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MCQs – Adult Pathology – Single Best Answer

- A 42-year-old builder sustains an injury to his knee while playing football. An MRI scan of his knee reveals an isolated posterior cruciate ligament (PCL) injury. What would be the most appropriate management step in this situation?
Answer: c. Immobilisation in a PCL brace.
 There are no published series that report improved results of surgical treatment versus conservative management for isolated posterior cruciate ligament tears. Treatment should consist of a knee brace in full extension with the tibia lifted forward for six weeks followed by graduated mobilisation.¹
- Which of the following nerves is at risk while performing a surgical repair of the tendo Achilles?
Answer: a. Sural nerve.
 The sural nerve passes lateral to the tendo Achilles and can be injured during repair of the tendon. Making a skin incision slightly medial to the tendo Achilles when performing a surgical repair can reduce this risk.²
- Which of the following prosthetic areas is termed as zone IV of the Gruen zone classification?
*Answer: a. The medullary distal tip of the prosthesis and the cement.*³
- All of the following are involved in the regulation of the activity of osteoclasts except:
*Answer: e. Insulin.*⁴
- Most post-operative deep infections in total hip replacements result from:
Answer: a. Airborne bacteria in the operating room.
 Sir John Charnley⁵ first published evidence about this risk factor for post-operative prosthetic infection and developed clean-air operating enclosures, which greatly reduced the rate of infection.

Vivas

Adult Pathology

A 62-year-old lady who underwent a total hip replacement four weeks ago presents to A & E following a fall with severe pain and inability to weight-bear. This is her radiograph (Fig. 1).

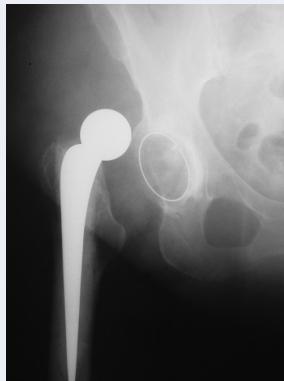


Fig. 1

- Describe the abnormal findings on the radiograph.
Answer: The patient has a total hip replacement with a cemented acetabular component and a cemented stem. There is a dislocation of the femoral head and the femoral shaft is externally rotated. This would be consistent with an anterior dislocation although I would want to correlate this with clinical examination. Both components seem to be well-fixed, although the version of the acetabular component is not ideal. A
- What further information would you like to obtain on history?
Answer: I would like to know what the patient was doing when she dislocated her hip. Did she have any other symptoms prior to this fall and was her collapse preceded by pain in the hip? If this were the case, it would imply that the dislocation was the cause of the fall. Has the patient been systemically well since her discharge or has she shown any signs of infection?
- What further investigations would you request, if any?
Answer: I would request a lateral radiograph of the hip, and routine bloods including inflammatory markers to rule out infection. Once the hip has been reduced, I would consider requesting a CT scan of the pelvis to determine the degree of anteversion of the femoral stem and the degree of version of the acetabular component.
- What is the diagnosis?
Answer: The patient has a dislocation of her total hip replacement.
- What are the causes for a dislocation following a total hip replacement?
Answer: The causes of dislocation include component design, component alignment, soft-tissue problems with tensioning and soft-tissue function.⁶
- What treatment would you offer her? Why?
Answer: I would take the patient to the operating theatre on an urgent basis to reduce the dislocation

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and perform an examination under anaesthetic (EUA). This would enable me to determine the positions that the hip is unstable in. Depending on the results of the EUA and any further imaging, I would treat the patient conservatively or offer surgical revision of the component/s.

Trauma

A 22-year-old student fell off his bicycle and sustained an injury to his elbow. These are the radiographs obtained in A & E (Figs 2a and 2b).



Fig. 2a



Fig. 2b

1. Describe the abnormality on the radiographs.

Answer: There is a comminuted fracture of the proximal ulna and a posterior dislocation of the radio-capitellar joint. There does not appear to be an associated fracture of the radial head or neck.

2. What is the diagnosis?

Answer: This is a Monteggia fracture-dislocation.

3. How would you classify this injury?

Answer: Bado⁷ classified this fracture pattern in 1967 into four types and this is a Bado type II fracture.

4. What other structures are likely to be involved in this injury?

Answer: The posterior interosseous nerve can be injured with this fracture pattern. If the nerve was damaged at the time of injury and the radial head reduces easily, the nerve injury is likely to be a neuropraxia and does not require surgical exploration at the time of fracture fixation. The annular ligament can also be ruptured.

5. How would you like to treat this patient?

Answer: I would treat this patient surgically. I would reduce the radio-capitellar dislocation and perform an open reduction and internal fixation of the ulna. Restoring ulna length with a comminuted fracture can be difficult and I would reduce the radial head first to act as guide for this. After the fracture is fixed, I would evaluate the stability of the radio-capitellar joint. If this is found to be unstable, the usual cause is non-anatomical fixation of the ulna and so I may have to consider revising my fixation. Persistent instability can be caused by rupture of the annular ligament and this would also need to be repaired if this was the case.⁸

Hands

A 6-year-old boy was brought to A & E following a fall at home, complaining of pain in his wrist. These are the radiographs obtained in A & E (Figs 3a and 3b).

1. Describe the radiographs.

Answer: The radiographs show a stable dorsal buckle fracture of the distal radius in a patient with an immature skeleton.

2. What is the diagnosis?



Fig. 3a



Fig. 3b

Answer: Incomplete buckle fracture of the distal radius. Also known as a Torus fracture.

3. Describe the pathomechanics of this specific pattern of injury.

Answer: This fracture is the result of a supination force exerted on the distal forearm following a fall onto the radial side of the hand. Torus fractures are extremely common injuries in children. Because children have softer bones, one side of the bone may buckle upon itself without disrupting the other side, leading to an incomplete fracture. The word 'torus' is derived from the Latin word 'Tori' meaning swelling or protuberance.

4. How would you treat him at this stage?

Answer: If the child is compliant and the parents understanding, I would treat this fracture in a 'Futura-type' wrist splint or a self-removable light weight cast for 3-4 weeks to provide pain relief and protect the fracture with no further follow-up. If there is significant parental concern/anxiety I would apply a lightweight synthetic below-elbow cast for the same period of time and remove this in the clinic. This is a stable fracture and does not routinely require follow-up.^{9,10}

5. What is the prognosis?

Answer: The prognosis is normal function and development of the limb with rapid return to all activities and no long-term implications.

Children's Orthopaedics

This is the clinical photograph and radiograph of a four-day-old baby who is not moving his left arm (Figs 4a and 4b).



Fig. 4a



Fig. 4b

1. What is the diagnosis and how could you confirm it?

Answer: The diagnosis is traumatic separation of the lower humeral epiphysis. The radiograph shows an anteroposterior view of the

humerus and a lateral of the forearm. The diagnosis could be confirmed nowadays by a MRI scan.¹¹

2. How would you treat the condition?

Answer: For treatment a simple bandage is sufficient. The injury will heal rapidly and remodel. Fig 4c shows appearances one year later.



Fig. 4c

Here is a photograph and radiograph of an eighteen-month-old child (Figs 5a and 5b).

1. What is the condition and how would you manage this case?

Answer: The condition is polydactyly. There is a six-ray foot with duplication of toes in the second ray.

The management is to confirm there are no associated abnormalities, followed by resection of the second ray.

The operative photograph and result are shown in Fig. 5c and 5d.



Fig. 5a



Fig. 5b



Fig. 5c



Fig. 5d

Basic Science

1. Describe the structure of bone.

Answer: The structure of bone consists of cortical lamellar bone and cancellous trabecular bone. The main structural unit within cortical bone is the Haversian system with its central neurovascular channels enclosed within concentric lamellae and separated from the interstitial lamellae, remnants of lamellae from the Haversian system, by cement lines. This cortical layer forming the outer surface of bone surrounds, and connects

with, the less dense cancellous bone with its lattice honeycomb and interconnecting trabeculae made up of parallel sheets of lamellae.

2. What are the main types of bone cells and what are their functions?

Answer: The main types of bones cells, and their function, are as follows:

- Osteoblast: bone forming cells
- Osteoclast: bone resorbing cells
- Osteocyte: calcium and phosphate homeostasis
- Osteoprogenitor cell: precursors to osteoblasts that line the Haversian system and can be stimulated to differentiate into osteoblasts and form new bone.
- Bone lining cells: inactive osteoblasts

3. How do osteoclasts resorb bone?

Answer: Osteoclasts resorb bone by binding to the bone surface using integrin anchor proteins and secreting protons into the sealed area produced with a carbonic anhydrase system allowing dissolution of hydroxyapatite mineral matrix. They also secrete proteolytic lysosomal enzymes which hydrolyse the organic cellular components.⁴

4. What do you understand by the term remodelling? Describe the process.

Answer: Remodelling is the process whereby the structure of bone is transformed from disorganised, haphazard immature bone to organised lamellar bone by osteoclast cutting cones. The osteoclasts dissolve the inorganic matrix by acid secretion and as they move forwards the resorption cavity is occupied by osteoblasts that lay down osteoid before it is calcified.

5. How and where does bone derive its blood supply from?

Answer: The blood supply to bone is derived from three sources:

- The high-pressure nutrient artery system. The nutrient arteries are branches of the systemic circulation and enter the bony mid-diaphysis through the nutrient foramen passing to the medullary canal before branching into ascending and descending vessels and arteriolar branches supplying the inner two-thirds of the diaphyseal cortex (endosteal circulation).
- The metaphyseal-epiphyseal system is the peri-articular vascular complex that penetrates the cortex and supplies the metaphysis, physis and epiphysis with end-arterioles.
- The periosteal system. The low-pressure periosteal circulation supplies the outer third of the cortex and consists of an extensive network of capillaries covering the length of the diaphysis.

6. Describe the structure of the periosteum.

Answer: The periosteum consists of an outer layer of fibroblasts and an inner layer of osteoblasts. The outer fibrous layer is structural and continuous with the joint capsule while the inner cambial layer is vascular, osteogenic and contributes to bone growth and fracture healing.⁴

References

- Dowd GS.** Reconstruction of posterior cruciate ligament: indications and results. *J Bone Joint Surg [Br]* 2004;86-B:480-91.
- Hoppenfeld S, deBoer P.** *Surgical exposures in orthopaedics: the anatomic approach.* Third ed. Philadelphia: Lippincott, Williams & Wilkins, 2003:653.
- Gruen TA, McNeice M, Amstutz HC.** "Modes of failure" of cemented stem-type femoral components: a radiographic analysis of loosening. *Clin Orthop* 1979;141: 17-27.
- Ramachandran M.** *Basic orthopaedic sciences: the Stanmore guide.* Great Britain: Hodder Arnold, 2007.
- Charnley J.** Postoperative infections after total hip replacement with special reference to air contamination in the operating room. *Clin Orthop* 1972;87:167-87.
- Miller MD.** *Review of Orthopaedics.* Fifth ed. Philadelphia: Saunders Elsevier, 2008:313-18.
- Bado JL.** The Monteggia lesion. *Clin Orthop* 1967;50:71-86.
- Miller MD.** *Review of Orthopaedics.* Fifth ed. Philadelphia: Saunders Elsevier, 2008:464.
- Davidson J et al.** Simple treatment for torus fractures of the distal radius. *J Bone Joint Surg [Br]* 2001;83-B:1173-5.
- May G, Grayson A.** Do buckle fractures of the paediatric wrist require follow up? *Emerg Med J* 2009;26:819-22.
- Costa M, Owen-Johnstone S, Tucker JK, Marshall T.** The value of MRI in the assessment of an elbow injury in a neonate. *J Bone Joint Surg [Br]* 2001;83-B:544-6.