patient with rheumatoid arthritis.



Solution to Question 9:

Methotrexate with anti-TNF is superior to any other treatment in limiting progression of joint destruction and disability.

In rheumatoid arthritis (RA) joint inflammation is the main cause of joint damage and is the most important factor of joint disability and deformities.

Methotrexate belongs to the category of drugs known as disease-modifying antirheumatic drugs (DMARDs). They slow down or prevent the structural progression of RA and hence are used in most combination therapies. Among the DMARDs, methotrexate is the preferred first-line drug.

Biologic DMARDs such as anti-TNF agents target cytokines and cell-surface molecules to slow the progression of joint inflammation. These drugs are typically used in combination with background methotrexate therapy.

Combination therapy with methotrexate and an anti-TNF drug is the most commonly used next step for the treatment of patients with deformities, having an inadequate response to methotrexate therapy.

Steroids are used when rapid control of the disease is required. They have a rapid onset of action, while the DMARDs take anywhere from 6-12 weeks to come into effect. They can be used as a cover during this period. Steroids can also be used in short courses for acute flare-up episodes of RA. Long-term use of steroids is not advised due to their adverse effects such as osteoporosis. They are usually not used alone (option A) but are used as an adjunct to DMARDs like methotrexate (option B).

Nonsteroidal anti-inflammatory drugs (NSAIDs) are used as adjunctive therapy for the management of uncontrollable symptoms because of their analgesic and anti-inflammatory properties. Chronic use is not advised due to their side effects namely gastritis and peptic ulcer disease as well as impairment of renal function (option D)

Hence, among the given options methotrexate with anti-TNF is the best therapy in a patient with deformity.

Solution to Question 10:

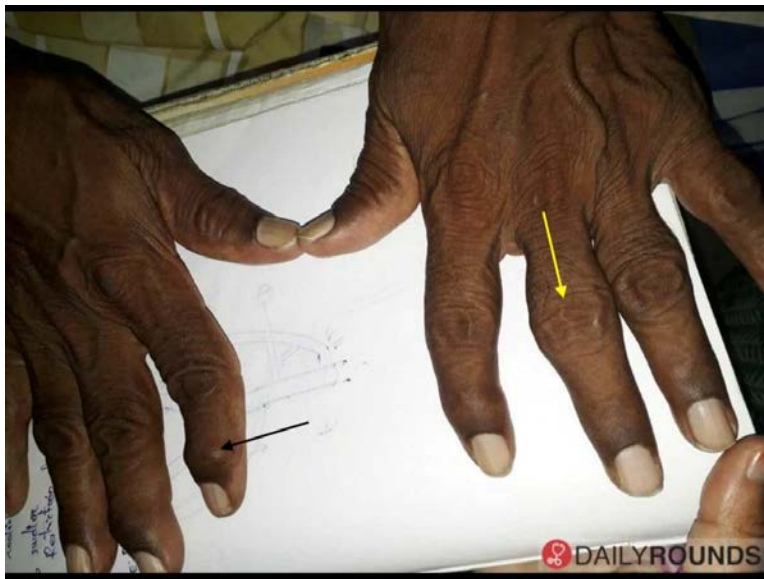
The earliest pathological change in osteoarthritis is commonly seen in the articular cartilage, which is asymmetrical hyaline articular cartilage loss.

Solution to Question 11:

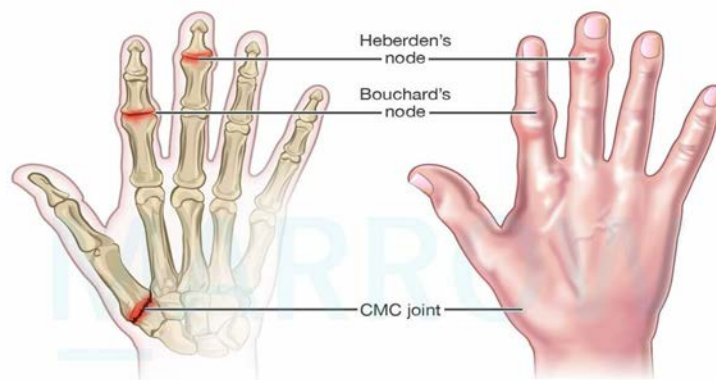
The above image showing the knob-like appearance of the proximal interphalangeal joints (PIP) in a patient with OA is suggestive of Bouchard's nodes. They are formed due to the formation of osteophytes and tissue swelling.

Heberden's nodes develop in distal interphalangeal joints (DIP).

The images below show Bouchard's (yellow arrow) and Heberden's nodes (black arrow).



Bouchard's and Heberden's nodes



©Marrow

Solution to Question 12:

The arrows in the plain radiograph given above show subchondral sclerosis.

It refers to a denser area of bone just under the cartilage of the joint, appearing as abnormally white bone along the joint line. It is seen in osteoarthritis.

Radiographic features of osteoarthritis:

- Localized joint space narrowing (blue arrows in the image below)
- Subchondral cysts and sclerosis (black arrows in the image below)
- Marginal osteophytes (yellow arrow in the image below)



- Loose bodies and chondrocalcinosis
- Central or subchondral erosions give rise to the seagull wing appearance (as shown below).



Solution to Question 13:

The above scenario is suggestive of Milwaukee's shoulder.

It is a rapidly progressive destructive osteoarthritis with extensive bone loss, such that the whole head of the humerus disappears. There is the rapid destruction of the rotator cuff and the glenohumeral joint.

It is characterized by Intraarticular or periarticular hydroxyapatite crystals.

Synovial fluid can be stained by alizarin red staining. It is often hemorrhagic with low cellularity (<2000 leucocytes/mL) cells.

Solution to Question 14:

The above scenario along with the X-ray showing joint space narrowing and osteophytes is suggestive of osteoarthritis of the knee. Quadriceps are the most common muscle to undergo atrophy and wasting in a case of osteoarthritis of the knee joint.

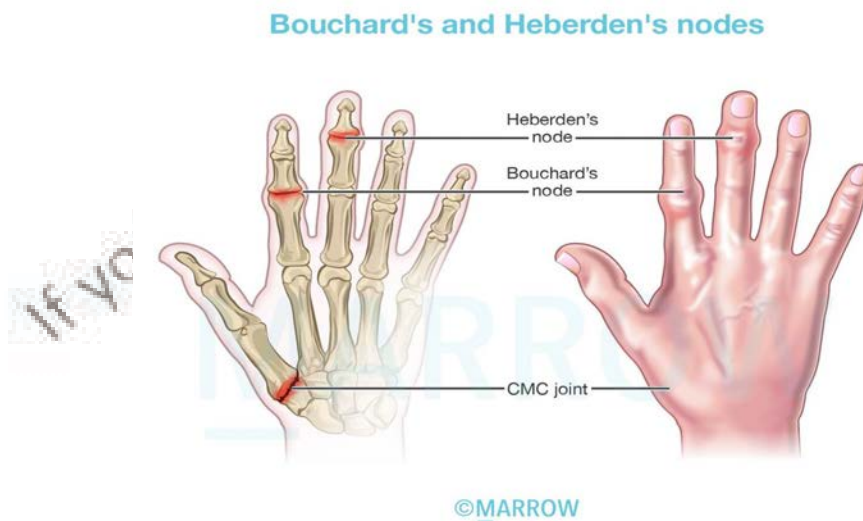
The vastus medialis is the commonest muscle to atrophy amongst the quadriceps following neurologic disease or musculoskeletal injury.

Solution to Question 15:

The most likely diagnosis is osteoarthritis (OA) of the hand.

In OA of the hand, the joints involved are the distal and proximal interphalangeal joints (DIP & PIP), and the first carpometacarpal joint (base of the thumb), while the metacarpophalangeal (MCP) joint, wrist, elbow, and ankle are usually spared.

The nodules palpable in the DIP are called Heberden's nodes, while those palpable in the PIP are called Bouchard's nodes.



The image below shows OA of the hand:



Other options:

Option B: There is relative sparing of the DIP joint in rheumatoid arthritis.

Option C: Psoriatic arthritis of the hands commonly involves the PIP, DIP, and metacarpophalangeal joints.

Option D: In pseudogout, the knee joint is most commonly affected, followed by the wrist, while the first metatarsophalangeal joint (podagra) is rarely affected.

*If you purchased this from somewhere else,
you may have been scammed.*

Spondyloarthropathies and Crystal arthropathies

Question 1:

Which of the following is not a seronegative spondyloarthropathy?

- a) Ankylosing spondylitis
- b) Rheumatoid arthritis
- c) Reactive arthritis
- d) Psoriatic arthritis

Question 2:

A 55-year-old woman presented with low back pain for 3 months. An X-ray of the lumbosacral spine was taken as shown below. Identify the skeletal abnormality seen and the likely diagnosis.



- a) Ivory vertebra - Paget's disease
- b) Codfish vertebra - Osteoporosis
- c) Bamboo spine - Ankylosing spondylitis
- d) Corduroy vertebra - IBD associated arthritis

Question 3:

A 34-year-old man presented with on-and-off low back pain and early morning stiffness for 2 years. X-ray spine showed squaring of the lumbar vertebra and erosion of the sacroiliac joints. He is at an increased risk of developing all of the following except:

- a) Anterior uveitis
- b) Inflammatory bowel disease
- c) Hyperparathyroidism
- d) Aortic regurgitation

Question 4:

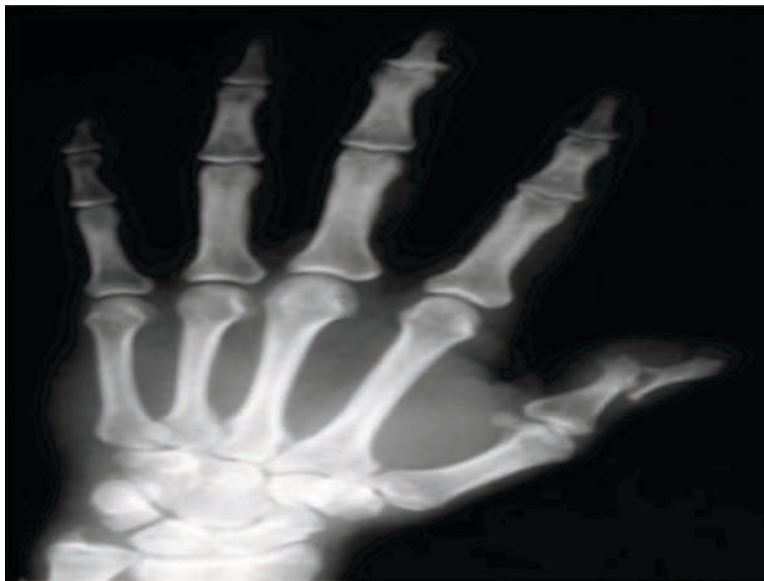
A 37-year-old man presented with pain and swelling in the finger of the right hand. Appearance on examination and X-ray is shown below. Which of the following criteria aids in the diagnosis of this condition?



- a) EULAR
- b) SLICC
- c) CASPAR
- d) ASAS

Question 5:

What is the likely diagnosis from the X-ray shown below?



- a) Ankylosing spondylitis
- b) Psoriatic arthritis
- c) Rheumatoid arthritis
- d) Enteropathic arthritis

Question 6:

A boy is brought with complaints of pain and deformity of the right knee. He is a known case of severe hemophilia A. On examination, a boggy swelling is noticed over the right knee. Which of the following is least likely to be found on radiography of the right knee?



- a) Subchondral bone cyst

- b) Subchondral thinning
- c) Juxta-articular osteosclerosis
- d) Increase in intercondylar distance

Question 7:

Which is the most common joint/(s) to be affected by neuropathic arthritis in patients with diabetes mellitus?

- a) Knee
- b) Shoulder
- c) Hip
- d) Tarsal

Question 8:

Which is the most common joint/(s) involved in pseudogout?

- a) Metatarsophalangeal joint
- b) Ankle joint
- c) Knee joint
- d) Metacarpophalangeal joint

Question 9:

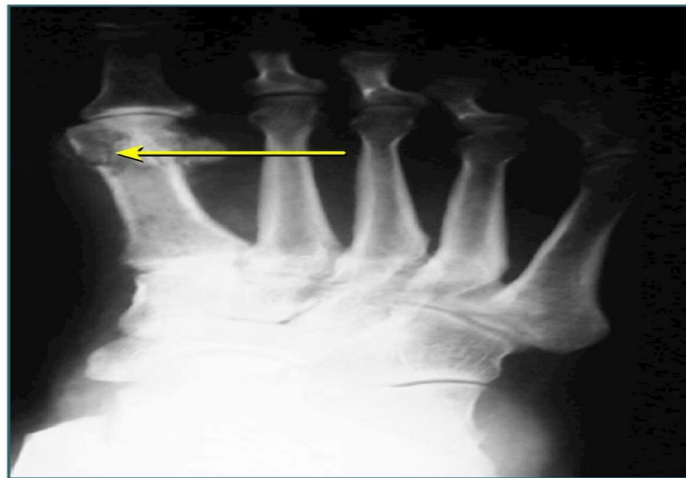
A 55-year-old man presents to the OPD with sudden onset of swelling and pain around the great toe. He gives a history of similar episodes in the past. Synovial fluid is aspirated and light microscopy findings are shown below. Which of the following is not a precipitating factor for this condition?



- a) Excess alcohol intake
- b) Myocardial infarction
- c) Trauma
- d) Bleeding

Question 10:

What does the arrow in the X-ray given below indicate?



©MARROW

- a) Martel's sign
- b) Bony ankylosis

- c) Comolli's sign
- d) Periarticular osteoporosis

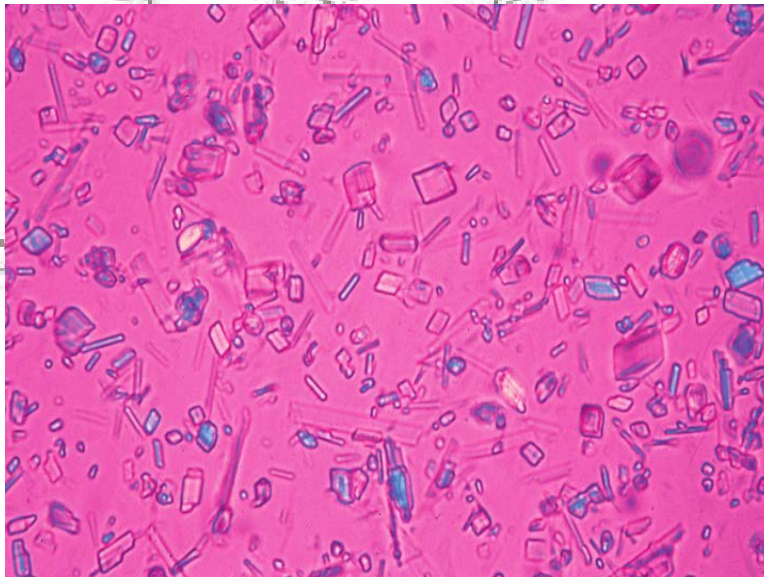
Question 11:

A 44-year-old woman presents with right knee swelling. On synovial fluid examination, showed calcium pyrophosphate crystals. What is the next best investigation?

- a) ANA
- b) RF
- c) CPK
- d) TSH

Question 12:

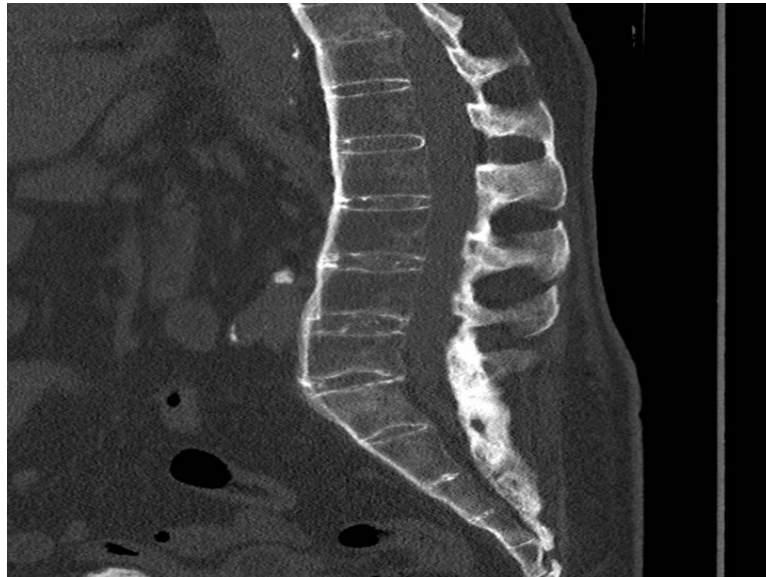
An elderly man has pain and swelling in the knee joint. Synovial fluid on polarized light microscopy demonstrated the following. What is the likely diagnosis?



- a) Osteoarthritis
- b) Pseudogout
- c) Gout
- d) Rheumatoid arthritis

Question 13:

A 40-year-old man is suffering from increasing difficulty in bending forward with increasing stiffness of the spine and reduced chest movements. A CT was performed and shown below, the likely diagnosis is?



- a) Ankylosing spondylitis
- b) Rheumatoid arthritis
- c) Reiter's syndrome
- d) Fluorosis

Answer Key

Question No.	Correct Option
1	b
2	c
3	c
4	c
5	b
6	c
7	d
8	c
9	d
10	a
11	d

12	b
13	a

Detailed Explanations

Solution to Question 1:

Rheumatoid arthritis is not a seronegative arthritis as it is associated with the presence of autoantibodies (rheumatoid factor) in the blood.

Seronegative spondyloarthropathies are associated with:

- Absence of autoantibodies
- Involvement of the spine
- Increased incidence in young individuals
- HLA B-27

They include:

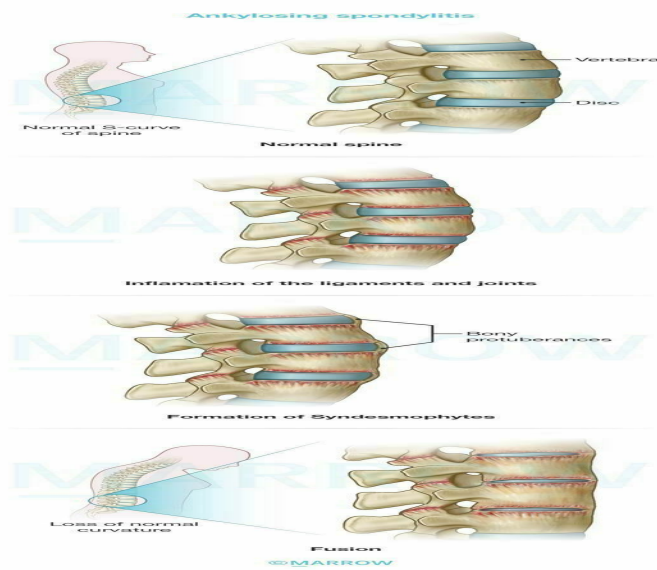
- Ankylosing spondylitis
- Psoriatic arthritis
- Reactive arthritis
- Enteropathic arthritis

Solution to Question 2:

The above lateral view X-ray view shows the bamboo spine appearance. It is seen in ankylosing spondylitis.

It is due to the ossification of the annulus fibrosis, sparing the anterior longitudinal ligament and disc.

The image below shows the pathogenesis of ankylosing spondylitis.



Other named vertebral abnormalities:

Vertebral abnormality	Associated condition
Bamboo spine	Ankylosing spondylitis
Ivory vertebra	Paget's disease
Codfish vertebra	Osteoporosis
Rugger jersey spine	Renal osteodystrophy
Corduroy vertebra	Hemangioma
Picture frame vertebra	Paget's disease

Solution to Question 3:

The above scenario is suggestive of ankylosing spondylitis. Hyperparathyroidism is not an extra-articular manifestation of ankylosing spondylitis.

The extra-articular manifestations of ankylosing spondylitis are a consequence of uncontrolled systemic inflammation. They include:

- Eye - Anterior uveitis (commonest overall) , glaucoma
- Renal - IgA nephropathy, secondary amyloidosis
- Cardiac - Aortic regurgitation, aortitis, carditis, conduction defects
- Respiratory - Upper lobe pulmonary fibrosis, pleural thickening
- Neurological - Cauda equina syndrome

- GIT - Inflammatory bowel disease
- Diffuse osteoporosis

Solution to Question 4:

The above scenario is suggestive of psoriatic arthritis. The CASPAR criteria is used to make the diagnosis.

Image A shows psoriatic nail dystrophy and image B shows the arthritic changes with evidence of new bone formation in the 4th DIP on X-ray.

The CASPAR criteria includes:

- Evidence of current psoriasis, a personal history of psoriasis, or a family history of psoriasis
- Typical psoriatic nail dystrophy observed on the current physical examination
- A negative test result for rheumatoid factor
- Either current dactylitis or a history of dactylitis
- Radiographic evidence of juxta-articular new bone formation in the hand or foot

Only current psoriasis is assigned 2 points; all other features are assigned 1 point. To meet the criteria, a patient must have an inflammatory articular disease (joint, spine, or enthesal) with ≥ 3 points from the above five categories.

Other commonly used criteria include:

- EULAR - Rheumatoid arthritis
- SLICC - Systemic lupus erythematosus
- ASAS - Ankylosing spondylitis

Solution to Question 5:

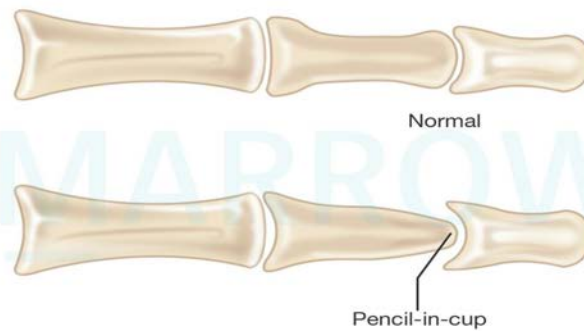
The above image shows the classic 'pencil-in-cup deformity' of psoriatic arthritis with subluxation of the thumb.

These changes occur due to periarticular erosion and bony resorption.

The images below shows the pencil-in-cup deformity in psoriatic arthritis.



Pencil-in-cup Deformity in Psoriatic Arthritis



©Marrow

Other deformities in psoriatic arthritis:

- Marginal erosions with the adjacent bony proliferation
- Small joint ankylosis and osteolysis of phalangeal and metacarpal bones
- Telescoping of digits, periostitis, and proliferative new bone
- Axial changes like asymmetric sacroiliitis

Psoriatic arthritis of the hands commonly involves proximal and distal interphalangeal joints (PIP, DIP) and metacarpophalangeal joints (MCP).

The image below shows psoriatic arthritis of the hands.

Psoriatic arthritis involving the distal interphalangeal joint



Solution to Question 6:

The above scenario is suggestive of hemophilic arthritis. Juxta-articular osteopenia is seen in hemophilic arthritis, not juxta-articular osteosclerosis.

It is caused due to repeated hemarthrosis into the joint leading to chronic synovitis and articular cartilage erosion.

Other radiological features include:

- Soft tissue swelling
- Increase in intercondylar distance
- Subchondral thinning
- Subchondral bone cyst
- Hemophilic pseudotumors

Solution to Question 7:

Tarsal and tarsometatarsal joints are affected in neuropathic arthritis associated with diabetes mellitus.

Solution to Question 8:

Most common joint affected in pseudogout is the knee joint.

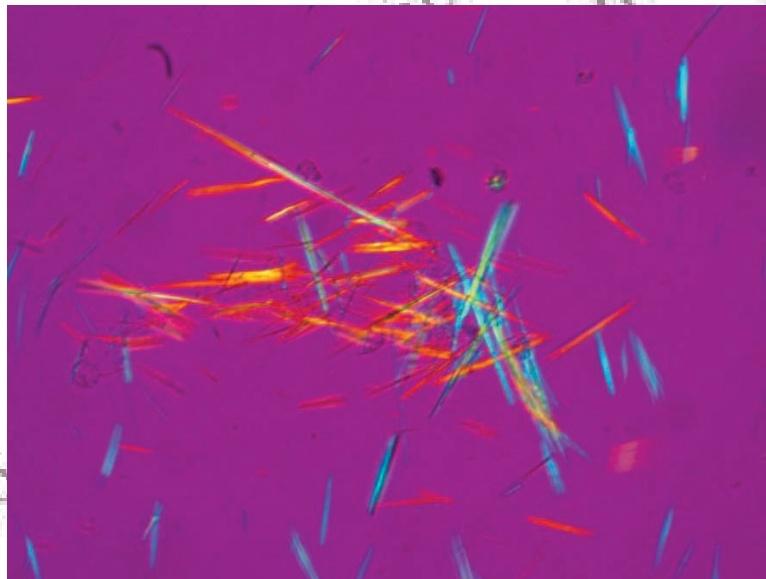
Solution to Question 9:

The above image shows needle-shaped crystals of monosodium urate (MSU) monohydrate seen in gout. Bleeding is not a precipitating factor for gout.

The precipitating factors for gout include:

- Dietary excess
- Trauma
- Surgery
- Excessive ethanol ingestion
- Hypouricemic therapy
- Serious medical illness e.g., MI, stroke

On polarized microscopy, the crystals appear as negatively birefringent yellow needles (as shown below).



Solution to Question 10:

The image shows Martel's sign (G-sign) which is periarticular erosions with overhanging margins. It is a radiographic finding in gout.

The X-ray findings in gout are:

- Acute attack - soft tissue swelling.
- Chronic gout - joint space narrowing and secondary osteoarthritis.
- Tophi - characteristic punched out cysts or deep erosions with overhanging bony edges (Martel's sign or G sign).

Comolli's sign refers to a triangular swelling corresponding to the outline of the scapula seen in scapular fracture.

Solution to Question 11:

The above scenario is suggestive of pseudogout. Secondary calcium pyrophosphate deposition is associated with hypothyroidism, hence TSH level should be assessed next.

Common associations of pseudogout are:

- Hypothyroidism
- Hypophosphatasia
- Hemochromatosis
- Hyperparathyroidism

Solution to Question 12:

The above image shows positively birefringent rhomboid-shaped crystals that are seen in pseudogout.

Crystals on polarised microscopy	
Gout	Pseudogout
Negatively birefringent	Positviely birefringent
Needle shaped	Rhomboid crystals
Na Urate (sodium urate)	Ca pyrophosphate

Solution to Question 13:

The given clinical scenario of a 40-year-old man with increasing stiffness in the spine, along with CT spine showing ossification of the anterior longitudinal ligament and ankylosis involving the thoracolumbar vertebral bodies points to a diagnosis of ankylosing spondylitis (AS).

AS is a chronic inflammatory disease affecting the spine and sacroiliac joint. It is more common in young males and has a strong association with HLA-B27.

Features of lower back pain in AS:

- Age at onset < 40 years
- Insidious onset
- Morning stiffness > 30 minutes
- Improvement with exercise
- Pain persists with rest and is also present at night.

- Alternating gluteal pain
- Persistence for more than 3 months

Examination findings in AS:

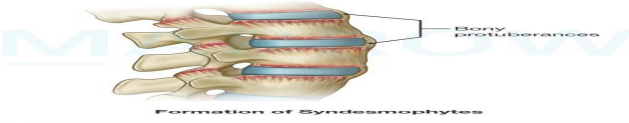
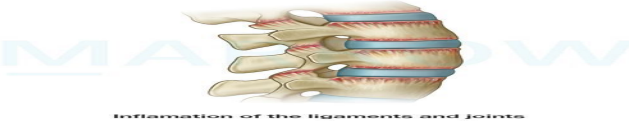
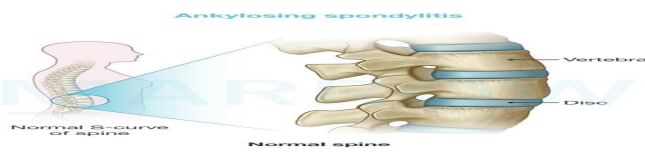
- Loss of lumbar lordosis
- Increased thoracic kyphosis
- Diminished spinal movements
- Decreased chest expansion (<7 cm)
- Tenderness over sacroiliac joints

Important X-ray features of ankylosing spondylitis:

- Sacro-iliac joints:
 - Cardinal sign/earliest sign is the erosion and fuzziness of the sacroiliac joints
 - Later- periarticular sclerosis and bony ankylosis of the joint.
- Vertebral changes:
 - Early spondylitis is characterized by small erosions at the corners of vertebral bodies with reactive sclerosis: Romanus lesions of the spine (Shiny corner sign)
 - Squaring of vertebral bodies or flattening of the normal anterior concavity of the spine due to inflammatory resorption of the bone.
 - Later signs are ossification of the ligaments around the intervertebral discs producing syndesmophytes (bridges) between adjacent vertebrae
 - Bamboo spine appearance is due to bridging at several vertebral levels
 - Linear ossification along the central spine, representing interspinous ligament ossification can give a Dagger sign appearance on frontal radiographs.

CT imaging in AS helps to visualize bone erosions, osteoporosis/osteosclerosis, and new bone formation in the form of syndesmophytes, ligamentous ossification, and ankylosis.

The X-ray below shows the bamboo spine appearance in AS:



Nerve Injuries

Question 1:

A man, after sleeping the whole night with his arm hanging over the back of the chair wakes up with an inability to extend his wrist. What is the mechanism behind this phenomenon?

- a) Neurotmesis
- b) Neurolysis
- c) Axonotmesis
- d) Neuropraxia

Question 2:

In which of the following types of nerve damage would the sprouting axons form an end neuroma?

- a) Neurotmesis
- b) Axonotmesis
- c) Neuropraxia
- d) Neurolysis

Question 3:

Choose the wrong match among the following muscles wasted and associated nerve injuries:

- a) Atrophy of hypothenar eminence - Ulnar nerve
- b) Atrophy of thenar eminence - Median nerve
- c) Hollowing between metacarpals - Ulnar nerve
- d) Calf wasting - Femoral nerve

Question 4:

A throw ball player presents to the emergency room with pain over the shoulder. On examination, his arm is abducted and externally rotated. There is a loss of sensation over the proximal lateral aspect of the arm. Which of the following nerve injuries is likely associated

with this condition?

- a) Lateral cutaneous nerve of arm
- b) Radial nerve
- c) Axillary nerve
- d) Musculocutaneous nerve

Question 5:

A newborn baby is found to have deformity as shown in the image. Which of the following findings would you not expect in him?



- a) Loss of abduction of the arm
- b) Loss of lateral rotation of the arm
- c) Loss of sensation in the lateral 2 fingers
- d) Loss of flexion of the elbow

Question 6:

Which of the following is seen in Klumpke's paralysis?

- a) Loss of sensation along lateral forearm
- b) Loss of flexion of forearm
- c) Claw hand deformity
- d) C5 nerve root is affected

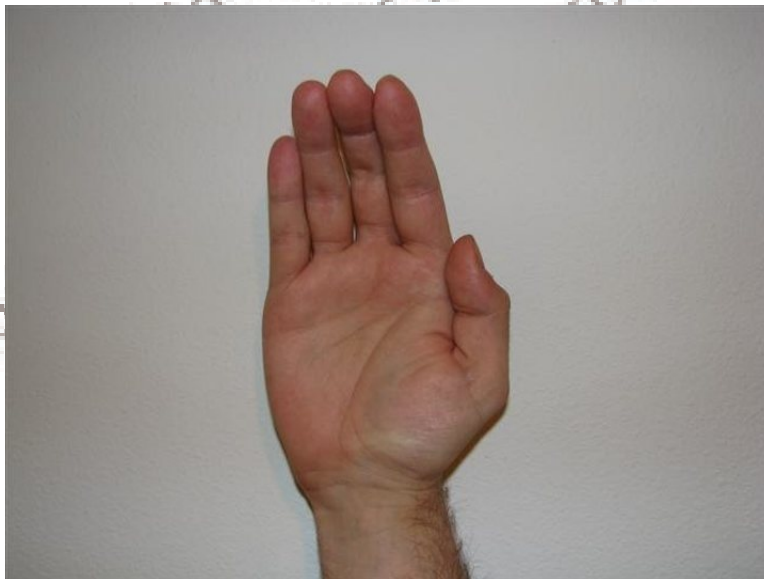
Question 7:

Following anterior dislocation of the shoulder, a patient develops weakness of flexion at elbow and lack of sensation over the lateral aspect of forearm. Which of the following nerves is injured?

- a) Radial nerve
- b) Axillary nerve
- c) Musculocutaneous nerve
- d) Lateral cutaneous nerve of forearm

Question 8:

A person presents with the deformity shown in the picture and is unable to move the thumb away from the rest of the hand. Which of the following nerves is injured?



- a) Ulnar nerve
- b) Median nerve
- c) Posterior interosseous nerve
- d) Radial nerve

Question 9:

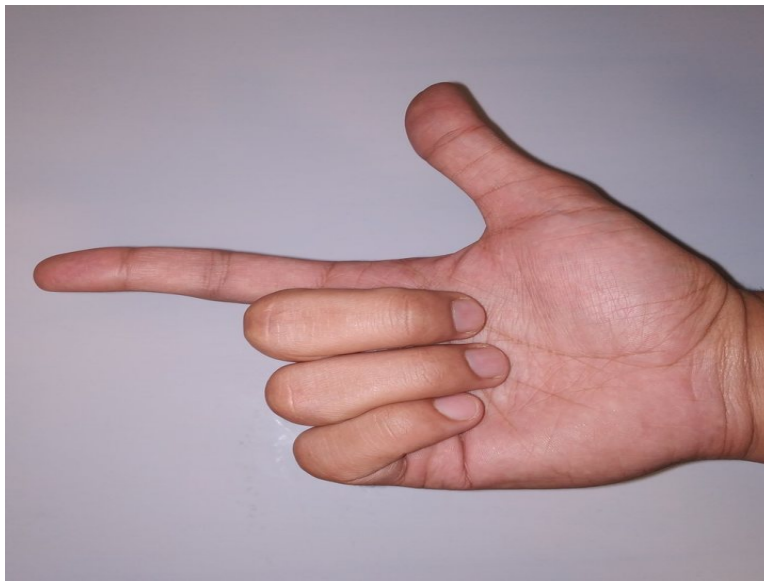
A 60-year-old man who is known to have end-stage renal disease comes to the OPD for follow-up. He says that he has been having a burning type of pain mainly over the first, second, and third digits. Examination shows the below findings. Which of the following is true about this condition?



- a) Can be confirmed by X ray
- b) Tinel's sign is negative
- c) Not associated with hypothyroidism
- d) Median nerve is involved

Question 10:

While examining a patient with a right forearm fracture, you ask him to make a fist. The following finding is noted during this procedure. Which of the following nerves is injured?



- a) Radial nerve
- b) Median nerve
- c) Ulnar nerve
- d) Posterior interosseous nerve

Question 11:

Which of the following findings would you expect to see in patients with median nerve palsy?

- a) Positive Egawa's test
- b) Wartenberg's sign
- c) Positive book test
- d) Positive pen test

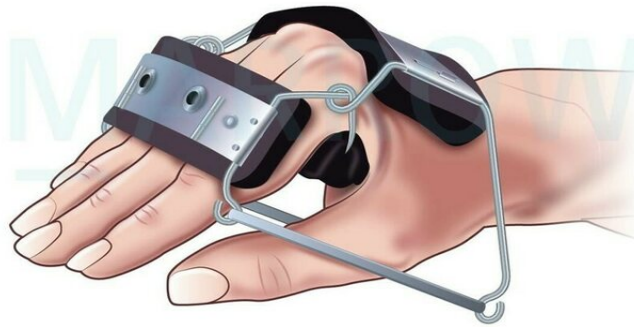
Question 12:

Tardy ulnar nerve palsy is associated with which of the following conditions?

- a) Cubitus valgus
- b) Cubitus varus
- c) Excision of elbow joint
- d) Fracture of internal condyle

Question 13:

The splint shown in the image is used in the palsy of which nerve?



- a) Radial nerve
- b) Median nerve
- c) Ulnar nerve
- d) Posterior interosseous nerve

Question 14:

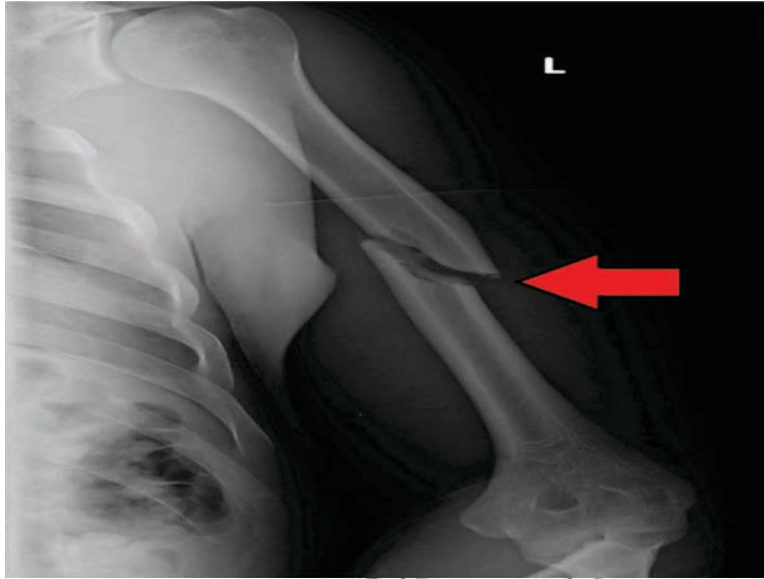
A woman presented with complaints of weakness of the right hand. History is significant for a Monteggia fracture-dislocation a few years back. On examination, she is not able to extend her metacarpophalangeal joints but she can extend the wrist joint. There was no sensory loss. Which of the following nerves is injured?

- a) Ulnar nerve
- b) Radial nerve
- c) Median nerve
- d) Posterior interosseus nerve

Question 15:

A patient is brought to the casualty after a fall on an outstretched hand. He is found to have wrist drop during examination. X-ray showed the following finding. Which of the following

muscles are least likely to be affected in this patient?



- a) Extensor carpi radialis longus and triceps
- b) Extensor carpi radialis longus and anconeus
- c) Supinator and anconeus
- d) Triceps and anconeus

Question 16:

You observe that a patient has a high stepping gait while walking into the OPD. Which of the following nerves is likely to be injured in this patient?

- a) Femoral nerve
- b) Common peroneal nerve
- c) Tibial nerve
- d) Obturator nerve

Question 17:

A 65-year-old patient complains of pain in the back of thigh and leg with mild weakness in the leg muscles following hip replacement surgery. Which nerve is likely to be injured?

- a) Femoral nerve
- b) Obturator nerve
- c) Sciatic nerve

d) Common perineal nerve

Question 18:

You have been asked to perform Phalen's test on a patient during rounds. This test will be useful in detecting compression of which of the following nerves?

- a) Median nerve
- b) Ulnar nerve
- c) Radial nerve
- d) Axillary nerve

Answer Key

Question No.	Correct Option
1	d
2	a
3	d
4	c
5	c
6	c
7	c
8	b
9	d
10	b
11	d
12	a
13	c
14	d
15	d
16	b
17	c
18	a

Detailed Explanations

Solution to Question 1:

This is a case of Saturday night palsy, which is a type of neuropraxia.

Neuropraxia is a reversible physiological block in nerve conduction. Saturday night palsy occurs when radial nerve is compressed in the arm from direct pressure against a firm object. It can occur when the person sleeps on the arm, often after alcohol intoxication. Therefore, it is known as Saturday night palsy or weekend palsy.

Other examples for neuropraxia include crutch palsy and tourniquet palsy.

Solution to Question 2:

Sprouting axons can form an end neuroma in neurotmesis.

A neuroma is an overgrowth of fibrous tissue and randomly sprouting axons following nerve injury. A neuroma may form following axonotmesis and neurotmesis. In neurotmesis, neuroma does not bridge the break in continuity and is called end neuroma. In axonotmesis, the neuroma formed bridges the continuity and is called neuroma in continuity.

Tinel's sign is used to assess nerve regeneration following injury. The nerve is percussed along its course to elicit a tingling sensation. The point of tingling marks the site of newly sprouting axons.

Solution to Question 3:

In femoral nerve injury, thigh wasting can occur, not calf wasting. Calf wasting can occur in sciatic nerve injury.

Nerve involved	Muscle wasting
Axillary nerve	Flat shoulder
Median nerve	Thenar eminence
Ulnar nerve	Hypothenar eminence
Ulnar nerve	Hollowing between metacarpals
Femoral nerve	Thigh wasting
Sciatic nerve	Calf wasting

Solution to Question 4:

The clinical presentation is suggestive of anterior dislocation of shoulder. The most common nerve injured in these cases is the axillary nerve as it winds around the humerus.

In axillary nerve injury, there is loss of sensation over a small part of the deltoid region in upper arm (regimental badge area) and weakness in abduction (15-90 degrees) due to denervation of deltoid. Overhead abduction is unaffected as it is the function of serratus anterior and trapezius muscles.

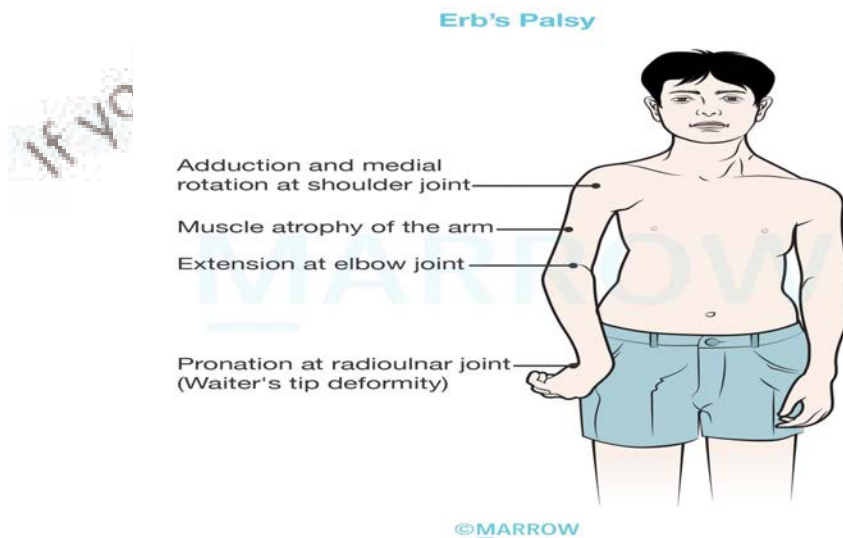
Solution to Question 5:

The image shows Erb's palsy (waiter's tip deformity). In this condition, there is a loss of sensation over a small area of the lower part of the deltoid, and not in the lateral 2 fingers.

It is caused by injury to C5, C6, and rarely C7. It is seen most commonly in babies with shoulder dystocia at delivery.

The following are seen in Erb's palsy:

- Loss of abduction and lateral rotation of the arm
- Loss of flexion of the elbow
- Loss of supination of the forearm
- Loss of biceps, supinator, and inverse supinator jerks
- Loss of sensation over a small area of the lower part of the deltoid



Solution to Question 6:

In Klumpke's paralysis, there is loss of strength in intrinsic muscles of the hand causing claw hand deformity. The site of injury is at the lower trunk of brachial plexus, where the nerve roots C8 and T1 are affected.

The following are seen in Klumpke's paralysis:

- Loss of strength in intrinsic muscles of the hand causing claw hand deformity.
- Unilateral Horner's syndrome (ptosis, miosis and anhidrosis).
- Loss of sensation along the medial border of forearm and hand.

Solution to Question 7:

The given clinical scenario is suggestive of injury to musculocutaneous nerve. Musculocutaneous nerve supplies the biceps brachii and a branch of musculocutaneous nerve namely, the lateral cutaneous nerve of forearm supplies the lateral aspect of forearm. So, injury to musculocutaneous nerve results in weakness of flexion at elbow and lack of sensation over lateral aspect of forearm.

Though axillary nerve is the most common nerve damaged in shoulder dislocation, other nerves such as musculocutaneous nerve and radial nerve can also be damaged.

Solution to Question 8:

The above picture shows ape thumb deformity. It results from median nerve palsy. Ape thumb deformity is characterized by the inability to abduct and oppose the thumb due to paralysis of opponens pollicis muscle. The thumb remains parallel by the side of other fingers.

In the hand, the median nerve supplies muscles of the thenar eminence, mainly abductor pollicis brevis, opponens pollicis and flexor pollicis brevis.

Solution to Question 9:

The image shows atrophy of thenar eminence as seen in carpal tunnel syndrome. It is due to compression of the median nerve where it passes under the flexor retinaculum in the wrist.

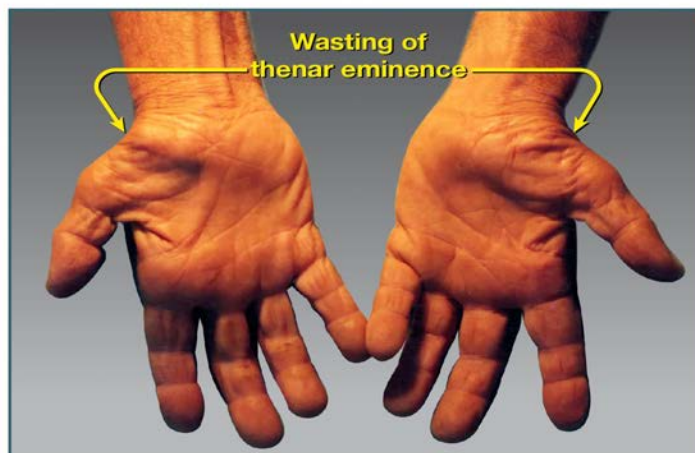
Patients present with pain and paresthesia over the radial 3 and a half digits. There may be weakness of thumb opposition. In chronic cases, the thenar eminence is wasted. Carpal tunnel syndrome can be associated with rheumatoid arthritis, pregnancy, chronic renal failure, acromegaly, hypothyroidism, and gout. The diagnosis is usually made on clinical grounds but nerve conduction studies can confirm the diagnosis.

Tinel's sign is positive in this condition. Sensory symptoms are reproduced by percussing over the median nerve.

Phalen's test is positive where the symptoms are reproduced by holding the wrists in full flexion with the dorsum of the hands pressed together.

Durkan's test is the most specific test for the diagnosis of carpal tunnel syndrome. In Durkan's test, direct median nerve compression elicits paresthesias and pain.

Chronic untreated carpal tunnel syndrome



Solution to Question 10:

The given image shows the pointing index sign and is associated with median nerve injury at the forearm or elbow.

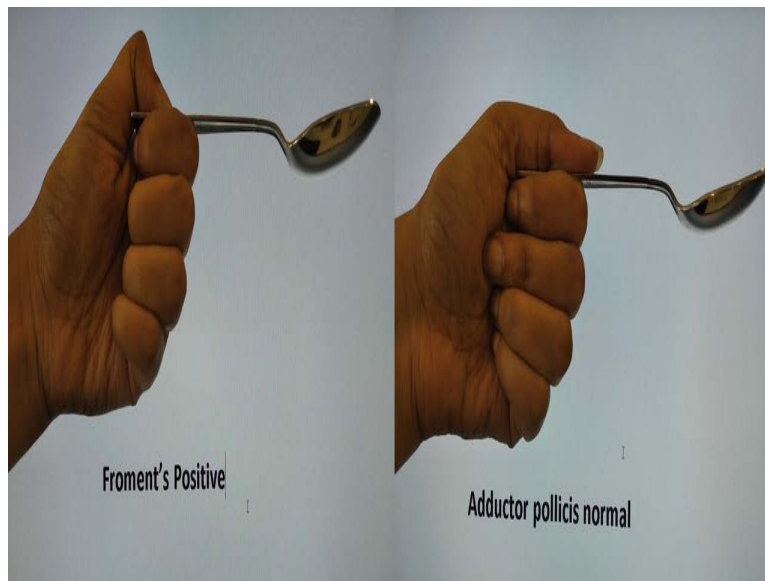
Median nerve supplies flexor digitorum superficialis and lateral half of flexor digitorum profundus muscles. Hence injury to the median nerve leads to paralysis of these muscles. This causes inability to flex the index finger and thumb, leading to the pointing index sign.

Solution to Question 11:

A positive pen test is seen in median nerve palsy. It tests the abductor pollicis brevis. The hand must remain flat with palm facing upwards; a pen is held above the palm and the patient is asked to touch the pen with his thumb - Positive sign is the inability to touch the pen.

Tests used in ulnar nerve injuries include:

- Wartenberg's sign - Due to weakness of the palmar interossei muscles and unopposed action of the extensor digiti minimi, there is involuntary abduction of the little finger.
- Positive Egawa's test - Due to weakness of dorsal interossei, side to side movements of middle finger is weak.
- Positive book test or Froment's sign - Due to weakness of adductor pollicis muscle, adduction of thumb is lost. When asked to hold a book, patient tries to hold the book by using flexor pollicis longus muscle. This produces flexion at inter-phalangeal joint while holding the book.



- Card test - Inability to hold a card between the fingers due to loss of adduction by palmar interossei muscles.

Positive card test

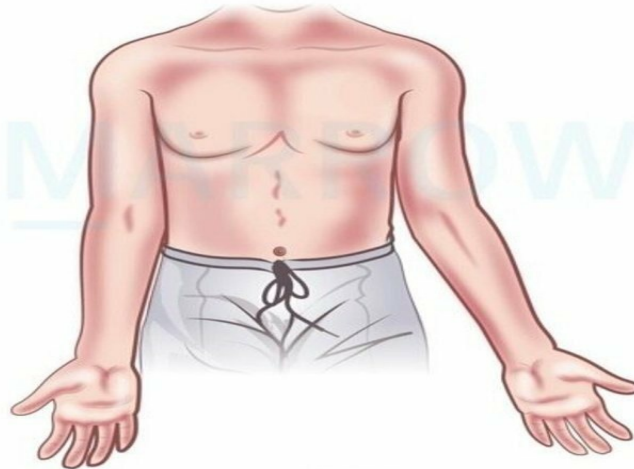


Solution to Question 12:

Tardy ulnar nerve palsy, also called late ulnar nerve palsy is associated with cubitus valgus deformity.

Cubitus valgus deformity can occur as a complication of fracture of lateral condyle of the humerus. Friction neuritis of the ulnar nerve occurs as it moves over the medial epicondyle in cubitus valgus.

The following image shows cubitus valgus deformity:



©Marrow

Solution to Question 13:

The above image shows a knuckle bender splint which is used in the management of ulnar nerve palsy.

In ulnar claw hand, there is loss of function of intrinsic muscles of the hand. So, knuckle bender splint is used to flex the metacarpophalangeal joint and extend the interphalangeal joint.

The following is an image of the cock-up splint used for radial nerve palsy:



©Marrow

Solution to Question 14:

The most likely nerve injured in this case is the posterior interosseous nerve. The posterior interosseous nerve is a pure motor nerve and hence there is no sensory loss in its injury.

The patient cannot extend the metacarpophalangeal joints but wrist extension is preserved as extensor carpi radialis longus is spared.

The most common nerve injury associated with Monteggia fracture-dislocation is posterior interosseous nerve injury.

Solution to Question 15:

The given X-ray shows a shaft of humerus fracture. In this condition, the radial nerve is injured in the radial groove. This is a high radial nerve palsy, where all the muscles supplied by the radial nerve are paralyzed, except the triceps and anconeus.

The following are the various levels at which radial nerve injury can occur:

- Occasionally, the radial nerve may be injured high up as in axilla, called very high radial nerve palsy. This can occur due to lesions around the shoulder joint, axilla, and crutch palsy. In this case, even the triceps may be paralyzed. Extension of the elbow, wrist, and hand are lost in these lesions.
- In high lesions like fractures of the humerus and prolonged tourniquet pressure, there is wrist drop, due to weakness of the radial extensors of the wrist, as well as inability to extend the metacarpophalangeal joints. There will also be sensory loss on the skin over the anatomical snuff box.
- Low lesions occur due to the fracture or dislocations of the elbow. The wrist and elbow extension is preserved but the patient cannot extend the metacarpophalangeal joint. There is also a radial extension of the wrist.

Solution to Question 16:

High stepping gait is seen in common peroneal nerve injury.

Common peroneal nerve supplies the extensors and evertors of the foot. Its injury results in foot drop. So the patient attempts to lift the leg high enough during walking so that the foot does not drag on the floor. This is known as high stepping gait.

Causes of common peroneal nerve injury:

- Fracture of the fibular neck
- Pressure from a splint or a plaster cast over the neck of fibula

It is treated using an ankle-foot orthosis brace - a type of orthotic used to support the foot and ankle in foot drop.



Solution to Question 17:

The given clinical scenario is suggestive of sciatic nerve injury.

Sciatic nerve is the most commonly injured nerve during hip replacement surgery especially during posterior approach. Hence, the patient presents with pain and weakness in the area of distribution of sciatic nerve.

Solution to Question 18:

Phalen's test is a provocative clinical test used to detect the compression of the median nerve in carpal tunnel syndrome.

The patient is asked to actively place the wrist in complete but forced flexion. The test is considered positive if tingling and numbness are produced in the median nerve distribution of the hand within 60 seconds.

The given image shows Phalen's test:

Phalen's test



Median nerve paresthesia indicates a positive test

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you may have been scammed.
else,*

Benign Tumors Of Bone

Question 1:

What is the most common benign tumor of the bone?

- a) Osteoma
- b) Osteoblastoma
- c) Osteochondroma
- d) Unicameral bone cyst

Question 2:

According to the Enneking system of classification, which of the following is not a feature of an active benign bone tumour?

- a) Intracapsular location
- b) Wide area of activity
- c) Well defined margins
- d) Thin rim of reactive bone

Question 3:

Which of the following statements is false with respect to a solitary bone cyst?

- a) They are asymptomatic unless complicated by pathological fracture
- b) Trapdoor sign can be seen on X-ray
- c) They commonly occur in the diaphysis of the bone
- d) They may cause growth abnormalities

Question 4:

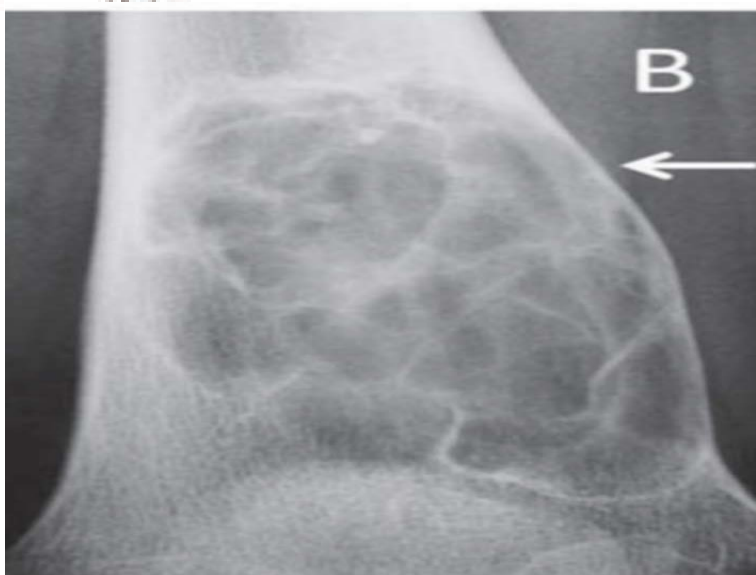
A 14-year-old boy presents to the OPD with pain in the right upper arm and a history of a trivial fall a few days ago. His X-ray is given below. Which of the following is not a treatment modality for the above condition?



- a) Curettage and bone grafting
- b) Intra-lesional steroids
- c) Radiotherapy
- d) Injection of a sclerosing agent

Question 5:

A 16-year-old girl presented to the OPD with a painful swelling below her left knee. An X-ray is obtained which is given below. Aspiration of the lesion revealed blood. Which of the following statements is true with regards to this condition?



- a) It is a uniloculated lesion

- b) It is central in location
- c) It is not locally destructive
- d) It can rarely occur in the spine

Question 6:

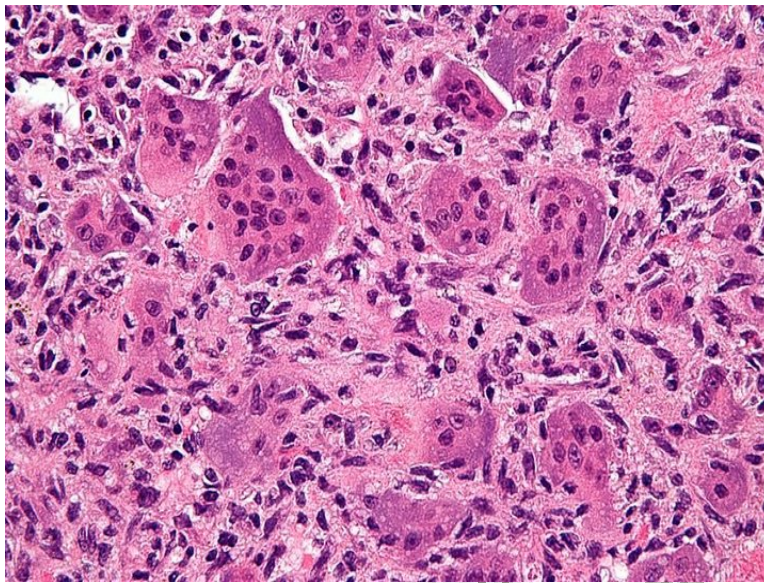
The following X-ray shows a lytic lesion of the lower limb. The biopsy shows fibroblastic proliferation, osteoclast and inflammatory cells. From the given options, the most likely diagnosis that can be inferred from the above clinical picture is_____.



- a) Aneurysmal bone cyst
- b) Giant cell tumor
- c) Chondroblastoma
- d) Langerhan cell histiocytosis

Question 7:

A 30-year-old woman developed a tumor at the knee joint. Biopsy-image is given below. What is the most likely condition?



- a) Osteosarcoma
- b) Ewing's sarcoma
- c) Giant cell tumour
- d) Osteblastoma

Question 8:

Identify the following correctly.



- a) 1 - Simple bone cyst, 2 - Aneurysmal bone cyst, 3- Osteoclastoma
- b) 1- Aneurysmal bone cyst, 2 - Osteoclastoma, 3- Simple bone cyst

- c) 1 - Osteoclastoma, 2- Aneurysmal bone cyst, 3- Simple bone cyst
- d) 1- Osteoclastoma, 2 - Simple bone cyst, 3 - Aneurysmal bone cyst

Question 9:

An X-ray is done for a patient with a knee swelling and the lesion is noted to have a soap-bubble appearance. Which of the following is false about the condition he is likely suffering from?

- a) It commonly presents in the 20-40 years age group
- b) Egg shell crackling is seen on palpation
- c) Osteoclastic giant cells form the proliferative component of the tumor
- d) It can produce lung metastasis

Question 10:

An 18-year-old boy presents to the orthopedician with complaints of painful swelling below the knee joint. An X-Ray was obtained which is given below. Which of the following is the preferred treatment modality for this patient?



- a) Extended curettage and bone grafting
- b) Simple curettage and bone grafting
- c) Radiofrequency ablation
- d) Radical excision

Question 11:

A patient with a giant cell tumor is set to undergo an extended curettage. Which of the following adjuvants used in this procedure is associated with least rate of recurrence?

- a) Liquid nitrogen
- b) Phenol
- c) Polymethyl methacrylate
- d) Thermal cautery

Question 12:

Which of the following lesions contain giant cells?

- a) 1,2,4,5
- b) 3,4,5,6
- c) 2,3,4,6
- d) 1,2,3,5

Question 13:

During an annual health check-up, the following finding was seen on the ankle X-ray of a man. Which of the following is false about the given condition?



- a) It is a metaphyseal tumor

- b) It commonly presents in 4th-5th decade
- c) It is usually asymptomatic
- d) Histology shows spindle cells, foam cells and giant cells

Question 14:

A 49-year-old woman presented to your clinic with progressive pain in her left thigh. The X-ray of her thigh is shown below. What is the most likely diagnosis?



- a) Ossifying fibroma
- b) Fibrous dysplasia
- c) Aneurysmal bone cyst
- d) Enchondroma

Question 15:

Which condition is characterized by the presence of polyostotic fibrous dysplasia with intramuscular myxomas?

- a) Mazabraud syndrome
- b) McCune Albright syndrome
- c) Maffucci syndrome
- d) Stewart- Treves syndrome

Question 16:

Which of the following is not seen in patients with McCune-Albright syndrome?

- a) Polyostotic fibrous dysplasia
- b) Cafe-au-lait lesions with smooth borders
- c) Hyperfunction of an endocrine system
- d) Mutation affecting G protein signal

Question 17:

A 20-year-old man presented with pain in the thigh which is worse at night and relieved by aspirin. An X-ray is performed which is given below. What is the diagnosis?



- a) Solitary bone cyst
- b) Osteoid osteoma
- c) Chondroblastoma
- d) Aneurysmal bone cyst

Question 18:

Which of these is the least likely cause of multiple bone lesions in a patient?

- a) Osteoid osteoma
- b) Enchondroma

- c) Osteochondroma
- d) Multiple myeloma

Question 19:

A 33-year-old woman presents with multiple bony swellings in her hands as seen in the image below marked 1. The X-ray of her hands is as shown in the image marked 2. Identify her condition.



- a) Ollier disease
- b) Maffucci's syndrome
- c) Melorheostosis
- d) Hemangiopericytoma

Question 20:

Which of the following tumors do not have osteoblasts as the predominant histological cell type?

- a) Osteoid osteoma
- b) Osteochondroma
- c) Osteosarcoma
- d) Osteoblastoma

Question 21:

Which of the following is the most common cause of pain in osteochondroma?

- a) Nerve compression
- b) Fracture
- c) Malignant transformation
- d) Bursitis

Question 22:

A young boy with a bony swelling at his knee is diagnosed to have an osteochondroma. Which of the following suggests malignant degeneration of the lesion?

- a) Fracture displacement >2 cm
- b) Obstruction to joint movement
- c) Weight loss $>10\%$
- d) Thickness of cartilage cap >2 cm

Question 23:

What is the pathology seen in patients with Trevor's disease?

- a) Multiple osteochondromas
- b) Intraarticular epiphyseal osteochondroma
- c) Osteochondroma associated with false aneurysms
- d) Osteochondroma associated with hemangiomas

Question 24:

Which of the following is false with respect to multiple hereditary exostoses?

- a) Autosomal dominant disorder
- b) Affected genes are EXT1 and EXT2
- c) Associated with multiple enchondromas
- d) Increased risk of malignant transformation

Question 25:

Which of the following lesions is an epiphyseal lesion?

- a) Enchondroma
- b) Osteoid osteoma
- c) Chondroblastoma
- d) Osteoblastoma

Question 26:

A bone biopsy was performed on a child with a skull swelling. It showed the presence of eosinophils and dendritic cells and was found to be CD 207 positive on immunohistochemistry. Which of the following skeletal manifestations would you not expect to see in this child?

- a) Vertebra plana
- b) Geographic skull
- c) Floating tooth
- d) Short 4th metacarpal

Question 27:

A child presents with difficulty in walking. On biopsy of the hip, some cells with grooved nuclei and eosinophilic cytoplasm are present. Which investigation would you order next?

- a) MRI
- b) Serum calcium
- c) Serum PTH
- d) CD1a marker

Question 28:

The CT scan image of a 50-year-old female with backache is given below. What is the likely diagnosis?



- a) Vertebral metastasis
- b) Hemangioma
- c) Eosinophilic granuloma
- d) Ossifying fibroma

Question 29:

Which of the following statements is false with respect to hemangiomas?

- a) Biopsy is rarely needed for diagnosis
- b) They usually arise from posterior elements of vertebra
- c) They cause local gigantism when they occur on an extremity
- d) They are also common in the skull

Answer Key

Question No.	Correct Option
1	c
2	b
3	c
4	c
5	d

6	b
7	c
8	c
9	c
10	a
11	a
12	d
13	b
14	b
15	a
16	b
17	b
18	a
19	b
20	b
21	d
22	d
23	b
24	c
25	c
26	d
27	d
28	b
29	b

Detailed Explanations

Solution to Question 1:

The most common benign tumor of the bone is osteochondroma.

However, osteochondromas are developmental malformations rather than true neoplasms. Hence, osteoid osteoma is the most common true benign tumor of the bone.

Solution to Question 2:

According to the Enneking system of classification, an active benign tumor will have a narrow zone of activity.

Solution to Question 3:

A solitary bone cyst (unicameral bone cyst/ simple bone cyst) most commonly occurs in the metaphysis of the bone.

Simple bone cyst always occurs during the first two decades of life, most often between 4-10 years of age with a 2:1 male preponderance. It is a benign unilocular cyst filled with straw coloured serosanguinous fluid.

The commonest site is the proximal humerus. They are usually asymptomatic, but pathological fractures may occur through the cyst wall and may cause pain and swelling. The cyst may cause growth disturbances due to its proximity to the growth plate.

On X-ray, a bone fracture fragment may be seen resting in a dependent portion of the cyst. This is known as the fallen fragment/fallen leaf sign and it is pathognomonic of a simple bone cyst.

The trapdoor sign is a variant of the fallen leaf sign. Here, a periosteal hinge keeps the fragment from falling dependently and allows it to change position with a change in the patient's position.

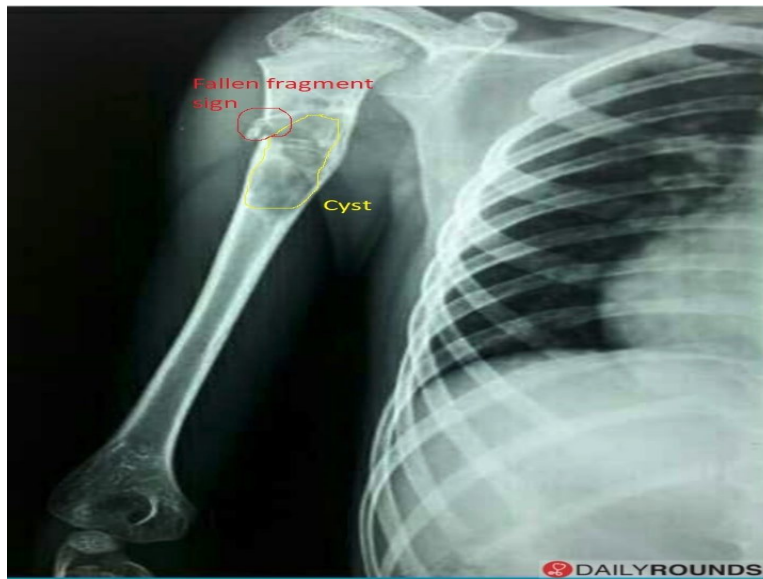
Solution to Question 4:

Radiotherapy is not a treatment modality used in the treatment of the above condition.

The given X-ray reveals a fracture running through a central cystic lesion situated on the proximal humeral metaphysis, and also shows a fallen fragment sign. This along with the clinical scenario (male within 2nd decade of life) is strongly suggestive of a unicameral bone cyst (simple bone cyst).

Treatment of simple bone cyst:

- Small, asymptomatic lesions - serial observation with plain radiographs as lesions will regress following skeletal maturity
- Larger lesions (at risk of pathologic fracture) and symptomatic lesions -
 - Curettage
 - Aspiration and injection using:
 - Corticosteroids
 - Bone marrow aspirate
 - Demineralized bone matrix
 - Pathological fractures -
 - Upper limb: managed conservatively as the fracture may initiate cyst healing
 - Lower limb: curettage, bone grafting, and internal fixation



Solution to Question 5:

The given clinical scenario and X-ray are suggestive of an aneurysmal bone cyst. It can involve the spine in 15-20% of cases.

Aneurysmal bone cysts are eccentric, expansile, multiloculated cysts filled with blood. They are benign lesions but they are locally destructive. Most cases occur in patients younger than 20 years old. There is a slight female preponderance.

The most common sites involved are the metaphysis of long bones like proximal humerus, distal femur, and proximal tibia. It presents with pain and swelling. Spinal lesions may cause neurologic deficits or radicular pain.

Solution to Question 6:

The provided X-ray reveals a lytic lesion in the epiphysis of the distal tibia, and the biopsy, which shows osteoclast cells, suggests a diagnosis of a giant cell tumor (GCT).

Important X-ray features of a GCT:

- A solitary, possibly loculated, lytic lesion in the epiphysis.
- Eccentric location, most often subchondral.
- Expansion of the overlying cortex.
- Soap bubble appearance - The tumor is homogeneously lytic with trabeculae of the remnants of bone traversing it, giving it a loculated appearance called soap bubble appearance.
- No calcification within the tumor.
- No or minimal reactive sclerosis around the tumor.

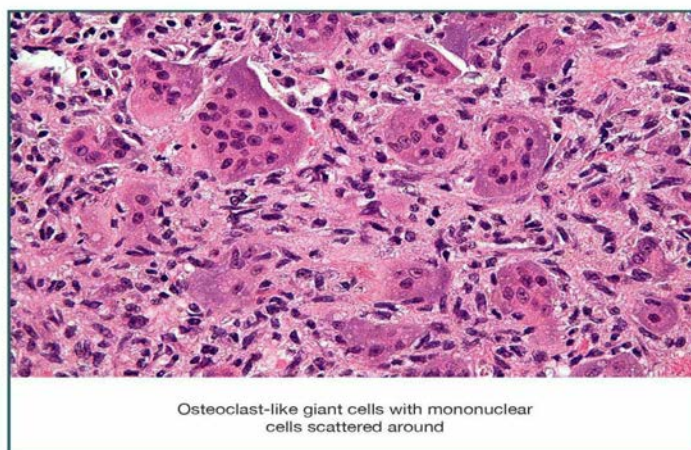
The image below shows an X-ray of a giant cell tumor showing the typical soap bubble appearance:



Histologically, GCT is characterized by the presence of a large number of osteoclast-like giant cells among scattered round or spindle-shaped mononuclear cells. The tumor stroma is well-vascularized with bands of cellular or collagenous fibrous tissue.

The image below shows the histopathology of GCT:

Osteoclastoma



Other options:

Option A: Aneurysmal bone cyst usually occurs in the metaphysis of long bones and the posterior elements of vertebral bodies. It is characterized by multiloculated blood-filled cystic spaces separated by septae, composed of multinucleated osteoclast-like giant cells and reactive woven bone. Radiographically, an aneurysmal bone cyst is seen as an eccentric, expansile, lesion with well-defined margins. Most lesions are completely lytic and often contain a thin shell of reactive bone at the periphery.



Option C: Chondroblastoma is a benign cartilaginous tumor that occurs mainly in bones around the knee joint. On x-ray, the tumor appears as a well-circumscribed, round, or oval lytic lesion in the center of the epiphysis of long bones, with areas of calcification within the tumor, giving the characteristic mottled appearance. On histology presence of "chicken wire calcification" is pathognomic.



Option D: Langerhans cell histiocytosis commonly involves the skull, pelvis, femur, and mandible. Radiographs show a lytic lesion with periosteal bone formation. In the skull, lesions appear as a hole within a hole, and in the vertebra, vertebra plana (flattening of the vertebral body) can be seen. Histopathologically, Langerhans cells have a single large nucleus with a characteristic folded or grooved nucleus ("coffee-bean" appearance) with small inconspicuous nucleoli. On electron microscopy, the presence of Birbeck granules in the cytoplasm is characteristic.



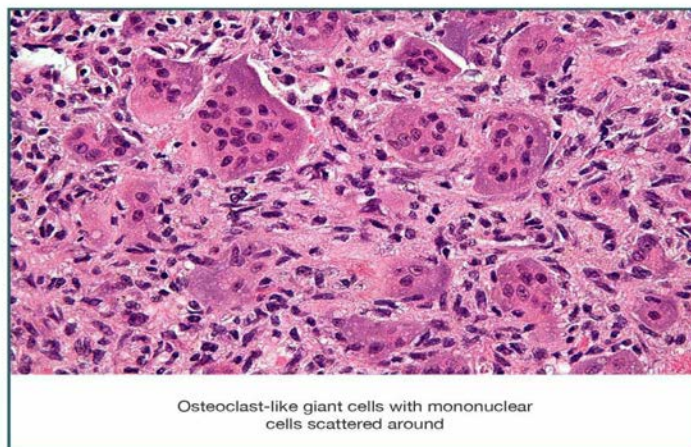
Solution to Question 7:

The biopsy image shows multinucleated osteoclast-like giant cells with scattered mononuclear cells, indicating a diagnosis of giant cell tumor (GCT)/osteoclastoma.

GCT usually affects young adults of age 20 to 40 years, with slight female predominance. It is a benign but locally aggressive tumor. It is exclusively seen in adults and affects the ends of long bones, typically involving the epiphysis. The most common location of the tumor is the distal femur followed by the proximal tibia.

Histologically, GCTs show uniform oval mononuclear tumor cells alongside numerous osteoclast-type giant cells containing 100 or more nuclei. Necrosis and mitotic activity may be prominent.

Osteoclastoma

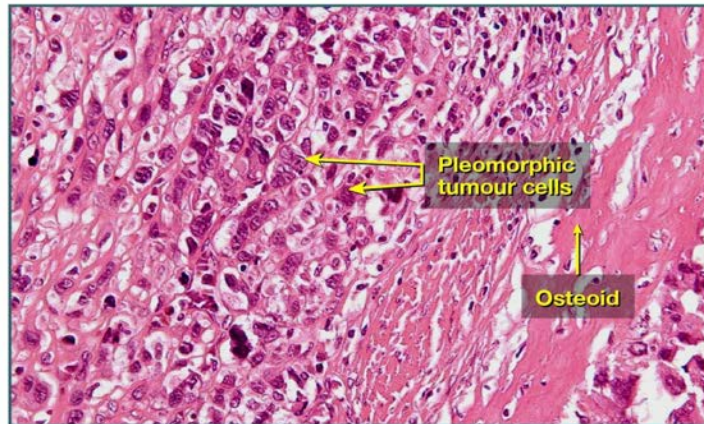


Osteoclast-like giant cells with mononuclear cells scattered around

Other options:

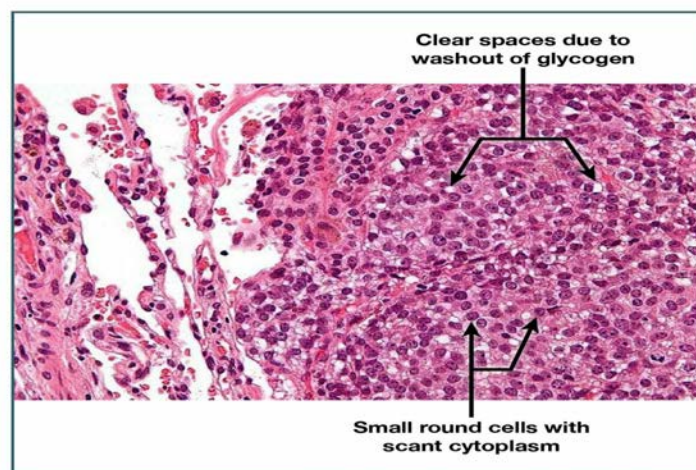
Option A: Histologically, osteosarcoma shows pleomorphic tumor cells with hyperchromatic nuclei and abundant mitoses. A definitive diagnosis requires the presence of malignant tumor cells producing unmineralized osteoid or mineralized bone, which is typically fine and lacelike in appearance.

Osteosarcoma



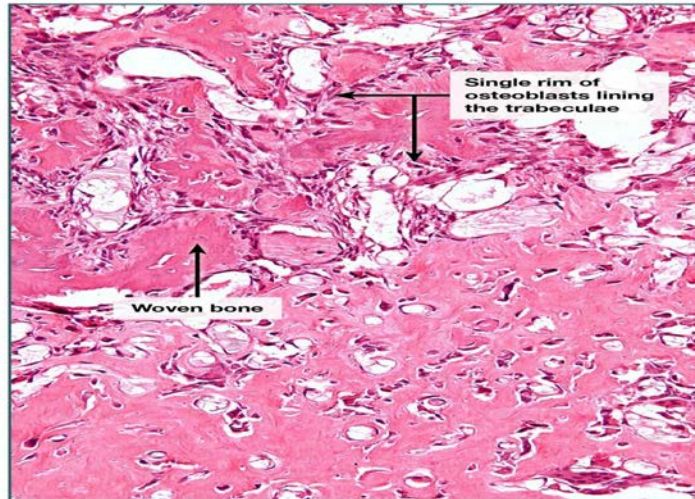
Option B: Histologically, Ewing's sarcoma shows sheets of uniform, small, round cells with scant cytoplasm, which may appear clear because they are rich in glycogen. The presence of Homer–Wright rosettes indicates a greater degree of neuroectodermal differentiation.

Ewing Sarcoma



Option D: Histologically, osteoblastoma shows randomly interconnecting trabeculae of woven bone, which are prominently rimmed by a single layer of osteoblasts. The stroma surrounding the neoplastic bone is composed of loose connective tissue that contains numerous dilated and congested capillaries.

Osteoblastoma



Solution to Question 8:

An osteoclastoma or giant cell tumor (GCT) has soap-bubble appearance with minimal marginal sclerosis. It is epiphyseal in location.

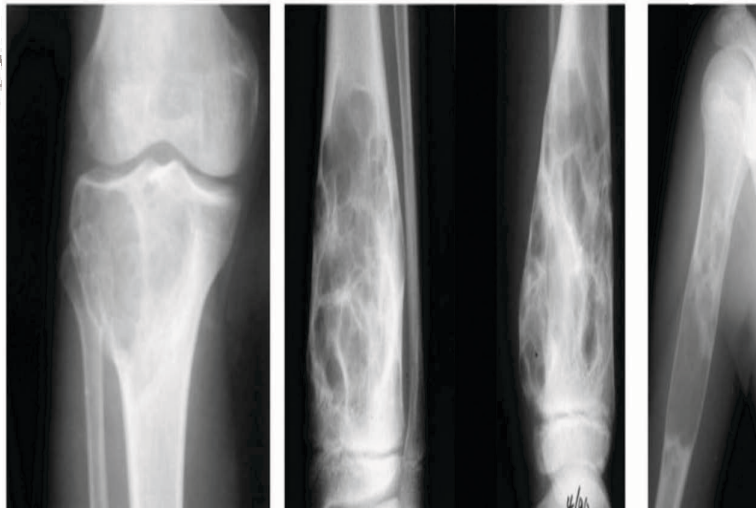
An aneurysmal bone cyst is eccentrically located, lytic lesion. It is metaphyseal in location.

A simple bone cyst is centrally located, lytic lesion. It is also metaphyseal in location

Giant cell tumour

Aneurysmal bone cyst

Simple bone cyst



The below table summarises the findings seen in these conditions:

	GCT	ABC	Simple bone cyst
Location	Epiphyseo-Metaphyseal	Metaphyseal	Meta-diaphyseal

	GCT	ABC	Simple bone cyst
Commonly involved	Distal femur/radius Proximal humerus/tibia	Humerus/femur/tibia Posterior spine	Proximal humerus/femur/tibia
Age	2nd-4th decade	1st-2nd decade	1st-2nd decade
X-ray appearance	Eccentric, lytic lesion Soap bubble appearance Minimal marginal sclerosis	Eccentric, lytic lesion Highly trabeculated, lobulated	Central location, lytic location Fallen fragment sign (Fracture fragment sinks in fluid)
Gross examination	Reddish Brown mass with cystic degeneration	Blood filled cystic spaces lined by fibrous septa	usually Solitary tumor filled with serous fluid

Solution to Question 9:

The given clinical scenario is suggestive of giant cell tumor (GCT). The proliferative component of this tumor is made up of mononuclear stromal cells. Their nuclei are identical to the osteoclast-like giant cells which are characteristically seen in this condition.

GCT is a very aggressive benign tumor arising from the epiphysis and typically in the age group of 20-40 years. It has slight female predominance.

The most common site is lower end of femur. It has an egg shell crackling feel on palpation. Benign pulmonary metastasis can occur in about 3% of cases.

Solution to Question 10:

The given x-ray showing an expansile, eccentric, multiloculated lytic lesion, at the end of a long bone with a soap-bubble appearance suggests a giant cell tumor (GCT) or osteoclastoma. The treatment of choice for this condition is extended curettage and bone grafting.

Giant cell tumor is a benign but locally aggressive tumor seen involving the metaphysis and /or the epiphysis of long bones, as seen in the image, in young adults of age 20-45 years and rarely teenagers less than 20 years.

Although an aneurysmal bone cyst (ABC) is also a benign, locally destructive, eccentric multiloculated lytic tumor that can present with a similar radiographical picture in any age group (most commonly in adolescents), it is confined within the metaphysis of the long bones, unlike GCT, thus ruling it out in this case. On MRI a fluid sign can be seen.

The following is an x-ray image of the knee showing ABC confined to the metaphysis of the long bones:



An ABC is treated by extended curettage and grafting with a bone graft substitute (option B).

GCT is most commonly seen in the distal femur, proximal tibia, proximal humerus, and distal radius. It presents with complaints of swelling and vague pain and Sometimes, the patient can presents for the first time with a pathological fracture because of the lesion.

Important x-ray features of a GCT:

- Eccentric, solitary lytic lesion
- In epiphysis and metaphysis
- Expansile- expands overlying cortex
- Soap bubble appearance - due to the trabeculae of the remnants of bone traversing the lytic lesion, giving it a loculated appearance.
- No or minimal reactive sclerosis around the tumor
- No calcification

Histologically, GCTs consist of undifferentiated spindle cells profusely interspersed with multi-nucleated giant cells. The tumor stroma is well-vascularized with bands of cellular or collagenous fibrous tissue.

The treatment of choice for GCT is by

- Extended curettage and bone grafting (Option A).
- GCT in the relatively insignificant bone like the distal ulna, clavicle, and proximal fibula is treated by resection without reconstruction.
- Bisphosphonates have been shown to reduce the proliferation of osteoclasts and hence have been shown to stabilize local and metastatic disease.
- Radiotherapy can be used for vertebral tumors
- Additional supportive therapy such as cryotherapy, when used reduce the recurrence rate.

Solution to Question 11:

The least rate of recurrence following extended curettage is seen with liquid nitrogen use.

This technique is used in the treatment of giant cell tumours as they are locally aggressive, for local tumour clearance and prevention of recurrence.

It is applied by the direct pour technique. Complications of this technique include pathological fractures and nerve injuries.

Note: Even though phenol and methacrylate can also be used as adjuvants for extended curettage, studies have shown that liquid nitrogen is far superior for the purpose.

Solution to Question 12:

Aneurysmal bone cyst, brown's tumor, osteoclastoma, and osteosarcoma all contain giant cells.

Enchondroma and osteoid osteoma do not contain giant cells.

Lesions containing giant cells are:

- Simple bone cyst
- Aneurysmal bone cyst
- Osteoclastoma
- Chondroblastoma
- Fibrous dysplasia
- Non-ossifying fibroma
- Brown's tumor
- Osteosarcoma
- Clear cell chondrosarcoma

The most common variant of a giant cell tumor is non-ossifying fibroma & fibrous dysplasia.

Solution to Question 13:

The given X-ray shows a well-defined lobulated lesion located eccentrically and sclerotic scalloped borders is suggestive of non-ossifying fibroma. The common age of presentation of this condition is 2-20 years.

It is also known as fibrous cortical defect and it is the most common benign lesion of bone. It is a metaphyseal eccentric lesion that usually affects the distal femur, tibia and fibula.

On biopsy, foam cells, spindle shape cells and giant cells may be seen.

It is usually asymptomatic and regresses spontaneously in adulthood. If the defect is very large, it can be treated by curettage and bone grafting.

Solution to Question 14:

The above X-ray shows bending of the femur known as Shepherd's crook deformity. It is seen in fibrous dysplasia of proximal femur.

Fibrous dysplasia is a developmental disorder in which areas of trabecular bone are replaced by cellular fibrous tissue. If this occurs in the weight-bearing bones like the femur, it will lead to bending of the bones.



Solution to Question 15:

Polyostotic fibrous dysplasia with intramuscular myxomas is seen in Mazabraud syndrome.

Fibrous dysplasia is a disorder where bone is replaced by fibrous tissue, leading to weak bones, uneven growth, and deformity. Polyostotic fibrous dysplasia is a form of this condition affecting more than one bone.

McCune - Albright syndrome consists of a characteristic triad of polyostotic fibrous dysplasia, café au lait spots with rough borders and hyperfunction of an endocrine system.

Maffucci syndrome is characterised by multiple enchondromas with soft tissue hemangiomas and phleboliths. Malignant transformation is common in these lesions.

Stewart- Treves syndrome refers to the occurrence of lymphangiosarcoma in the setting of chronic lymphedema. It can be evident as upper extremity lymphedema following radical mastectomy.

Solution to Question 16:

Cafe-au-lait lesions with rough borders (coast of Maine) are seen in McCune Albright syndrome. Cafe-au-lait lesions with smooth borders (coast of California) is seen in neurofibromatosis.

Features of McCune Albright syndrome:

- Polyostotic fibrous dysplasia - most commonly in maxilla and other craniofacial bones, ribs, femur or tibia
- Cafe-au lait spots with rough borders (coast of Maine)
- Hyperfunction of an endocrine system - most common endocrinopathy is precocious puberty in girls

McCune-Albright syndrome occurs due to activating mutations in the GNAS1 gene, which encodes the alpha subunit of the G protein Gs alpha.

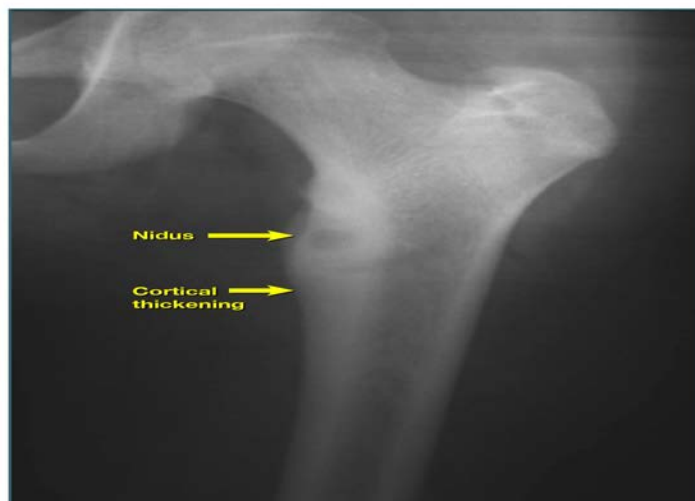
Solution to Question 17:

The given clinical scenario is suggestive of an osteoid osteoma.

The given X-ray shows the presence of a metadiaphyseal cortical lesion involving the upper end of the femur with radiolucent nidus surrounded by cortical sclerosis.

The nidus of osteoid osteoma is present in the cortex as can be seen in the image below. Hence, CT scan is the best investigation to diagnose osteoid osteoma.

Osteoid osteoma



Osteoid osteoma is the most common benign bone tumour of the body. It contains osteoblastic as well as osteoclastic components.

It is most often seen in young men. The most common site is diaphysis of femur. It typically presents with pain that is worse at night and is relieved by aspirin or other nonsteroidal anti-inflammatory medications.

Multiple treatment options are available for this condition as follows:

- If symptoms are adequately controlled and patient is willing to undergo long-term medical management, anti-inflammatory medication can be used as the definitive treatment. Spontaneous healing of the lesion usually occurs within 3 to 4 years.
- Patients having lesions of the pelvis or long bones of the extremities can be treated with percutaneous radiofrequency ablation. This method is not preferred for vertebral lesions and lesions of small bones of hand and feet.
- Surgical management involves removal of the entire nidus. This can be accomplished by curettage or en bloc resection.
- Magnetic resonance-guided focused ultrasound (MRgFUS) ablation is a new method that is under investigation.

Solution to Question 18:

Osteoid osteoma is the least likely cause of multiple bone lesions. It is usually solitary.

Differential diagnosis for multiple bone lesions:

- Histiocytosis
- Enchondroma
- Osteochondroma
- Fibrous dysplasia
- Multiple myeloma
- Metastases
- Hemangioma
- Osteomyelitis
- Giant cell tumor

Solution to Question 19:

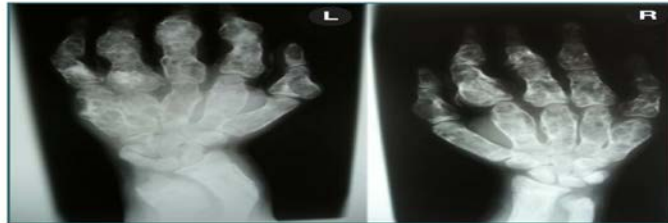
The above image shows hemangiomas of the hand. The radiograph shows multiple tumors affecting the small bones of hand with soft tissue swellings and calcification suggestive of enchondromatosis. This is suggestive of Maffucci's syndrome.

Maffucci's syndrome is characterised by enchondromatosis with hemangiomas of the overlying soft tissue.

Maffucci syndrome



Hemangiomas of the hand



Enchondromas of small bones of the hand

Malignant potential of enchondromas:

- Maffucci's syndrome has a 100% risk of turning into malignancy
- Ollier disease has a 30% risk of turning into malignancy
- Solitary enchondroma has a <2% risk of conversion to chondrosarcoma

The most common tumor affecting small bones of the hand is enchondroma. Ollier disease is characterized by multiple enchondromas when present without hemangiomas.

Melorheostosis is an uncommon mesenchymal dysplasia manifesting as regions of sclerosing bone with a characteristic dripping wax appearance a.k.a. flowing candle wax appearance. It is also known as Leri disease.

Haemangiopericytomas are soft tissue sarcomas of vascular origin, comprised of pericytes.

Solution to Question 20:

Osteochondroma does not have osteoblast as the predominant cell type. It is made up of physal chondrocytes showing active cartilage formation.

Osteoid osteoma, osteoblastoma, and osteosarcoma are bone-forming tumors. They show active ossification and have osteoblasts as the predominant histological cell type.

Solution to Question 21:

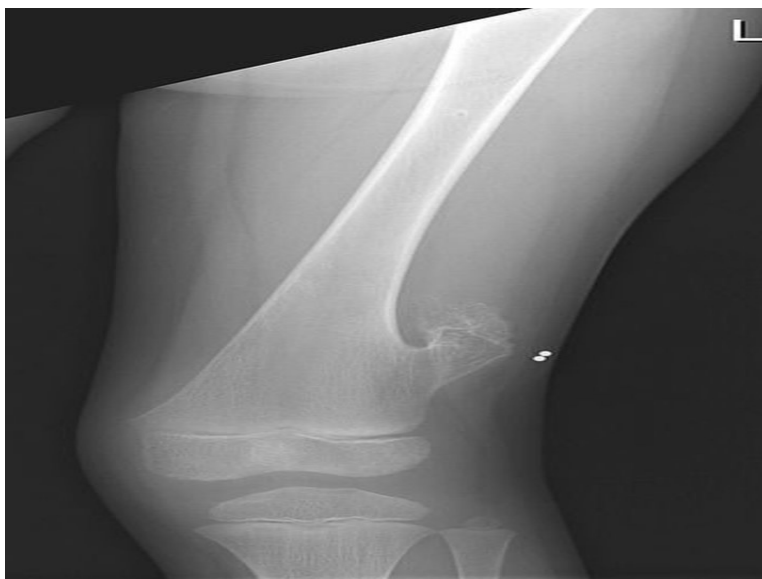
Bursitis is the most common cause of pain in an osteochondroma.

Osteochondromas are common benign bone tumors which are developmental malformations rather than true neoplasms.

Many of these lesions cause no symptoms and are discovered incidentally. However, some of them may become painful. Causes of pain in an osteochondroma are:

- Inflammation of overlying bursa
- Fracture of the bony stalk
- Compression of the neurovascular bundle of the limb
- Malignant transformation

The following X-ray shows a well-defined exostosis. It emerges from the metaphysis and moves towards the diaphysis. It angles away from the growth plate.



Solution to Question 22:

Malignant degeneration in an osteochondroma is suggested by the thickness of the cartilage cap exceeding 2 cm.

The cartilage cap overlies a bony stalk. It is irregular and usually cannot be seen on radiographs. Occasionally, calcification within the cap may be seen on X-rays.

Other features suggestive of malignant change in an osteochondroma are:

- Persistence of tumor growth after skeletal maturity
- Irregularly scattered flecks of calcification within the cartilage cap
- Spread into the surrounding soft tissue

Malignant degeneration of an osteochondroma may lead to development of chondrosarcoma.

Solution to Question 23:

Trevor's disease is characterized by the presence of intra-articular epiphyseal osteochondromas.

In Trevor's disease, bony lesions appear on the medial or lateral aspect of the epiphysis. The lesions are localized to a single side of the body. Knee and ankle are most frequently involved.

Multiple osteochondromas are seen in a condition known as diaphyseal aclasis or multiple hereditary exostoses.

The below lateral view X-ray of the lower limb shows non-uniform bone growth, and unconnected ossification centers related to the epiphyses at the knee and ankle. This is seen in Trevor's disease.



Solution to Question 24:

Multiple hereditary exostoses is associated with multiple osteochondromas. Multiple enchondromas are seen in Maffucci's syndrome and Ollier's disease.

Multiple hereditary exostoses is an autosomal dominant disease. The affected genes are EXT1 and EXT2 which are located on chromosomes 8 and 11 respectively.

There is an increased risk of malignant transformation of the osteochondromas in case of multiple lesions (about 5%). Solitary lesions have a 1% risk of malignant transformation.

The following X-ray image shows multiple osteochondromas around the knee.



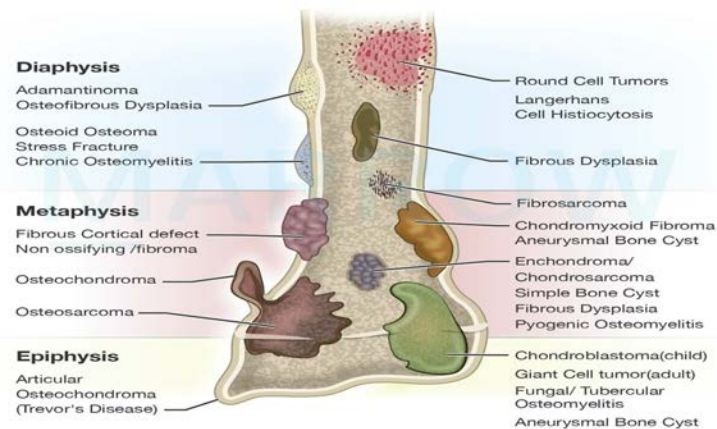
Solution to Question 25:

Among the given options, chondroblastoma is an epiphyseal lesion.

Epiphyseal lesions include:

- Chondroblastoma
- Giant cell tumor in adults
- Clear chondrosarcoma
- Articular osteochondroma (Trevor's disease)

Location of Bone Tumors within the Bone



©MARROW

Solution to Question 26:

The given clinical scenario is suggestive of Langerhans cell histiocytosis. It is not characterised by the presence of a short 4th metacarpal. This feature is seen in pseudohypoparathyroidism.

The skeletal and radiological manifestations of Langerhan's cell histiocytosis are:

- Skull:
 - solitary or multiple punched out lytic lesion without sclerotic rim
 - double contour or beveled edge appearance (hole-within-a-hole sign)
 - button sequestra representing residual bone
 - geographic skull
- Mandible:
 - floating tooth: loss of lamina dura
- Spine:
 - vertebra plana: most common cause of vertebra plana in children; mostly seen in thoracic spine

Solution to Question 27:

Histopathologically, cells with grooved nuclei and eosinophilic cytoplasm can be observed in both Langerhans cell histiocytosis (LCH) and chondroblastoma. Therefore, the next step to differentiate between them would be to obtain a CD1a marker, which is typically positive in LCH.

The specific markers for LCH are CD1a and langerin (CD207)

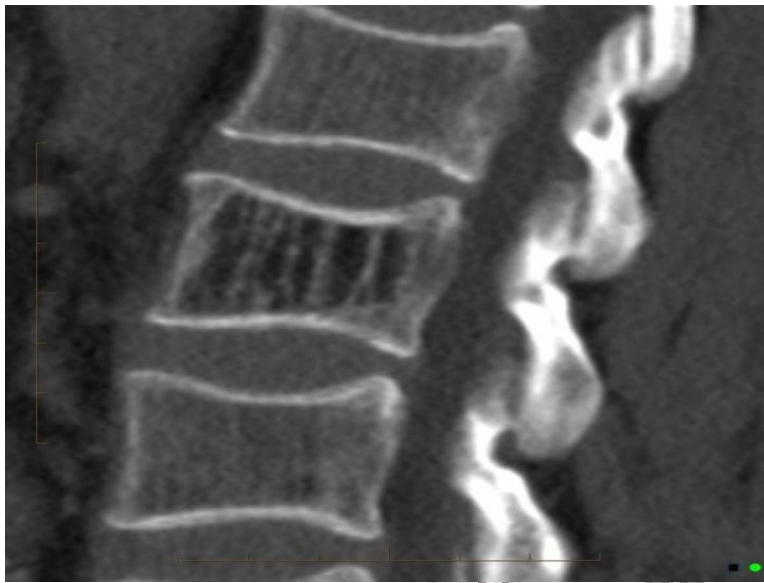
It is worth noting that while an MRI can provide valuable information for evaluating the pathology, it is ideally performed before the biopsy.

Solution to Question 28:

The image shows the classical polka dot sign (on axial section) and the Corduroy sign /jailhouse appearance (on vertical section). These are seen in vertebral hemangioma.

These signs are the result of the replacement of normal cancellous bone by thickened vertical trabeculae.

The corduroy sign is shown in the following image.



Solution to Question 29:

Hemangioma arises more commonly from the vertebral body.

Hemangioma is a benign tumor and consists of vascular channels (capillary, venous or cavernous). Apart from the spine, skull is also a common site for hemangiomas.

Biopsy is rarely needed due to the threat of hemorrhagic shock. Imaging techniques such as CT/MRI are used to make the diagnosis.

A hemangioma on a limb can lead to local hypertrophy. This can cause localised gigantism.

Malignant Tumors of Bone

Question 1:

Which of the following is the most common malignant lesion of the bone?

- a) Multiple myeloma
- b) Ewing's sarcoma
- c) Metastases
- d) Osteosarcoma

Question 2:

Which of the following statements about bone tumours are true?

- a) 2, 4, 5
- b) 1, 3, 5
- c) 1, 2, 3
- d) 3, 4, 5

Question 3:

Which of the following is a radio-resistant tumor?

- a) Ewing's sarcoma
- b) Osteosarcoma
- c) Lymphoma
- d) Bony metastases

Question 4:

A 19-year-old boy presented with progressive pain and swelling over the right leg. An X-ray of his leg is given below. What is the most probable diagnosis?



- a) Giant cell tumor
- b) Ewing's sarcoma
- c) Osteosarcoma
- d) Adamantinoma

Question 5:

While examining a patient with a suspected bone tumour, you find that the swelling is pulsatile in nature. Which of the following is the likely diagnosis?

- a) Chondrosarcoma
- b) Chondroma
- c) Ewing's sarcoma
- d) Osteosarcoma

Question 6:

Which of the following X-ray findings is not seen in an osteosarcoma?

- a) Codman's triangle
- b) Sunburst appearance
- c) Chicken wire calcification
- d) Periosteal reaction

Question 7:

A 25-year-old man who presented with a painful swelling in the lower end of his left thigh is suspected to have osteosarcoma. Which of the following investigations is not required to evaluate his condition?

- a) MRI of femur
- b) Bone scan
- c) Bone marrow biopsy
- d) CT chest

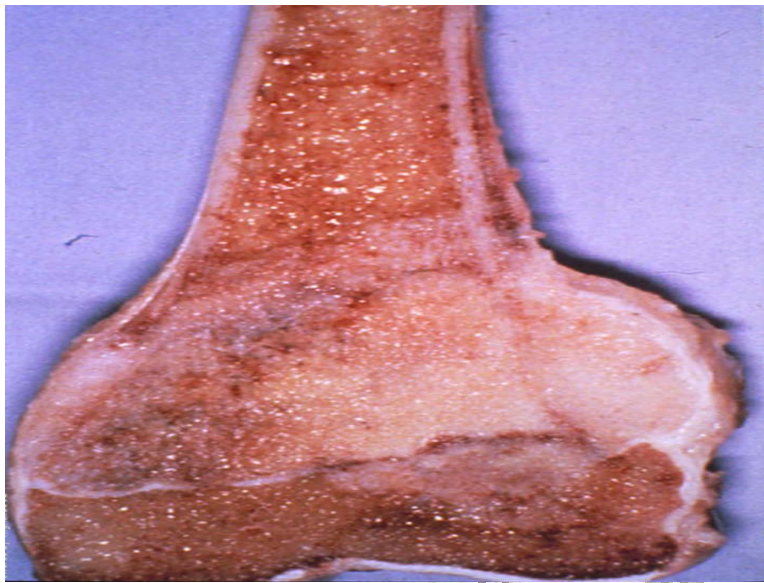
Question 8:

A bone biopsy was performed on a patient having a bone tumor that is suspected to be an osteosarcoma. Which of the following histological finding will confirm the diagnosis?

- a) Pleomorphic cells surrounded by osteoid
- b) Giant cells with multiple nuclei
- c) Monomorphic cells with Homer-Wright rosettes
- d) Mosaic pattern with cement lines

Question 9:

A 10-year-old boy presents with pain around the left knee joint. On X-ray, there is a lesion at the distal femur extending up to the terminal end. The gross image of the condition is given below. What can be the most probable diagnosis?



- a) Giant cell tumour
- b) Chondroblastoma
- c) Osteoid osteoma
- d) Osteosarcoma

Question 10:

A 20-year-old man is diagnosed with osteosarcoma of upper right tibia. Tumour size is such that safe margins are difficult to achieve. Chest X-ray is normal. What is the best next step in management?

- a) Radical excision of tibia and bone grafting
- b) Limb saving surgery with adjuvant chemotherapy
- c) Limb ablation surgery, neo-adjuvant and adjuvant chemotherapy
- d) Radiotherapy for local control and prevention of lung metastasis

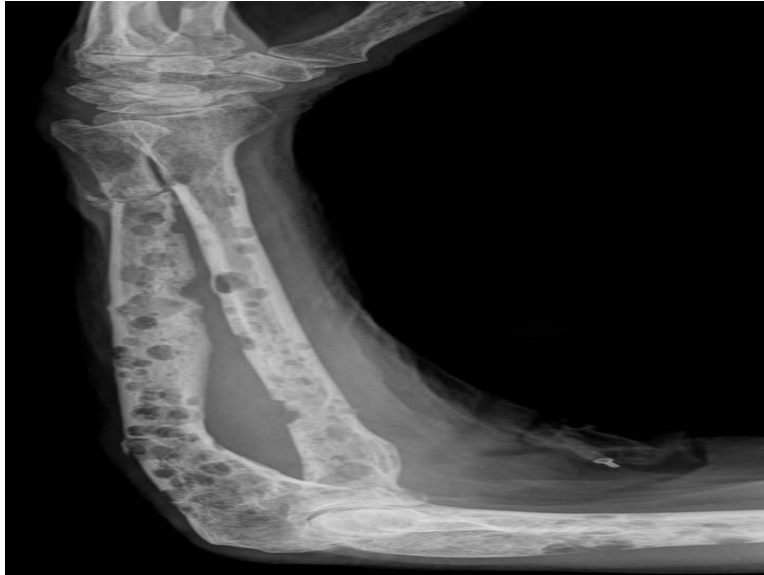
Question 11:

Which of the following is the earliest site of metastasis in osteosarcoma?

- a) Liver
- b) Lung
- c) Vertebrae
- d) Brain

Question 12:

A 66-year-old man presents with chronic low back pain and arm pain. He has a history of multiple urinary tract infections in the last year. On examination, he is pale and has bony tenderness. His X-ray is shown below. What is the most likely diagnosis?



- a) Osteosarcoma
- b) Ewing's sarcoma
- c) Multiple myeloma
- d) Eosinophilic granuloma

Question 13:

What is the most common symptom of multiple myeloma?

- a) Fatigue
- b) Oliguria
- c) Bone pain
- d) Weight loss

Question 14:

Which of the following conditions shows a moth-eaten appearance of the bone on X-ray?

- a) Chordoma
- b) Hemangioma
- c) Osteblastoma
- d) Multiple myeloma

Question 15:

A patient with Maffucci syndrome was noted to have persistent hyperglycemia. Which of the following tumours can cause such a presentation?

- a) Giant cell tumour
- b) Chondrosarcoma
- c) Osteosarcoma
- d) Ewing's sarcoma

Question 16:

Which of the following is the most common site for adamantinoma?

- a) Lower end of femur
- b) Tibia
- c) Mandible
- d) Skull

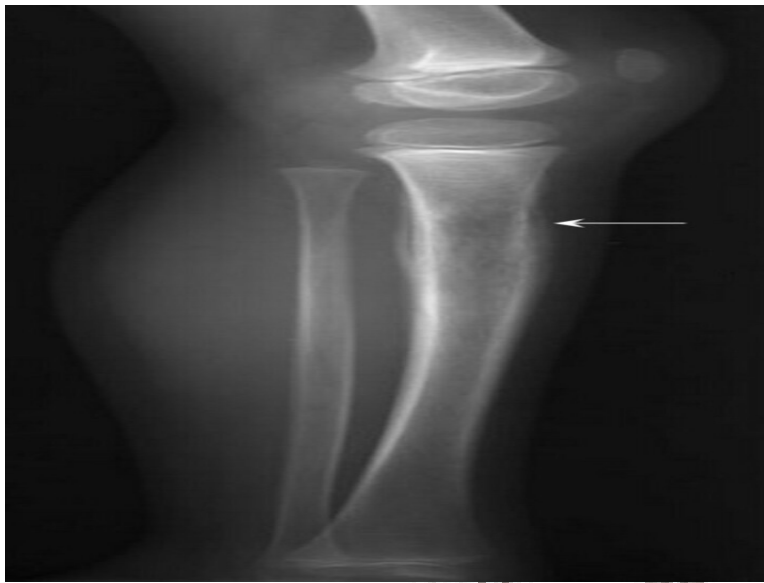
Question 17:

Which of the following tumours arises from the bone marrow?

- a) Hemangioma
- b) Synovial sarcoma
- c) Chordoma
- d) Ewing's sarcoma

Question 18:

A 12-year-old boy is brought with a history of fever and swelling over the right leg. His X-ray and lab investigations are given below. What is the most probable diagnosis?



- a) Ewing's sarcoma
- b) Osteosarcoma
- c) Osteoblastoma
- d) Chronic osteomyelitis

Question 19:

A bone biopsy sample is taken from a patient with suspected bone tumour. PAS staining was done and found to be positive. What is the most probable diagnosis?

- a) Ewing's sarcoma
- b) Osteosarcoma
- c) Fibrosarcoma
- d) Chondrosarcoma

Question 20:

What is the most common site of lesion in Ewing's sarcoma?

- a) Metaphysis
- b) Epiphysis
- c) Diaphysis
- d) Endosteum

Question 21:

A 5-year-old boy with Ewing's sarcoma is on chemotherapy. Which of the following is an indicator of poor prognosis?

- a) Levels of beta 2 microglobulin
- b) Fever
- c) Thrombocytosis
- d) Histologic grade

Question 22:

A 60-year-old man presents with low backache. On radiography, destructive lesions are seen in the sacrum. Biopsy of the lesion shows physaliferous cells. What is the most probable diagnosis?

- a) Ankylosing spondylitis
- b) Multiple myeloma
- c) Chordoma
- d) Synovial sarcoma

Question 23:

What is the genetic abnormality seen in patients with synovial sarcoma?

- a) t (11;22)
- b) t (x;18)
- c) p53 mutation
- d) Rb mutation

Question 24:

The spinal X-ray of a patient with chronic back pain revealed the winking owl sign. What could be the most probable diagnosis?

- a) Osteosarcoma
- b) Osteoid osteoma
- c) Chondrosarcoma

d) Metastases

Question 25:

A tumor at which of the following primary sites does not commonly give rise to bony metastases?

- a) Brain
- b) Breast
- c) Kidney
- d) Colon

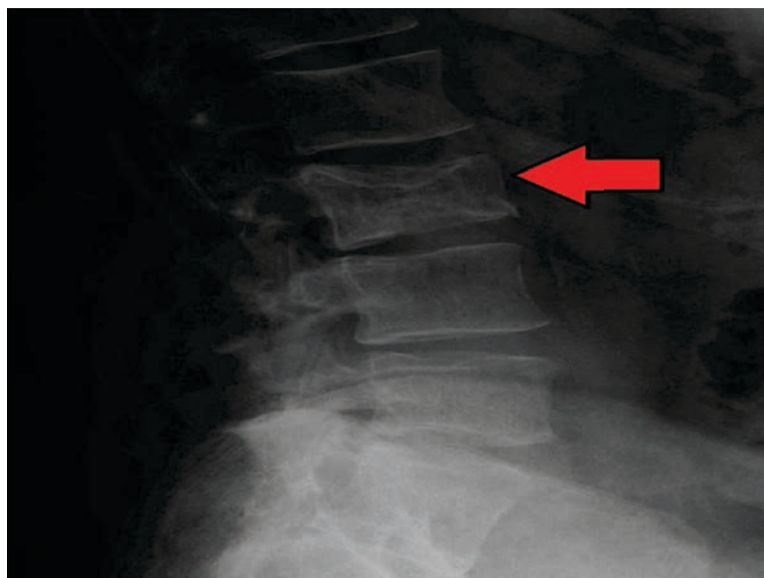
Question 26:

Which of the following primary tumours can cause purely lytic secondaries in the bone?

- a) Prostate cancer
- b) Renal cancer
- c) Breast cancer
- d) Lung cancer

Question 27:

A breast cancer patient developed back pain after a minor fall. Her X-ray is given below. Which of the following is not included in the Mirels scoring of this condition?



- a) Site of lesion
- b) Type of lesion
- c) Association with pain
- d) Response to bisphosphonates

Answer Key

Question No.	Correct Option
1	c
2	b
3	b
4	c
5	d
6	c
7	c
8	a
9	d
10	c
11	b
12	c
13	c
14	d
15	b
16	b
17	d
18	a
19	a
20	c
21	b
22	c
23	b
24	d
25	a
26	b

Detailed Explanations

Solution to Question 1:

The most common malignant lesions of the bone are metastases.

The most common site of metastasis in the skeleton is vertebra. Bony metastases are more common above 50 years of age.

The most common primary tumor giving rise to bony metastases is carcinoma breast. However, in children under 6 years of age the most common cause of bony secondaries is adrenal neuroblastoma. Carcinoma lung and carcinoma kidney are often implicated in cases of bony metastases from an unknown primary.

Solution to Question 2:

The most common primary malignancy of the bone is multiple myeloma which is a tumor of hematological origin. The most common non-hematologic primary malignancy of bone is osteosarcoma. However, in the first decade of life, the most common non-hematologic primary bone malignancy is Ewing's sarcoma.

The most common malignant lesions of the bone overall are metastases. The non-hematologic primary tumors of the bone arranged in decreasing order of incidence are: osteosarcoma > chondrosarcoma > Ewing's sarcoma.

The most common benign bone tumour is osteochondroma. However, it is not a true tumor as it stops growing after skeletal maturity. Hence, the most common benign true bone tumour is osteoid osteoma.

Solution to Question 3:

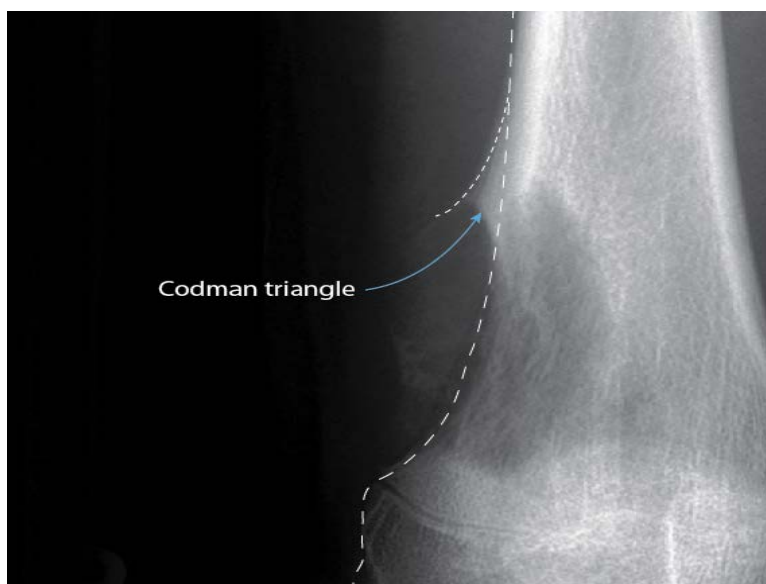
Osteosarcoma is a highly radio-resistant tumour.

Solution to Question 4:

The given X-ray shows the Codman triangle which is suggestive of osteosarcoma.

Osteosarcoma is the most common non-hematologic primary malignancy of bone. It occurs most commonly in the second decade of life. It is typically metaphyseal. Distal femur, proximal tibia and proximal humerus are the common sites.

The Codman's triangle is marked out in the X-ray given below. It is formed due to raising of the periosteum by the tumor.



Solution to Question 5:

Among the given options, osteosarcoma is the most likely diagnosis as it is a pulsatile bone tumour. Pulsations in the tumour occur due to hypervascularity.

Pulsatile bone tumours include:

- Osteosarcoma
- Aneurysmal bone cyst
- Angioendothelioma of bone
- Osteoclastoma/Giant cell tumour
- Metastases from kidney and thyroid carcinoma

Solution to Question 6:

Chicken wire pattern of calcification on HPE is seen in chondroblastoma.

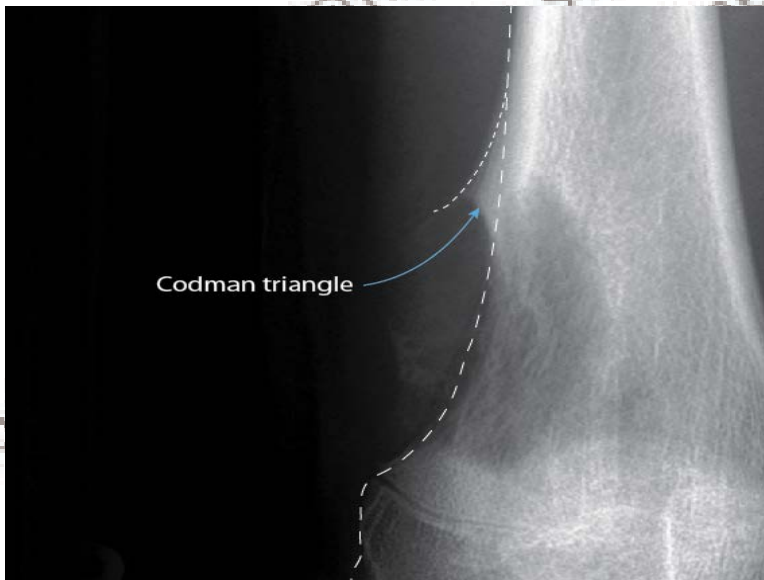
An osteosarcoma shows the following radiological features:

- Irregular destruction in the metaphysis overshadowed by the formation of new bone
- Codman's triangle or lifting of the periosteum due to the formation of new bone inciting a periosteal reaction
- Bone formation along the blood vessels within the tumour centrifugally, giving rise to sunburst (sunray) appearance

The image given below shows the sunburst appearance seen in osteosarcoma.



The image given below shows Codman's triangle seen in osteosarcoma.



Solution to Question 7:

Bone marrow biopsy is not performed for the evaluation of a patient of osteosarcoma. However, a bone biopsy is done for confirmation of the diagnosis by histopathology.

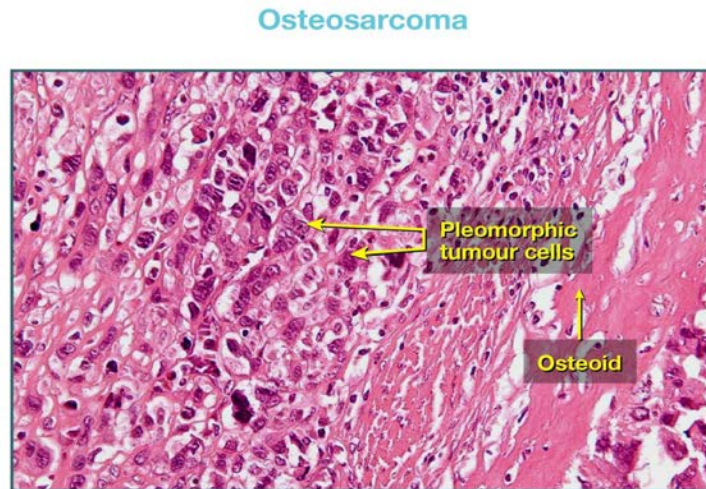
An MRI of the involved bone is always done for the evaluation of an osteosarcoma. It shows the extent of the tumour. A bone scan is useful for detecting skeletal metastases.

An osteosarcoma can metastasise to the lungs as well so a chest CT may be done. It is a sensitive detector of lung metastases but chest X-rays are done more commonly.

Solution to Question 8:

The presence of pleomorphic cells surrounded by osteoid on histological examination is characteristic of osteosarcoma. To establish the diagnosis, osteoid production from the tumour cells must be demonstrated histologically.

The image given below shows the histopathology of osteosarcoma.



Solution to Question 9:

The given clinical scenario, involving a child and a gross specimen revealing a metaphyseal tumor in the distal femur that has infiltrated through the cortex, lifted the periosteum, and extended through the epiphyseal plate, supports the diagnosis of osteosarcoma.

A giant cell tumor (option A) is primarily an epiphyseal tumor that usually affects adults between ages 20 and 40 years when skeletal maturity is complete. Chondroblastoma (option B) is a benign tumor of childhood most commonly seen in the epiphysis. Osteoid osteoma (option C) is a benign tumor most commonly seen in the diaphysis of the proximal femur.

Osteosarcoma is the most common non-hematologic primary malignancy of bone. It occurs most commonly in the second decade of life. It is typically metaphyseal. The distal femur, proximal tibia, and proximal humerus are common sites.

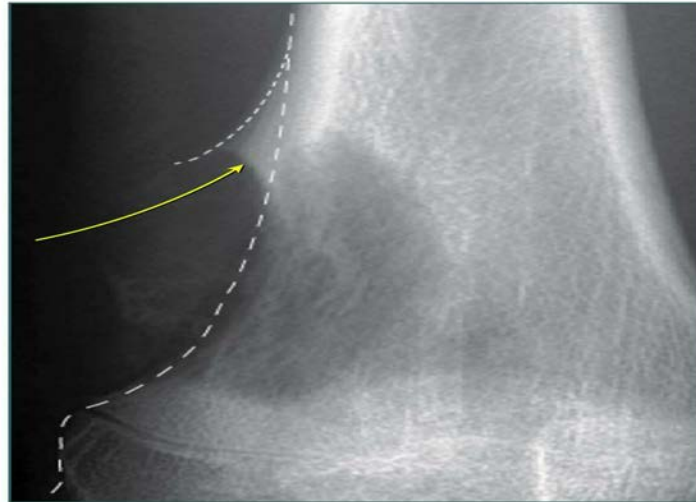
Morphologically, osteosarcomas are bulky, gritty, gray-white tumors, often with hemorrhage and cystic degeneration. They destroy cortices, form soft tissue masses, and spread extensively in the medullary canal, replacing hematopoietic marrow. Although infrequent, they may also penetrate the epiphyseal plate or enter the joint.

Radiological features:

- Irregular destruction in the metaphysis overshadowed by the formation of new bone
- Lifting of the periosteum (Codman triangle) due to the formation of new bone inciting a periosteal reaction

- Bone formation along the blood vessels within the tumor centrifugally, giving rise to a sunburst (sunray) appearance

Osteosarcoma - Codman Triangle



Solution to Question 10:

In the given scenario, as safe margins are difficult to achieve with wide resection of the osteosarcoma, treatment involves:

- Neoadjuvant chemotherapy - to control metastasis and to treat micrometastasis
- Limb ablation surgery - as safe margins are difficult to achieve
- Adjuvant chemotherapy - after the surgery to prevent recurrence

Chemotherapy is given based on the T-10 protocol. It involves:

- High dose methotrexate and citrovorum factor rescue
- Adriamycin
- BCD (bleomycin, cyclophosphamide, dactinomycin/doxorubicin)

Low-grade tumours, with resectable margins, are treated with wide resection and amputation without chemotherapy.

Radiotherapy can be given pre-operatively to prevent tumor dissemination by surgical trauma.

Solution to Question 11:

The earliest site of metastasis in osteosarcoma is the lungs.

Osteosarcomas are aggressive lesions and metastasize through the bloodstream. Approximately 15% of patients with osteosarcoma have detectable pulmonary metastases at the time of diagnosis.

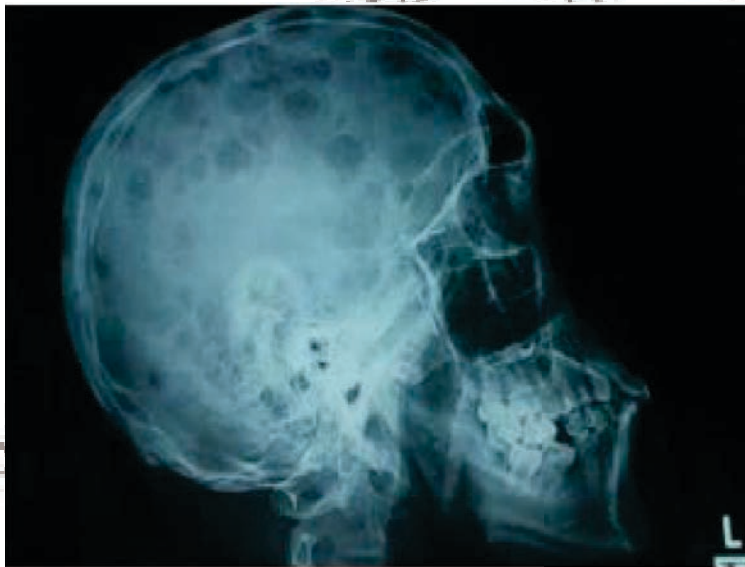
Solution to Question 12:

The given X-ray shows multiple, punched-out, sharply demarcated, lytic lesions without any surrounding reactive sclerosis. This along with the given clinical scenario are suggestive of multiple myeloma.

Clinical features of multiple myeloma include:

- Chronic low back pain
- Increased susceptibility to bacterial infections
- Anaemia
- Bony tenderness

The X-ray given below shows punched-out lytic lesions in the skull of a patient with multiple myeloma. This is characteristically known as the moth-eaten appearance of skull.



Solution to Question 13:

The most common symptom in multiple myeloma is bone pain.

Clinical features of multiple myeloma:

- Bone pain
- Fatigue
- Weight loss
- Anemia
- Hypercalcemia

- Renal failure
- Peripheral neuropathy
- Susceptibility to bacterial infections

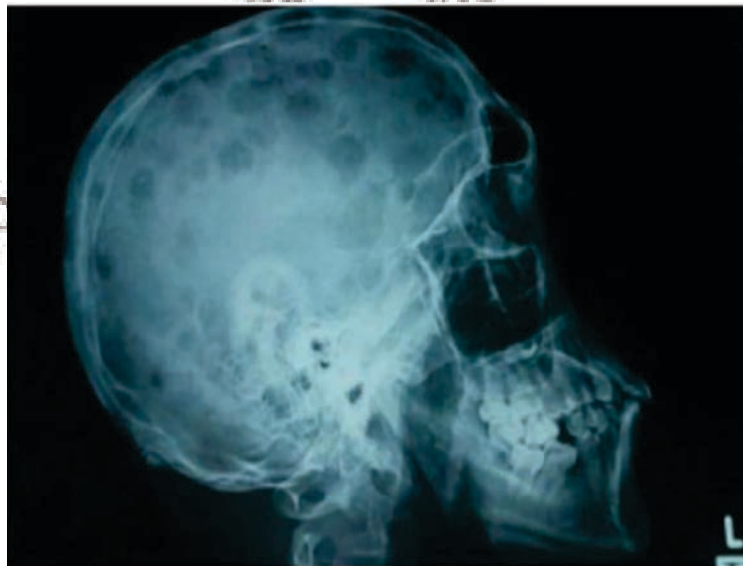
Solution to Question 14:

Moth-eaten appearance of bone is seen in multiple myeloma. In this condition, the bone has poorly defined areas of destruction with ragged edges.

Causes of moth-eaten appearance include: (Mnemonic - FIREMOD)

- Fibrosarcoma
- Infection
- Round cell tumors (Ewing's sarcoma)
- Eosinophilic granuloma
- Metastasis/ myeloma/ malignant fibrous histiocytoma
- Osteosarcoma
- Desmoid tumor

The skull X-ray given below shows moth-eaten appearance seen in multiple myeloma.



Note: Moth-eaten calyx is seen in genitourinary tuberculosis.

Solution to Question 15:

Hyperglycemia is seen as a paraneoplastic symptom in patients with chondrosarcoma.

Maffucci syndrome is a condition where the patient has multiple enchondromas and soft tissue hemangiomas. It is associated with an increased risk of malignant transformation to chondrosarcoma.

Chondrosarcoma is a malignant metaphyseal tumour most commonly located in a proximal location such as the pelvis, proximal femur, and proximal humerus. It arises in the medullary cavity with irregular matrix calcification, which is punctate, popcorn or comma-shaped in appearance. Treatment is wide local excision/radical excision.

Solution to Question 16:

The most common site for adamantinoma is tibia.

Adamantinoma is a rare malignant diaphyseal neoplasm that arises from epithelial cells. Patients usually present with pain and X-rays show honeycomb or soap bubble appearance.

Solution to Question 17:

Ewing's sarcoma arises from the mesenchymal stem cells in the bone marrow. Histologically, Ewing's sarcoma consists of small blue cells with very little intercellular matrix.

The most common translocation seen in Ewing's sarcoma is t(11;22) (q24;q12).

Solution to Question 18:

The most probable diagnosis is Ewing's sarcoma.

The clinical vignette of a 12-year-old boy presenting with fever, swelling over the right leg, an elevated leukocyte count, ESR and CRP, MIC-2 staining being positive and the X-ray showing onion skin appearance are all suggestive of Ewing's sarcoma.

It is a highly malignant tumour that frequently affects males between 10 and 20 years of age. It usually affects the diaphysis of long bones like the femur and tibia. The femur is the most commonly affected, followed by the tibia, humerus and fibula, but overall the pelvis accounts for the majority of cases.

Pain is the earliest symptom, followed by swelling and a low-grade fever. Serologically, the ESR and WCC may be elevated and haemoglobin may be reduced.

An x-ray shows an aggressive, poorly defined osteolytic lesion with cortical destruction and periosteal reaction. A distinct 'onion-skin' appearance is observed due to the destruction of the cortex and new bone formation in layers.

Histologically, Ewing's sarcoma is composed of primitive, undifferentiated, small, round blue cells with large nuclei and scant cytoplasm that bears no resemblance to normal tissue. The characteristic translocation between chromosomes 11 and 22 results in a fusion gene, EWSR1-FL11, which is present in 90% of cases. The presence of the translocation may be

supported by means of fluorescence in situ hybridization (FISH).

Immunohistochemical staining for MIC-2 is specific for Ewing's sarcoma.

The most common sites of metastasis include lungs, bones and lymph nodes. Bone marrow involvement is a unique feature of Ewing's sarcoma.

Preoperative chemotherapy with vincristine, ifosfamide, doxorubicin and etoposide results in extensive tumour necrosis and shrinkage. Wide excision may be combined with adjuvant radiotherapy if surgical margins are poor. Definitive radiotherapy rather than surgical excision may be advocated if it is non-resectable or metastasis has occurred. It is a radio-sensitive tumour.

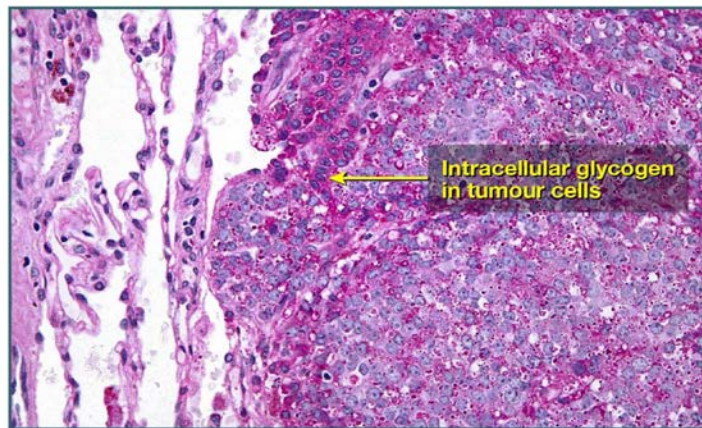
Indicators of a favourable prognosis include younger age, involvement of distal appendicular sites, small tumour volume, normal ESR and greater chemotherapy response.

Solution to Question 19:

PAS staining is positive in Ewing's sarcoma, as tumour cells are rich in glycogen. However, they stain negatively for reticulin.

The image given below shows PAS staining done in Ewing's sarcoma.

PAS staining - Ewing's Sarcoma



Note: Lymphomas are PAS negative and reticulin positive.

Solution to Question 20:

In Ewing's sarcoma, the lesion is most commonly seen in the diaphysis of a long bone.

Ewing's sarcoma is a highly malignant tumour. It is the most common malignancy of the first decade but its incidence is maximum in the second decade.

Femur is the most common long bone site. Other common sites include the flat bones, pelvis and calcaneum.

Solution to Question 21:

Fever is one of the indicators for poor prognosis in Ewing's sarcoma.

Indicators of poor prognosis in patients with Ewing's sarcoma:

- Presence of distant metastasis - worst prognostic factor
- Size and location of the primary lesion
- Presence of fever, anaemia
- Leukocytosis
- Raised ESR
- Male child and age 12–15 years

Histologic grade is of no prognostic significance because all Ewing's sarcomas are considered high grade.

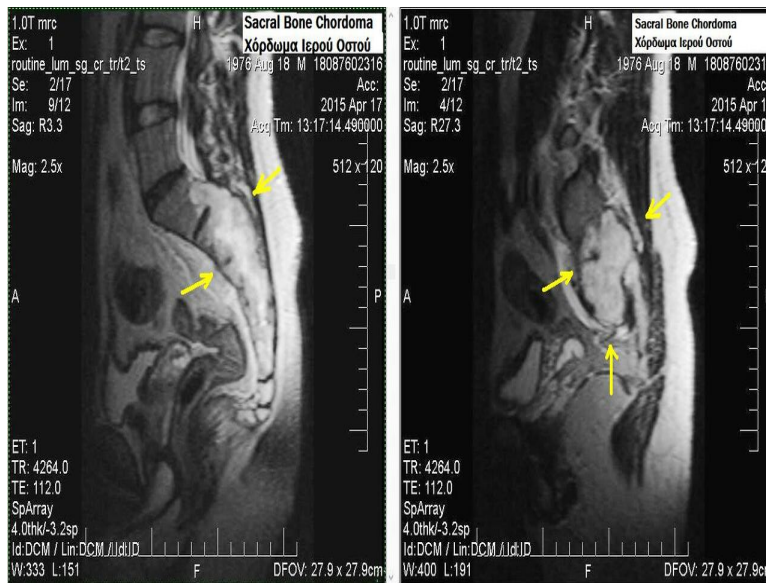
Note: High levels of beta 2 microglobulin is an indicator of poor prognosis in multiple myeloma.

Solution to Question 22:

The most likely diagnosis in the given clinical scenario is chordoma.

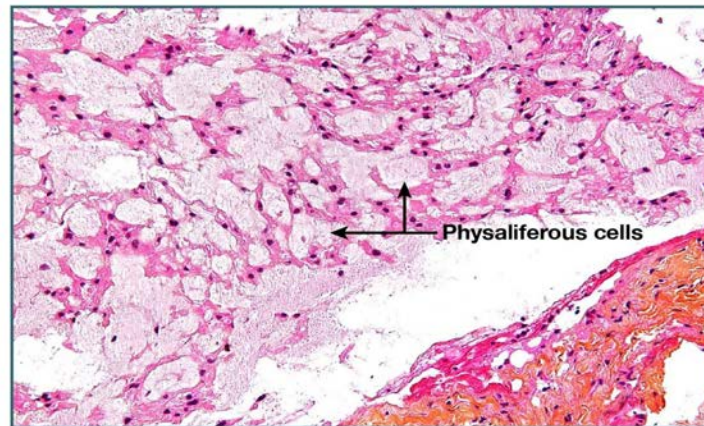
Chordoma is a rare malignant tumor arising from the primitive notochordal remnants. It is the most common primary malignancy of the sacrum. Radiographically, chordomas appear as destructive lesions. Since sacrococcygeal lesions can be obstructed by bowel gas, a lateral X-ray or MRI is used in diagnosis.

The image given below shows an MRI of a chordoma.



On histopathological examination, a chordoma shows cells containing abundant vacuolated cytoplasm known as physaliferous cells. They are arranged in long strands or chords in a mucinous background as seen in the image below.

Chordoma



Solution to Question 23:

The genetic abnormality seen in synovial sarcoma is chromosomal translocation $t(x;18)(p11;q11)$. This translocation gives rise to SYT- SSX fusion gene.

Synovial sarcoma is a misnomer as the tumour does not arise from the synovium but the histological appearance resembles normal synovial tissue. It is an uncommon malignant mesenchymal neoplasm.

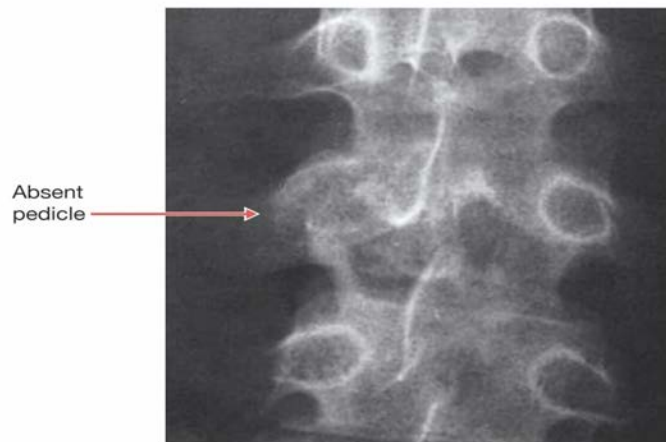
Synovial sarcomas are morphologically biphasic i.e. they have nests of epithelioid cells surrounded by malignant spindle cells.

Solution to Question 24:

The winking owl sign is seen in spinal metastases. It refers to the appearance of the spine when a pedicle is absent.

The usual appearance of the pedicle representing two eyes on the AP projection is lost, as one pedicle is destroyed. It then appears like one eye is open and the other is winking or shut. Potentially, all bony metastasis can do this. However, breast cancer and lung cancer are commonly associated with this condition.

The image given below shows an X-ray with winking owl sign.



©Marrow

Solution to Question 25:

Brain is not a common site of primary tumour for bone metastasis.

Most tumours metastatic to bone are from:

- Breast
- Prostate
- Lung
- Kidney
- Thyroid
- Gastrointestinal tract

Solution to Question 26:

Renal cancer produces pure osteolytic secondaries.

Osteolytic secondaries are produced by:

- Renal cancer
- Multiple myeloma
- Malignant melanoma
- Thyroid carcinoma, except medullary carcinoma thyroid

Mixed osteoblastic/osteolytic secondaries are produced by:

- Lung cancer
- Breast cancer
- Lymphoma

Osteoblastic secondaries are produced by:

- Prostate cancer
- Osteosarcoma
- Medullary carcinoma of thyroid

Solution to Question 27:

The given X-ray shows a fracture of the lumbar vertebrae. In the given scenario, this is suggestive of pathological fracture due to bony metastases. This can be evaluated with Mirels scoring system. It does not include response to bisphosphonates as one of the variables.

Mirels scoring is given below:

Prophylactic internal fixation should be considered in a patient with a score of ≥ 8 .

Variable	Score		
1	2	3	
Site	Upper limb	Lower limb	Peritrochanter
Pain	Mild	Moderate	Functional
Size	$<1/3$	$1/3-2/3$	$>2/3$
Type of lesion	Blastic	Mixed	Lytic

Implants, splints and traction

Question 1:

While performing bone grafting, which of the following instruments would you use to elevate the periosteum?



- a) A
- b) B
- c) C
- d) D

Question 2:

The postoperative X-ray of a patient who underwent femoral nailing is shown below. Which of the following statements is false regarding this nail?



- a) Cloverleaf shape provides tensile strength
- b) Proximal migration of the nail may lead to bursitis
- c) Based on the concept of three point fixation
- d) The eye of the nail is useful during its removal

Question 3:

Identify the instrument shown below.



- a) Malleolar screw
- b) Cortical screw

- c) Cancellous screw
- d) Steinmann pin

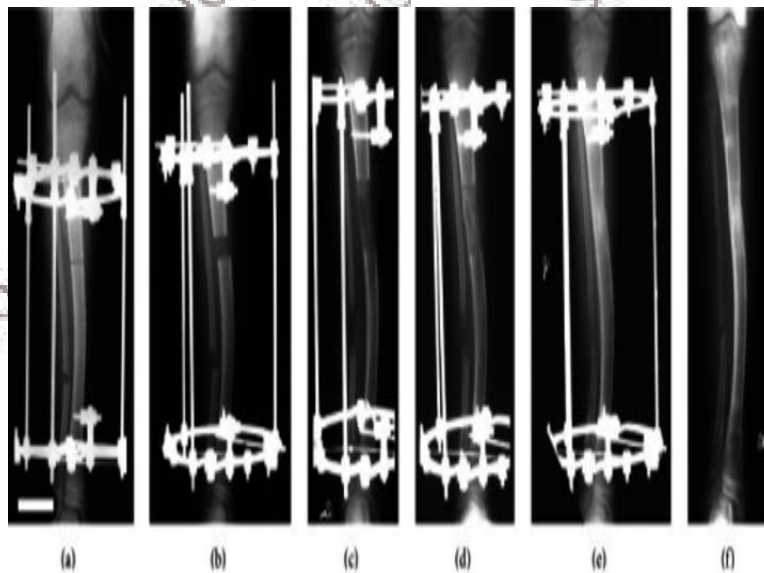
Question 4:

Which of the following instruments can be used in both internal fixation of small bones and Ilizarov's technique?

- a) Steinmann's pin
- b) Kirschner's wire
- c) Denham pin
- d) Knowles pin

Question 5:

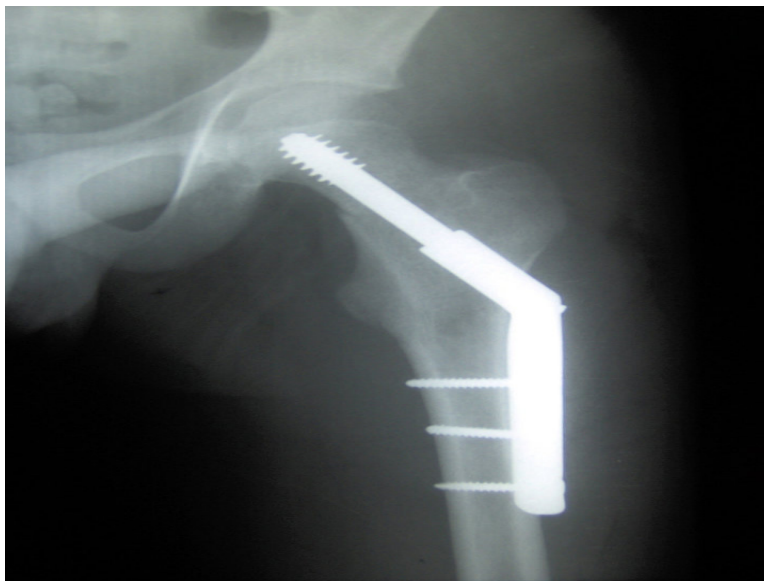
Which of the following is false about the procedure shown below?



- a) Compression/distraction at fracture site enhances osteogenesis
- b) The rate of compression or distraction is 2 mm per day
- c) K wire is required for this procedure
- d) Nerve palsy is a complication of the procedure

Question 6:

Following a road traffic accident, a patient with an intertrochanteric fracture of the femur was treated with the implant shown below. Identify the implant.



- a) Proximal femoral nail
- b) Dynamic hip screw
- c) Austin Moore prosthesis
- d) Herbert screw

Question 7:

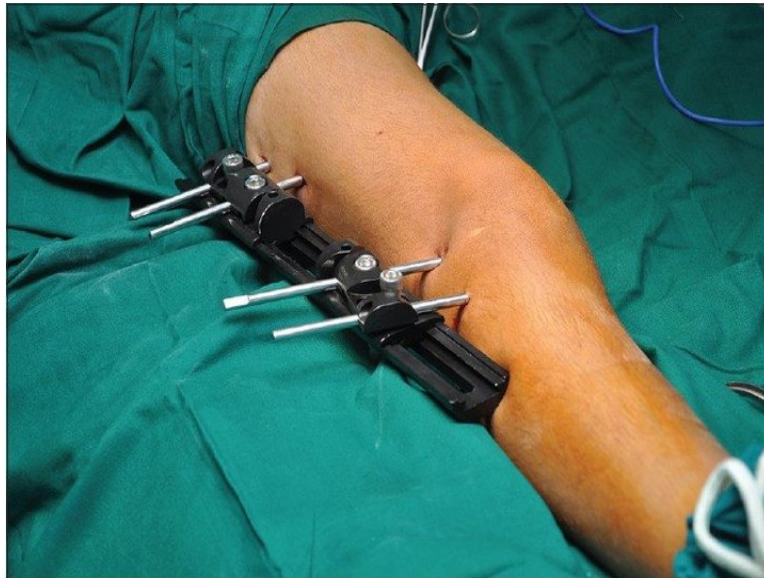
Identify the instrument given below.



- a) Bone nibbler
- b) Bone curette
- c) Plate holding forceps
- d) Bone holding forceps

Question 8:

Which of the following is used to stabilise a fracture of the distal femur as shown in the image below?



- a) Rail fixator
- b) Ilizarov fixator
- c) K wire binding
- d) Interlocking nail

Question 9:

The following instrument is used for:



- a) Nibbling the ends of the bones
- b) Holding the bone and plate
- c) Controlled traction of fracture segments
- d) Cutting the K- wire

Question 10:

A 35-year-old man was rushed to the ER following a road traffic accident. You suspect a femoral shaft fracture and decide to use the following splint. How is the length of this splint calculated?



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- a) Highest point on the medial side of the groin up to the heel plus 4 inches.

- b) Highest point on the medial side of the groin up to the heel plus 6 inches.
- c) Anterior superior iliac spine up to the heel plus 6 inches.
- d) Anterior superior iliac spine up to the heel plus 4 inches.

Question 11:

The splint shown below is used in the management of:



- a) Shaft of humerus fracture
- b) Brachial plexus injury
- c) Luxatio erecta
- d) Coracoclavicular ligament tear

Question 12:

Which of the following can be treated using the traction shown below?



- a) Fracture shaft of tibia
- b) Developmental dysplasia of the hip
- c) Fracture shaft of femur
- d) Pelvic fracture

Question 13:

Identify the following device.



- a) Cock-up splint
- b) Colles' cast

- c) Knuckle bender splint
- d) Dynamic finger splint

Question 14:

Identify the incorrectly matched pair of traction and its indication.

- a) Perkin's traction - Cervical spine injury
- b) Russell's traction - Trochantric fractures
- c) Halo-pelvic traction - Scoliosis
- d) Dunlop's traction - Supracondylar fracture of humerus

Answer Key

Question No.	Correct Option
1	a
2	a
3	c
4	b
5	b
6	b
7	a
8	a
9	b
10	b
11	b
12	c
13	a
14	a

Detailed Explanations

Solution to Question 1:

The instrument used in the elevation of the periosteum is a periosteal elevator shown in image A.

It is used to elevate the periosteum, as nerves and vessels are generally on this plane, and once elevated there is a safer plane for surgery.

Option B: The image shows a curette used for curetting a cavity in the bone or removing fibrous tissue from the ends of a fracture. It is used in the management of enchondroma, GCT, and osteomyelitis.

Option C: The image shows an osteotome. It has both sides beveled and is used for cutting bone in surgeries such as McMurray's osteotomy and corrective osteotomy.

Option D: It shows a bone gouge, a concave-bladed chisel used for cutting round bone surfaces or making holes in the bone.

Solution to Question 2:

The above radiograph shows a K-nail (Kuntscher nail), identified by the absence of interlocking screws. A cloverleaf shape is seen on cross-section. This is designed to give a good rotational stability.

Kuntschers clover leaf nail



©Marrow

K-nails have been used for the internal fixation of femur fractures, and fixation relies on the frictional fit between the nail and bone. It is based on the concept of three-point fixation i.e., at proximal and distal ends of the bone and at the isthmus (the narrowest part of the medullary cavity).

The eye at the end of the nail is useful for removing it after the fracture has healed.

Some common complications of K-nailing include:

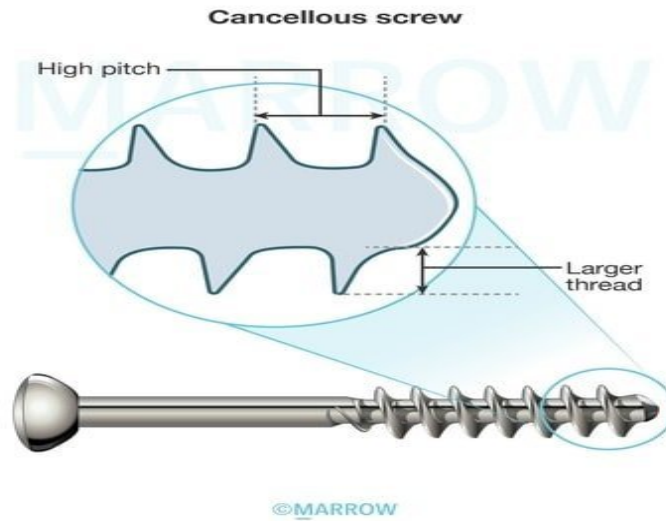
- The nail getting stuck
- Splintering of the cortex while hammering the nail
- Proximal migration of the nail, leading to bursitis over its protruding end
- Distal migration of the nail leading to stiffness of the knee

- Infection.

Solution to Question 3:

The given instrument is a cancellous screw.

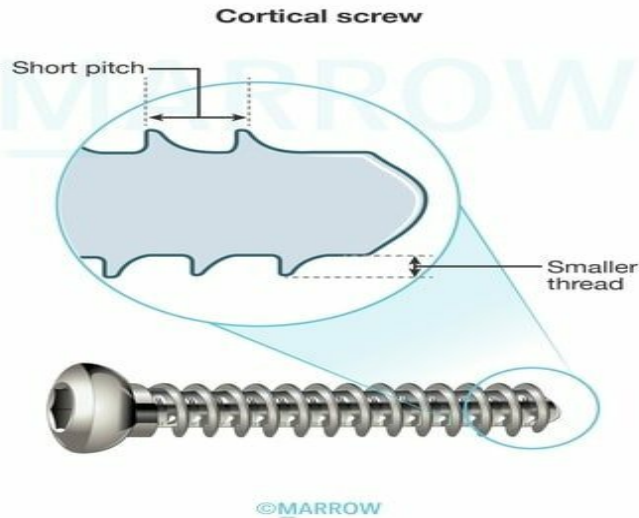
Cancellous screws have a larger thread and high pitch. Compression is produced by partial threading with a blunt tip.



A malleolar screw is a modified cancellous screw with a sharp-pointed tip.



Cortical screws have a smaller thread and low pitch. Compression is produced by over-drilling the proximal cortex.



Solution to Question 4:

Of the following, Kirschner's wire can be used in both the internal fixation of small bones and Ilizarov's technique.

Denham pin is used for giving skeletal traction in osteoporotic bone. It has threads at the center of the pin, as shown below.

Features	Steinmann's Pin	Kirschner's wire (K-wire)
Diameter	>1.5 mm	0.9 - 1.5 mm
Length	Short	Various sizes
Ends	One end sharp and the other blunt	Both ends are sharp
Uses	Internal fixation of fractures of long bones Used along with Bohler's stirrup for skeletal traction	Internal fixation of small bones Fixation of fractures in children Ilizarov's ring fixation system



Knowles pin may be used for impacted fractures, percutaneously for medically unfit persons, and for fractures in children.

Solution to Question 5:

The above radiograph depicts the lengthening of the limb using Ilizarov apparatus. The rate of compression/distraction is 1 mm per day, not 2 mm per day.

Ilizarov's technique is based on the principle of distraction osteogenesis. This is the mechanical induction of new bone which occurs between bony surfaces that are gradually pulled apart. Compression and distraction at the fracture site enhance osteogenesis.

A careful fracture of the bone is performed, followed by a short wait. The young callus formed is gradually distracted using a circular or unilateral external fixator system called a ring fixator. Transfixing thin Kirschner wires (K-wires) are the key components of the Ilizarov fixator regarding its axial stiffness. This affects the mechanobiological environment in which the bone heals.

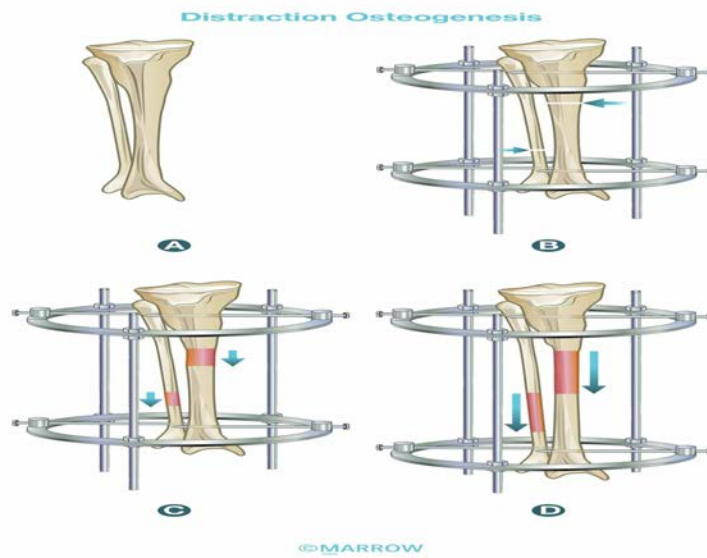
Distraction or compression can be applied by twisting nuts on the fixation system at the fracture or corticotomy site. Distraction or compression is carried out at the rate of 1 mm per day.

The uses of Ilizarov's apparatus are as follows:

- Limb lengthening
- Non-union
- Deformity correction
- Osteomyelitis - as it offers the possibility of liberal excision of bone
- Arthrodesis - crushing articular surfaces can stimulate union between opposing bones

Disadvantages of this technique include pin tract infection, nerve palsy, and joint stiffness.

The below images show the Ilizarov apparatus and an illustration of distraction osteogenesis.



Solution to Question 6:

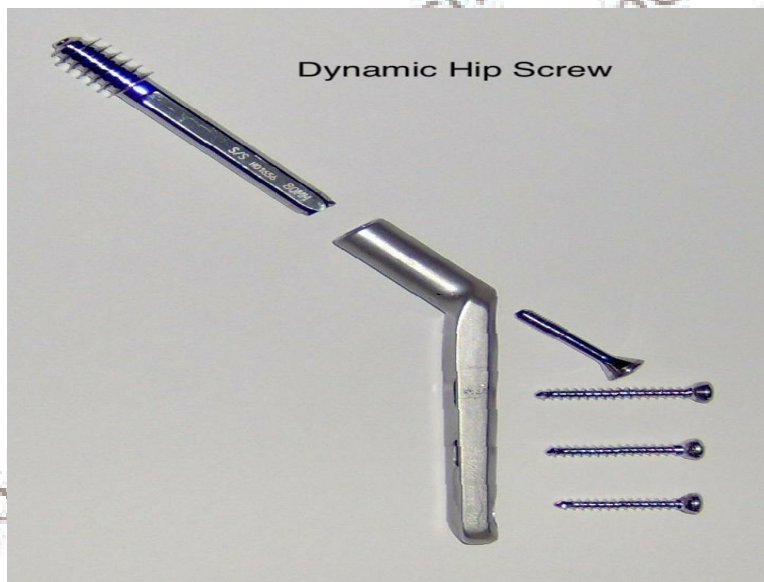
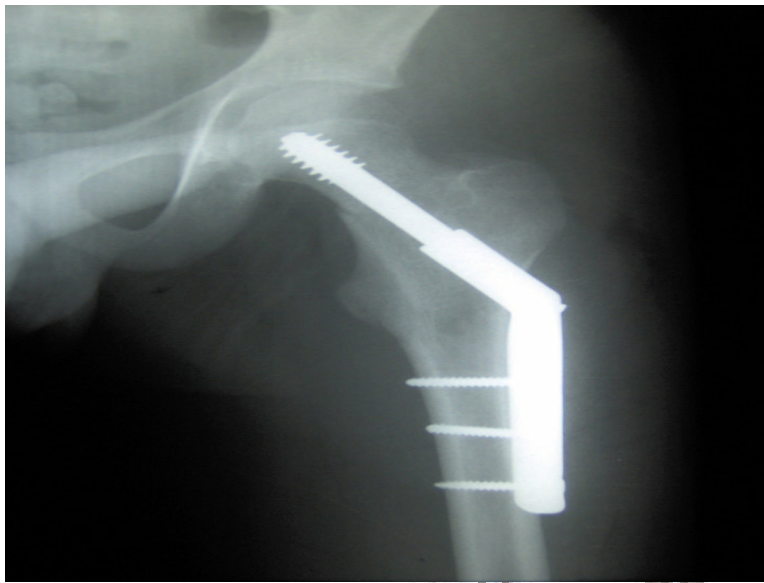
The above radiograph shows an extramedullary implant called a dynamic hip screw.

Intertrochanteric fractures of the femur can be treated by:

- Extramedullary implants - dynamic hip screw
- Intramedullary implants - proximal femoral nail and gamma nail.

Dynamic hip screws are used in undisplaced intertrochanteric fractures, whereas proximal femoral nails are used in displaced intertrochanteric fractures.

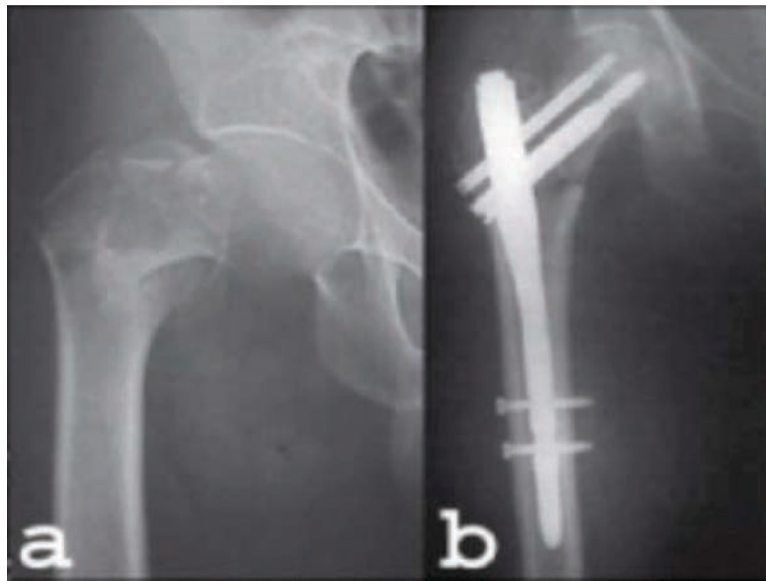
The below image shows a dynamic hip screw.



Advantages of using a proximal femoral nail over a dynamic hip screw include:

- Smaller incisions
- Reduced blood loss
- Decreased femoral neck shortening
- Decreased risk of infection

The below image shows a proximal femoral nail with locking and stabilization screws.



Proximal Femoral nail with locking and stabilisation screws



Austin Moore's implant is an older implant used in unipolar hemiarthroplasty. It can be identified by the fenestrations on the shaft of the prosthesis, as shown below.



Herbert screw is cannulated and threaded at both ends. It is designed for use in fractures of small articular bones such as carpals and scaphoid.



Herbert screw



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Solution to Question 7:

The instrument given is a bone nibbler, which is designed to remove or shape small sections of bone by gently nibbling or biting away at the bone tissue.

It is available in various sizes and with different angles of the nose:

- Straight nibbler – for general use.
- Curved nibbler – for spinal surgery.
- Double-action nibbler – straight or curved. The double-action reduces the force required for cutting the bone and is mechanically superior.

Solution to Question 8:

The above image shows a rail fixator.

In this type of external fixator, multiple pins are inserted into the bone. These pins are then attached to different blocks which can move over a track or rail.

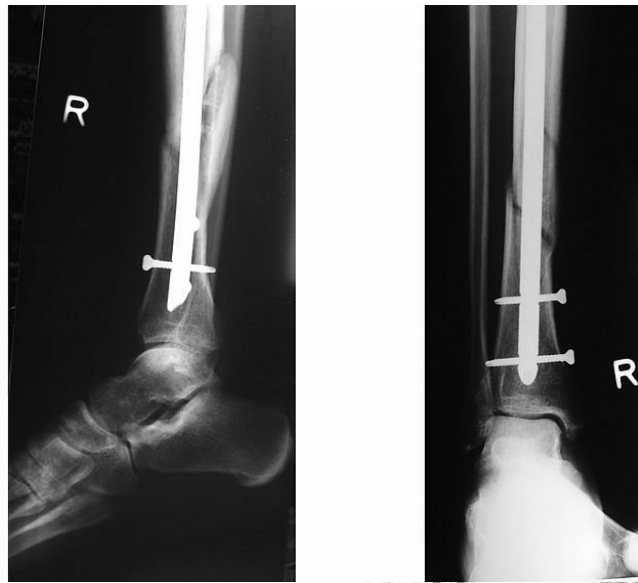
Given below is an Ilizarov ring fixator. Here, pins are attached to an adjustable ring system.



Tension band wiring is used in the fixation of transverse patellar fractures. In this method, two K-wires are used to transfix the reduced patellar fragments and a flexible wire is looped around them tightly.



The following X-ray image shows tibial intramedullary interlocking nailing.



Solution to Question 9:

The image shown is of bone holding forceps (Verbrugge forceps). It is used to hold the bone and plate.

It consists of a ratcheted clamp with a curved distal end.

Solution to Question 10:

The image shows the picture of a Thomas splint and its length is calculated by measuring the distance between the highest point on the medial side of the groin to the heel and adding 6 inches.

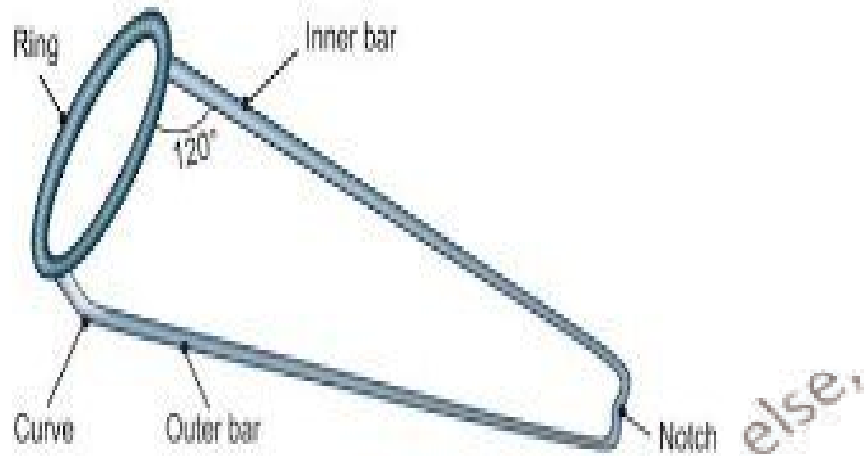
The ring size is calculated by adding 2 inches to the thigh circumference at the highest point of the groin.

The Thomas splint is used for immobilization following hip and thigh injuries.

Parts of the splint include:

- Outer bar
- Inner bar
- Ring

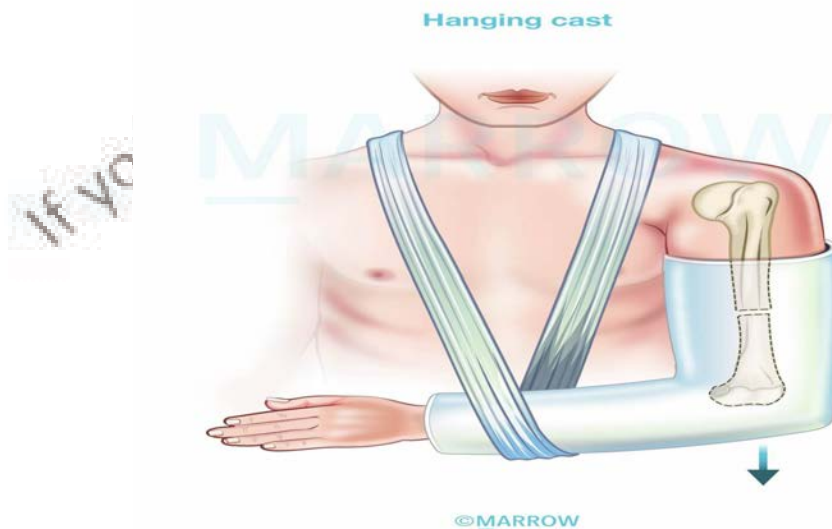
The outer bar has a curvature near its junction with the ring to accommodate the greater trochanter.



Solution to Question 11:

The above image shows the aeroplane splint, which is used in brachial plexus injury. It maintains the axilla at 90°.

A hanging cast is used to treat a shaft of humerus fracture.



Inferior dislocation of the shoulder is also known as luxatio erecta, as shown below. It is managed by closed reduction and post-reduction immobilization using a sling.

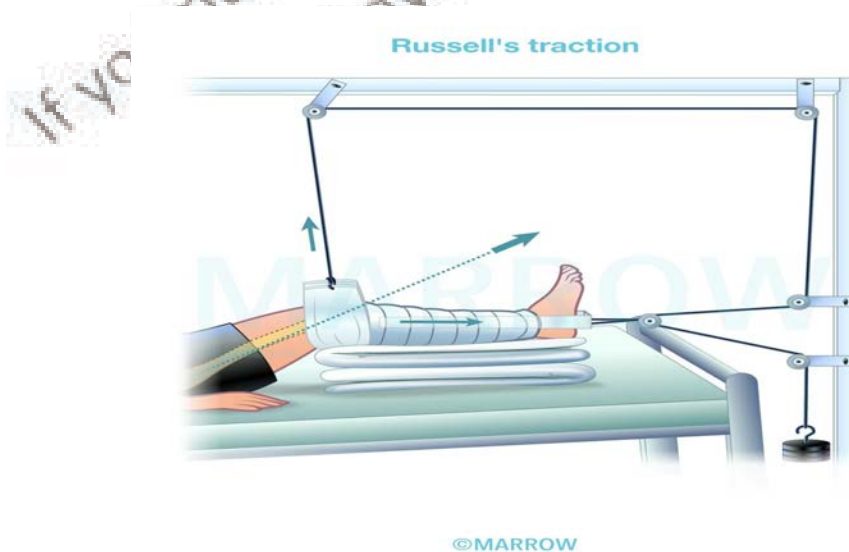


Solution to Question 12:

The image shows Gallow's traction which is used to treat fracture of shaft femur in children less than 2 years old and less than 12 kg in weight.

Here, skin traction is applied to both legs which are then suspended from a frame, providing just enough traction to keep the buttocks of the child just off the bed.

Older children are treated with Russell's traction or Thomas splint. After 2–4 weeks, when the fracture has sufficiently healed, it is replaced by a hip spica.



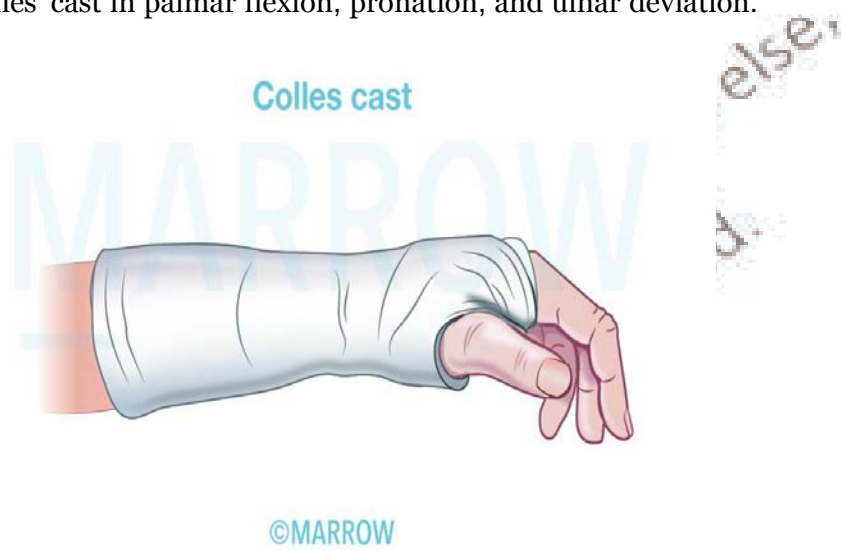
Solution to Question 13:

The device shown in the image is a cock-up splint. It is used to manage radial nerve palsy.

Radial nerve palsy manifests as an inability to dorsiflex the wrist and digits (wrist drop and finger drop). Numbness occurs on the dorsoradial aspect of the hand and the dorsal aspect of the radial 3 1/2 digits. The cock-up splint is designed to counteract the wrist drop position by holding the wrist in a slightly extended or neutral position, which helps prevent further contracture and allows for functional use of the hand.

Other options:

Option B: Undisplaced Colles' fracture is managed by immobilization in a below-elbow plaster cast for six weeks. Displaced fractures are managed by manipulative reduction followed by immobilization in Colles' cast in palmar flexion, pronation, and ulnar deviation.

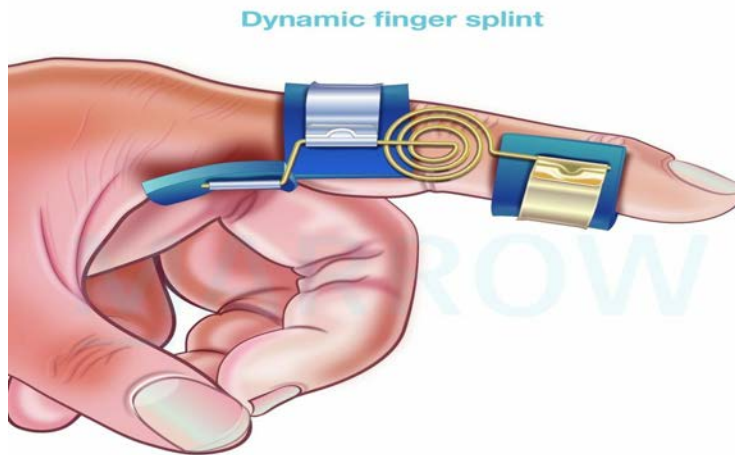


Option C: Knuckle bender splint is used in cases of ulnar claw hand where ulnar nerve recovery is anticipated. The splint can be used to correct and prevent metacarpophalangeal hyperextension by maintaining flexion as shown below.



Option D: Dynamic finger splint can be used for:

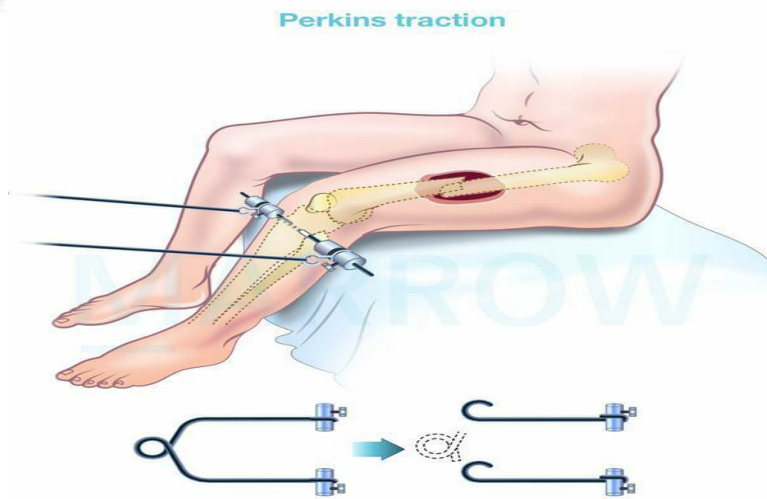
- Immobilization in case of fracture of the proximal phalanx
- Extensor tendon injuries of the finger
- Prevention of deformities in rheumatoid arthritis.
- Post-operative immobilization.



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Solution to Question 14:

Perkin's traction is used to treat fractures of the shaft of femur in adults, not cervical spine injuries.



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Trauma amputations, prosthetics and joint replacement surgery

Question 1:

Which of the following is the most common cause of amputations?

- a) Malignant bone tumours
- b) Crush injury
- c) Peripheral vascular disease
- d) Recurrent sepsis

Question 2:

Which of the following is not an indication for amputation?

- a) Fulminant gas gangrene
- b) Ankle-brachial index ≤ 0.45
- c) Severe peripheral vascular disease
- d) Transcutaneous oxygen tension 40mmHg

Question 3:

A construction worker is brought to the casualty following a crush injury to his right lower limb. Which of the following scores can be used to decide between amputation and limb-salvage surgery?

- a) Gustilo Anderson score
- b) Revised Trauma Score
- c) Mangled Extremity Severity Score
- d) Trauma Injury Severity Score

Question 4:

A patient suffering from leprosy is prescribed a Jaipur foot prosthesis in the rehabilitation center. Which of the following statements is true about this prosthesis?

- a) Restricted mobility
- b) Squatting is not possible
- c) Inversion and eversion are not possible
- d) Possible to walk on uneven ground

Question 5:

A patient presented to the casualty with left lower limb trauma. He underwent amputation of the limb and the tibial nerve was buried. After 2 months he presented with severe neurogenic pain with ambulation. What is the best treatment option for this patient?

- a) Intra-articular injection of steroids
- b) Transcutaneous electric nerve stimulation
- c) Revision surgery
- d) Interferential therapy

Question 6:

A blind patient from a low socioeconomic background suffered severe trauma to his upper limbs. The following procedure was performed on this patient. What is this amputation known as?



- a) Lisfranc's
- b) Syme's
- c) Chopart's

d) Krukenberg's

Question 7:

A patient presents with gangrene of the foot. On examination, there is necrosis extending up to the navicular bone without the involvement of the talus and calcaneum. Which amputation is more effective in the given condition without excessive loss of bone and soft tissue?

- a) Transmetatarsal
- b) Lisfranc's
- c) Chopart's
- d) Syme's

Question 8:

Amputation at the level of tarso-metatarsal joint is being performed in a patient with diabetic foot ulcer. What is this amputation known as?

- a) Chopart
- b) Pirogoff
- c) Syme
- d) Lisfranc

Question 9:

In which of the following conditions, is joint replacement surgery not done?

- a) Osteoarthritis
- b) Rheumatoid arthritis
- c) Ankylosing spondylitis
- d) Septic arthritis

Question 10:

Identify the option which is correctly matched with the name of the components marked in the picture.



- a) Option 1
- b) Option 2
- c) Option 3
- d) Option 4

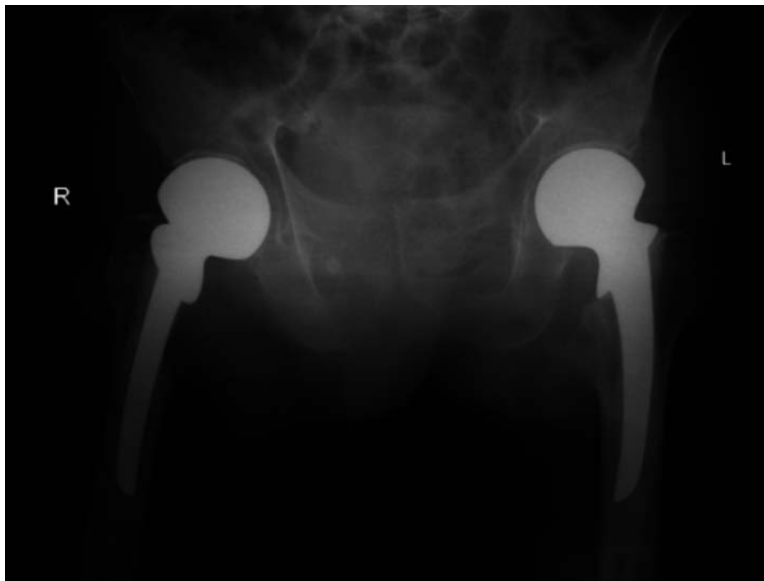
Question 11:

A young adult sustained a fracture in the shaft of the femur following a road traffic accident. Which among the following statements is incorrect regarding the correction of his condition?

- a) Russel traction may be used in this patient
- b) Metaphyseal fractures or fractures extending intra-articularly are the only indications for primary plating
- c) MIPO is a type of biological fixation
- d) Soft tissue damage is maximal in MIPO technique

Question 12:

Identify the prosthesis in the given image.



- a) Austin-Moore prosthesis
- b) Thompson prosthesis
- c) Jepson hip prosthesis
- d) Bohlmann prosthesis

Question 13:

Which of the following statements is false about metal on metal implants?

- a) High carbon cobalt chromium alloy has been shown to have lower wear rates
- b) It cannot be used in the patients with renal failure
- c) These implants are avoided in young females
- d) Patients with these implants have normal levels of cobalt and chromium levels in serum

Question 14:

Which of the following patients are at risk for heterotopic bone formation after hip arthroplasty?

- a) 2 and 3 only
- b) 1, 2 and 4 only
- c) 1,3 and 5 only
- d) 2,3,4 and 5 only

Question 15:

Uncemented arthroplasty is done in a patient with fracture of the neck of femur following prolonged steroid therapy. Which of the following statements is false about this procedure?

- a) It is usually preferred in younger patients
- b) The surface of the implant contains porous coating
- c) Hydroxyapatite decreases the formation of new bone
- d) Fixation of the prosthesis is by bone ingrowth

Question 16:

Which of the following is true regarding the scar tissue in patellar clunk syndrome?

- a) Superior pole of patella, impinging during flexion
- b) Superior pole of patella, impinging during extension
- c) Inferior pole of patella, impinging during flexion
- d) Inferior pole of patella, impinging during extension

Question 17:

De-gloving injury refers to _____

- a) Skin and subcutaneous fat are stripped from the underlying fascia
- b) Skin, subcutaneous fat and fascia are stripped from tendons
- c) Skin, subcutaneous fat, fascia and tendons are stripped from bone
- d) Only skin is stripped off

Question 18:

For which of the following conditions would a patient be prescribed the orthosis shown in the image below?



- a) Foot drop
- b) Pilon fracture
- c) Medial tibial stress syndrome
- d) Fracture of the calcaneum

Question 19:

Choose the wrong statement about the plaster cast wedging procedure.

- a) Procedure is done when there is incorrect correction of fracture
- b) It is used to correct angulation
- c) Plaster is cut off circumferentially above the level of fracture
- d) A cut is forced open on the concave side of angulation

Answer Key

Question No.	Correct Option
1	c
2	d
3	c
4	d
5	c

6	d
7	c
8	d
9	d
10	b
11	d
12	b
13	d
14	d
15	c
16	b
17	a
18	a
19	c

Detailed Explanations

Solution to Question 1:

Peripheral vascular disease is the most common cause of amputations.

Amputation is defined as removal of the limb through a part of the bone. Disarticulation is the removal of the limb through the joint.

Causes of amputations can be classified into 3Ds:

1. Dead

- Peripheral vascular disease
- Severe trauma
- Burns
- Frostbite

2. Dangerous

- Malignant tumour
- Potentially lethal sepsis
- Crush injury

3. Damned nuisance

- Severe pain
- Gross malformation

- Recurrent sepsis
- Severe loss of function

Note: In India, road traffic accidents (RTAs) are the top cause, while globally, peripheral vascular diseases, often linked to diabetes, are more common. Overall, peripheral vascular disease occurs more frequently than RTAs worldwide, unless the question specifies the primary cause in India, which would be crush injuries from RTAs.

Solution to Question 2:

Transcutaneous oxygen tension values below 20 mmHg are an indication for amputation.

Fulminant gas gangrene, ankle-brachial index ≤ 0.45 , and severe peripheral vascular disease are indications for amputation.

Transcutaneous oxygen pressure measurement is believed to be the most reliable and sensitive test for wound healing. The pressure may be falsely low in areas of edema, cellulitis, and venous stasis changes.

Solution to Question 3:

Mangled Extremity Severity Score (MESS) score can be used to decide between amputation and limb salvage in crushing injuries.

Components of MESS are:

- Shock
- Ischemia
- Velocity
- Age

Total score is 11. Six or less is consistent with a salvageable limb.

Other scores to assess if the limb is salvageable or not are:

- Limb salvage index
- Ganga score

Option A: Gustilo Anderson Classification is used to classify open fractures.

Option B: Revised Trauma Score (RTS) characterizes the injured patient's condition by incorporating the Glasgow Coma Scale (GCS), systolic blood pressure, and respiratory rate.

Option D: Trauma Injury Severity Score (TRISS) comprises Injury Severity Score (ISS), Revised Trauma Score (RTS), age of the patient and mechanism of Injury (blunt/penetrating).

Solution to Question 4:

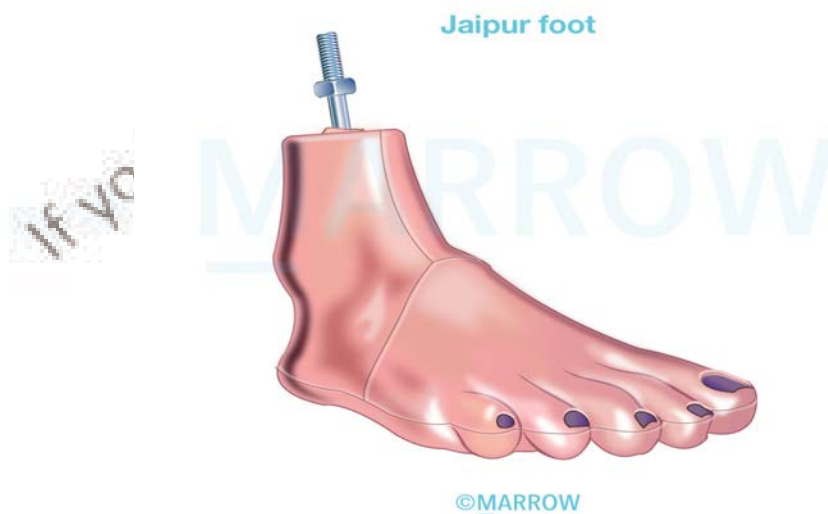
It is possible to walk on uneven grounds with Jaipur foot prosthesis as subtalar movements (inversion and eversion) are present.

Different types of foot prostheses are:

- Jaipur foot
- Solid ankle cushion heel (SACH)
- Stationary attachment flexible endoskeleton (SAFE), similar to Jaipur foot.

The above features make the Jaipur foot more suitable for the Indian scenario.

Prosthesis	SACH	Jaipur foot
Appearance	Does not look normal	Looks normal
Walking barefoot	Not possible	Possible
Mobility	Restricted	Allowed
Dorsiflexion	Absent	Present
Inversion/Eversion	Absent	Present
Squatting	Not possible	Possible
Cost	High	Low



Solid ankle cushion heel (SACH)



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Solution to Question 5:

Revision of transtibial amputation should be done in a patient experiencing exquisite neurogenic pain with ambulation as buried tibial nerve can form postoperative neuroma.

Transected nerves should not be buried, placed on tension, or compressed as doing so will promote the development of a postoperative neuroma. They should simply be transected sharply and allowed to retract into the soft tissues proximally.

Transcutaneous electrical nerve stimulation (TENS) is the use of electric current produced by a device to stimulate the nerves for the treatment of mild to moderate pain in acute or chronic setting. Interferential current therapy (ICT) is another variant of TENS, but works at a much deeper level of the targeted tissue.

Solution to Question 6:

The given image is of Krukenberg's amputation.

In this procedure, the radius and ulna are split to make a pincer mechanism. It has been recommended in blind patients with bilateral below-elbow amputation or in patients who can't afford expensive prostheses (to provide some amount of function).

Solution to Question 7:

In the given scenario, Chopart's amputation is preferred because the talus and calcaneum are not necrotic and can be preserved.

Chopart's amputation is done at the level of transverse tarsal joints i.e between the articulation of calcaneus with the cuboid and the articulation of talus with navicular bone.

Solution to Question 8:

Amputation at the level of tarso-metatarsal joint is known as Lisfranc amputation.

Solution to Question 9:

Joint replacement surgery is not done in septic arthritis.

Active infection at the joint is an absolute contraindication for joint replacement surgery.

Solution to Question 10:

Components of total knee replacement prosthesis are:

- Femoral component (A)
- Patellar button (B)
- Plastic spacer tibial base plate (C)
- Tibial implant (D)



Solution to Question 11:

In MIPO (minimally invasive plate osteosynthesis) technique, soft tissue damage is minimal.

MIPO is a type of bridge plating or biological fixation (option C). Here, the plate is fixed proximally and distally and the central fracture area is rendered untouched. Hence, fracture hematoma and soft tissue damage are minimised.

Option A: Gallow's traction, hip spica and Russel traction are measures commonly used in children. But Russell's traction can also be used in adults as a first-aid measure.

Option B: Metaphyseal fractures or fractures extending intra-articularly are the only indications for primary plating.

Solution to Question 12:

The given image shows Thompson's prosthesis.

Thompson prosthesis is used in hemiarthroplasty to replace the head of the femur. It is specially indicated in cases where the neck of the femur is absorbed. It can be used with or without cement.

Thompson prosthesis has no fenestrations. Austin-Moore prosthesis contains two fenestrations in the stem which are for the growth of bone as shown in the images below.





Solution to Question 13:

Patients with metal on metal implants have high levels of cobalt and chromium in serum, erythrocytes, and urine.

High carbon cobalt-chromium alloy carbides are 5 times harder than the metal matrix and have lower wear rates.

Impaired renal function leads to increased accumulation of cobalt and chromium compounds in the blood and hence, contraindicated in patients with renal failure. They are also transported through the placenta, hence they are not used in women of childbearing age.

Solution to Question 14:

Preoperative radiation is effective in preventing heterotopic bone formation after hip arthroplasty.

Risk factors for heterotopic bone formation after hip arthroplasty are:

- Posttraumatic arthritis
- Hypertrophic arthritis
- Diffuse idiopathic skeletal hyperostosis
- Paget's disease
- Ankylosing spondylitis
- History of heterotopic bone formation in either hip

Heterotopic bone formation around the hip is seen in about 20% of patients 5 years after joint replacement. Treatment consists of NSAIDs for 3–6 weeks post-operatively or a single dose of radiation.

Solution to Question 15:

In uncemented arthroplasty, hydroxyapatite increases the formation of new bone.

Uncemented arthroplasty is preferred in younger patients. Prosthesis contains pores or mesh on the surface to enhance bone growth. The prosthesis stem remains attached to the bone by bone ingrowth.

Solution to Question 16:

In patellar clunk syndrome, the scar tissue which is formed at the superior pole of the patella becomes impinged during knee extension.

Patellar clunk syndrome is seen after posterior-stabilized knee arthroplasty. A fibrous nodule forms on the posterior surface of the quadriceps tendon just above the superior pole of the patella. This can become entrapped in the intercondylar notch of the femoral prosthesis and cause the knee to "clunk" at 30- 45 degrees to the femoral axis while the patient actively extends the knee.

The recommended treatment is arthroscopic debridement of the nodule.

Solution to Question 17:

Degloving is the avulsion of skin and subcutaneous fat from the underlying fascia, muscle or bone.

Degloving injuries can be open or closed. An example of open degloving injury is finger avulsion injury with loss of skin. Closed degloving injuries result from shearing forces (e.g. motor vehicle collisions).

The extent of degloving injuries are often underappreciated and much of the skin may be non-viable. Disruption of perforating vascular and lymphatic vessels may result in a characteristic haemolympathic collection between the fascial planes called a Morel-Lavallée lesion.

Patterns of degloving injury:

- Limited degloving with abrasion or avulsion
- Non-circumferential degloving
- Circumferential single plane degloving
- Circumferential multiplanar degloving

Assessing the viability of degloved tissue can be difficult and may therefore require more than one surgical exploration and debridement before definitive reconstruction. Non-viable skin may show fixed staining and thrombosis of subcutaneous veins. Most surgeons serially excise the degloved skin until punctate dermal bleeding is seen from viable tissue.

Intravenous fluorescein can help in delineating non-viable tissue, but it requires specialist equipment and there is a small risk of anaphylaxis. Indocyanine green has been found to have less

risk of allergy.

Open degloving injuries are managed by reattaching the viable skin and grafting. Closed degloving injuries are managed by draining the accumulated fluid, removing the dead tissue and sclerotherapy. For severe, multiplanar degloving, amputation is done.

The given image below shows a degloving injury of the lower limb:



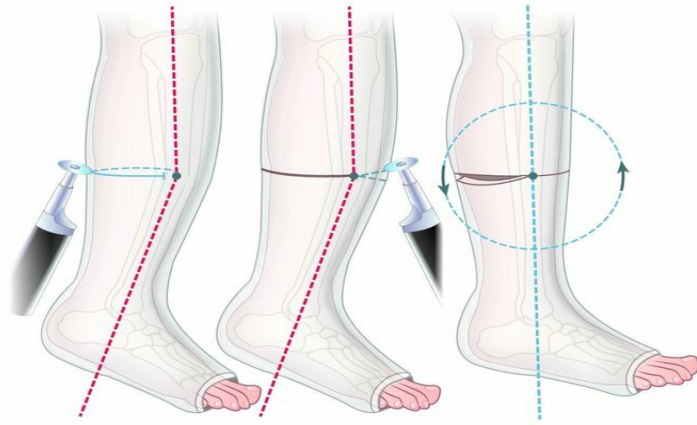
Solution to Question 18:

The given image shows ankle-foot orthosis (foot drop brace) which is commonly used in foot drop. Foot drop occurs due to common peroneal nerve injury.

Solution to Question 19:

The technique of plaster cast wedging involves the plaster cast being cut circumferentially at the level of fracture and not above the level of the fracture.

In certain situations, after the fracture is reduced and the plaster applied, a check x-ray may show some angulation. The angulation is corrected by forcing open a cut on the concave side of the angulation and the plaster is reinforced with extra bandages.



else,

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Sports Injury

Question 1:

You notice your senior resident performing the following test in a patient with an acute painful knee. Identify the test.



- a) Anterior drawer test
- b) McMurray's test
- c) Lachman test
- d) Apley's test

Question 2:

A young footballer is brought to the OPD by his teammates. He says that while tackling his opponent, he had heard a sudden 'pop' followed by severe pain in his right knee. On examination, the joint appears slightly swollen. Which of the following statements is false about his injury?

- a) It is a component of the O' Donoghue triad
- b) It can lead to hemarthrosis
- c) Anterior drawer test is preferred for evaluation
- d) Intercondylar fractures of tibia can lead to this injury

Question 3:

The unhappy triad of O'Donoghue refers to :

- a) Damage to medial meniscus, LCL, and PCL
- b) Damage to medial meniscus, ACL, and MCL
- c) Damage to lateral meniscus, ACL, and MCL
- d) Damage to lateral meniscus, LCL, and PCL

Question 4:

A 26-year old athlete presented with sudden pain in her right knee after performing a heavy deadlift. On examination of the joint, swelling is present and McMurray's test is positive. X-ray appears normal. Which of the following structures is likely to be injured?

- a) Anterior cruciate ligament
- b) Posterior cruciate ligament
- c) Menisci
- d) Collateral ligaments

Question 5:

What is the most likely mechanism of injury in a patient with a meniscal tear?

- a) Hyperextension force
- b) Rotational force
- c) Valgus force
- d) Varus force

Question 6:

A young man presented to your OPD with pain and swelling over the right knee following a traumatic injury. Aspiration of the joint revealed hemarthrosis. Injury to which of the following structures would not have led to this presentation?

- a) Lateral meniscus
- b) Anterior cruciate ligament
- c) Posterior cruciate ligament

d) Medial collateral ligament

Question 7:

Which of the following tests would be positive in a patient suspected to have tibial collateral ligament injury?

- a) Dial test
- b) Abduction stress test
- c) Adduction stress test
- d) Lachman test

Question 8:

A patient presented with complaints of recurrent patellar dislocation. Which of the following would not be a cause for this condition?

- a) Excessive joint laxity
- b) Small patella
- c) Patella alta
- d) Patella baja

Question 9:

A 22-year-old ballerina presented with severe pain following an injury to her right ankle while practicing a pirouette. On examination, tenderness and swelling were noted around the medial malleolus. X-ray showed the following finding. What is the structure most likely to be injured in this patient?



- a) Anterior talofibular ligament
- b) Spring ligament
- c) Deltoid ligament
- d) Talonavicular ligament

Question 10:

A 30-year-old squash player came limping to your OPD with pain and swelling above his left heel, as shown below. On examination, Thompson's test was also positive. What is the most likely diagnosis?



- a) Anterior talofibular ligament injury

- b) Calcaneal spur
- c) Achilles tendon rupture
- d) Achilles tendinitis

Answer Key

Question No.	Correct Option
1	a
2	c
3	b
4	c
5	b
6	d
7	b
8	d
9	c
10	c

Detailed Explanations

Solution to Question 1:

The test shown in the image is the anterior drawer test. This is done to detect injuries to the anterior cruciate ligament (ACL).

The patient is made to lie supine on the examining table. The hip is flexed to 45° and the knee is flexed to 90° with the foot flat on the examination table. The upper end of the tibia is held in both hands and is gently pulled anteriorly. Increased displacement compared to the normal knee indicates injury to the ACL.

Lachman test is also done to detect injuries to the anterior cruciate ligament. Here the leg is in slight external rotation and the knee is in a mid-flexed to 20° position. One hand is placed to stabilize the femur, while another hand applies the anterior force to the proximal tibia, as shown below.



Apley's grinding test and McMurray's test are done to detect meniscal injuries.

Solution to Question 2:

The above clinical scenario points to a diagnosis of anterior cruciate ligament injury. Lachman test is preferred in a swollen and acutely painful knee.

The anterior drawer test is not preferred in a painful knee, as it may not be possible to carry out the test in the conventional 90° flexed position.

Lachman test: The leg is kept in slight external rotation and the knee is in a position between flexion and extension. One hand is placed to stabilize the femur, while another hand applies the anterior force to the proximal tibia, as shown below.



The ACL is an intraarticular extra-synovial structure. Hence patients with an ACL injury can present with hemarthrosis. It is attached to the intercondylar area of the tibia, therefore intercondylar tibial fractures can lead to ACL injury.

Solution to Question 3:

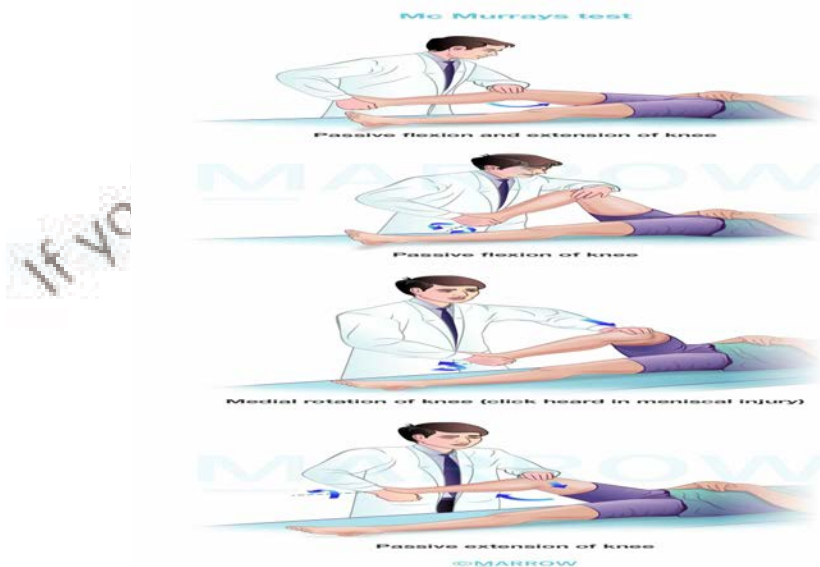
O' Donoghue triad refers to the injury of:

- Anterior cruciate ligament (ACL)
- Medial (tibial) collateral ligament (MCL)
- Medial meniscus

Solution to Question 4:

The given clinical scenario and a positive McMurray's test indicate a meniscal injury.

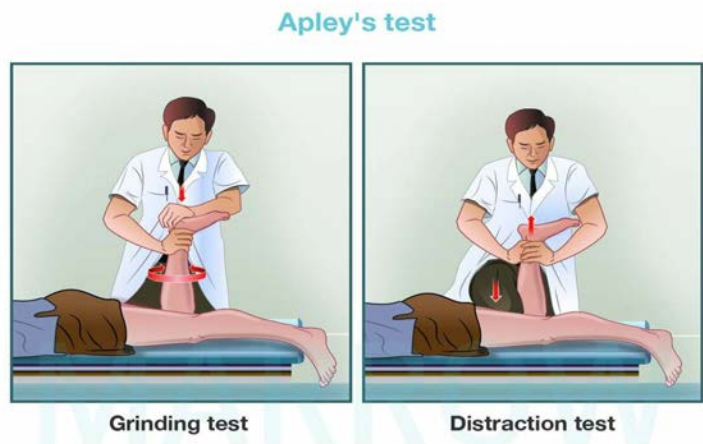
In this test, the patient is made to lie in the supine position and the knee is completely flexed. One hand is used to stabilize and palpate the knee joint, while the other hand is used to internally or externally rotate the leg, depending on which meniscus is to be tested. The leg is then slowly extended. Any palpable or audible click indicates injury to the menisci.



Other tests used to detect meniscal injury include:

- Apley's grinding test
- Thessaly test
- Squat test
- Ege's test
- Joint line tenderness test

Apley's test: In this test, the patient is made to lie in the prone position. The knee is flexed to 90° and rotated while a compression force is applied, which is called the grinding test. The reproduction of symptoms indicates a torn meniscus. The distraction test involves repeated rotation while the leg is pulled upwards by the examiner, holding the thigh down. This produces increased pain only if there is ligament damage.



Thessaly test: With the affected knee flexed to 20° and the foot placed flat on the ground, the patient bears his full weight on that leg while being supported by the examiner. The patient is then asked to twist his or her body to one side and then to the other three times. This test has shown a high diagnostic accuracy rate (95%) in detecting meniscal tears.



Solution to Question 5:

Meniscal injury is mainly caused by rotational force on a partially flexed knee.

The rotational forces at the knee compress and rotate the menisci anteriorly or posteriorly, causing a tear. The medial meniscus is less mobile than the lateral meniscus and hence is more prone to injury.

Solution to Question 6:

Medial collateral ligament injury does not lead to hemarthrosis, as it is an extra-articular structure.

The cruciate ligaments and menisci are intra-articular structures and hence their injury leads to hemarthroses.

Solution to Question 7:

In a patient with an injury to the tibial (medial) collateral ligament, the abduction or valgus stress test would be positive.

The abduction or valgus stress test is done as follows:

- The patient is made to lie in the supine position.
- One hand of the examiner is placed on the lateral aspect of the knee for support.
- The other hand is placed over the ankle.
- Gentle abduction or valgus stress is applied to the knee while the hand at the ankle externally rotates the leg slightly, and the knee is flexed to 30°.

The test is said to be positive when pain is reproduced, or there is excessive gapping at the medial joint. The below image shows the abduction or valgus stress test.



Adduction or varus stress test is positive in patients with a lateral collateral ligament injury.

Dial test is used to assess the posterolateral instability. This occurs when there is damage to the lateral collateral ligament, popliteofibular ligament, and popliteus tendon.

Solution to Question 8:

Patella baja is an abnormally low-lying patella and is not responsible for recurrent dislocation of the patella.

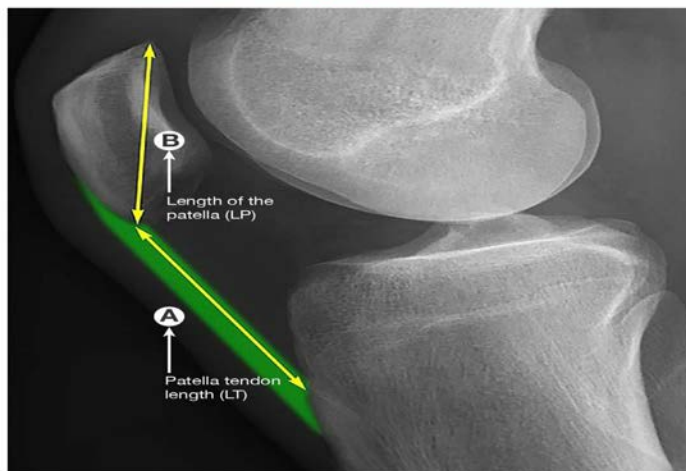
Causes for recurrent dislocation of the patella include:

- Excessive joint laxity as in connective tissue disorders like EDS, Marfan's syndrome
- Patella alta - the patella is high-lying in the shallow part of the inter-condylar groove
- Trochlear dysplasia
- Small patella
- Genu valgum

Given below is a lateral radiograph of the knee joint showing the Insall-Salvati index. This is the ratio of the patella tendon length (LT) to the length of the patella (LP).

- In patients with high-lying patella, the ratio is above 1.2. This is known as patella alta.
- In patients with low-lying patella, the ratio is below 0.8. This is known as patella baja.

Insall-Salvati index
Lateral radiograph of the knee



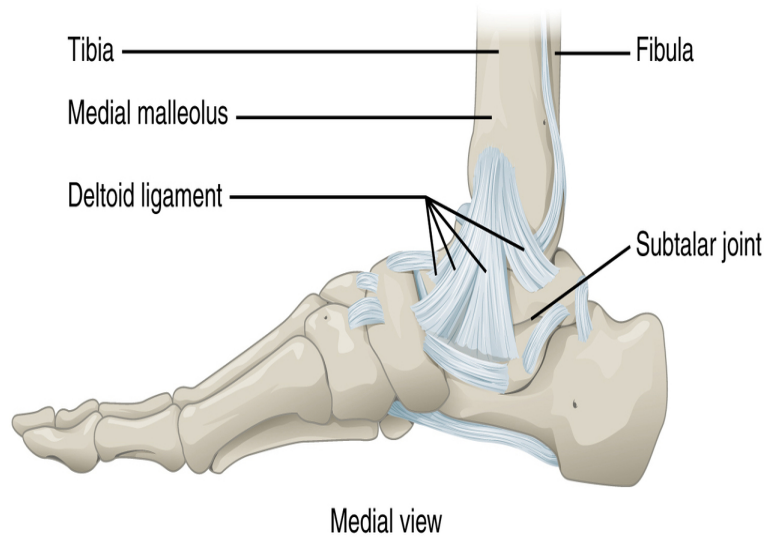
Solution to Question 9:

The presence of swelling around the medial malleolus and increased medial joint space on radiography indicates injury to the deltoid ligament.

The deltoid ligament is present on the medial side of the ankle joint and the fibers are attached to the medial malleolus. Hence injury to it can lead to the widening of the medial joint space, best

visualized on the mortise view of an ankle radiograph.

The below image shows the attachment of the deltoid ligament.



Solution to Question 10:

The above clinical scenario and positive Thompson's test point to a diagnosis of Achilles tendon rupture.

Achilles tendon rupture is usually seen in those playing sports like squash, badminton, and football. The pain is acute and the patient can feel a ripping or popping sensation at the back of the heel. The patient would be unable to plantarflex the affected foot.

In Thompson's test, the patient lies prone with his foot over the end of the examination table. The examiner squeezes the calf muscles, specifically the gastrocnemius-soleus complex, with his hand. This should normally cause contraction of the Achilles tendon, resulting in plantar flexion. If the Achilles tendon is completely ruptured, plantar flexion would be absent.

Achilles tendinitis is usually seen in athletes, joggers, and hikers. It is caused due to the local irritation of the tendon sheath. Patients present with gradually progressive pain over the Achilles tendon. On examination, there may be thickening of the tendon with inflammation over the affected area.

Ultrasound may be needed to exclude tendon tear or rupture. It is usually treated by physiotherapy.