Exam Corner

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MCQs – Adult Pathology – Single Best Answer

1. Arthroscopic debridement of the knee joint in osteoarthritis is most beneficial in which group of patients?

Answer: a. Patients with a joint space of > 3 mm.
In a cross-sectional study with a cohort of 122 patients undergoing arthroscopic debridement for osteoarthritis of the knee, 90% of patients with mild osteoarthritis, no deformity and a joint space of > 3mm improved following surgery compared with 25% in the cohort with deformity and more significant arthritic change. This may be due to correction of a specific internal mechanical derangement as a consequence of osteophytic impingement, meniscus, chondral tears or loose bodies.[1,2]

2. Which of the following is the most significant risk factor for the nonunion of fractures of the middle third of the clavicle?

Answer: b. Comminution at the fracture site.
Robinson et al[3] performed a prospective, observational cohort study of a consecutive series of 868 patients with a radiologically confirmed fracture of the clavicle, which was treated nonoperatively. On survivorship analysis, the overall prevalence of nonunion at 24 weeks for mid-shaft fractures was 4.5%. The risk of nonunion was significantly increased by advancing age, female gender, displacement of the fracture, and comminution ($p < 0.05$ for all). On multivariate analysis, the risk of nonunion was increased by lack of cortical apposition (relative risk = 0.43), female gender (relative risk = 0.70), comminution (relative risk = 0.69) and advancing age (relative risk = 0.99).[4]

3. Which of the following injuries is most commonly associated with a dislocation of the knee joint?

Answer: b. Common peroneal nerve injury.
Between 1994 and 2001, Niall et al[5] treated 55 patients with traumatic dislocation of the knee. Injury to the common peroneal nerve was present in 14 of 55 patients (25%) with dislocation of the knee. Injury to the popliteal artery was seen in 5.5% of patients.
In addition, 130 consecutive patients (138 knees) who had sustained an acute multiligamentous injury of the knee were evaluated by Stannard et al[6], between August 1996 and May 2002. Nine patients had flow-limiting popliteal artery damage, with an overall prevalence of 7%.

4. The Sarmiento functional cast brace cannot be used for which of the following fractures?

Answer: e. Fractures with neurological involvement.
Functional bracing is suitable for fractures that are comminuted, those where axial instability show acceptable maximal shortening and where angular instability is present but can be corrected within a few degrees of normal. While open fractures can be managed with functional bracing, this is limited in part by unacceptable shortening and compromise of the soft-tissue envelope required to compress the fracture site.[7]

5. The presence of a Hawkins sign following open reduction and internal fixation of the fracture of the talus signifies:

Answer: c. Revascularisation of the talus.
The Hawkins sign is a subchondral radiolucent band in the talar dome that is indicative of viability at six to eight weeks after a fracture of the talus. It is visible in the anterior-posterior view, but seldom appears on lateral radiographs. Tezval et al[8] studied 41 displaced talar fractures that underwent open reduction internal fixation (ORIF). No Hawkins sign[9] was found in all the patients who developed avascular necrosis (AVN) of the talus. In the remaining patients who did not develop AVN, a positive (full) Hawkins sign was observed 11 times, a partially positive Hawkins sign four times, and a negative Hawkins sign 11 times. The Hawkins sign thus showed a sensitivity of 100% and a specificity of 57.7%.

Vivas

Adult Pathology

A 78-year-old man, who underwent a total hip replacement of the right hip 18 years ago, now presents with a history of pain in his hip especially on weight bearing. This is his radiograph (Fig. 1).

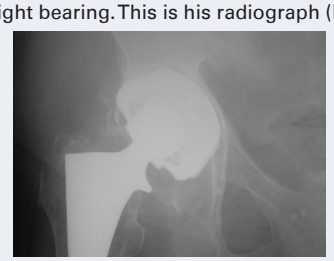

Fig. 1

1. Describe the abnormal findings on the radiograph.

Answer: The radiographs show an uncemented total hip replacement. Lucency behind the acetabular component is noted in DeLee and Charnley[11] Zones I, II and III. This is more than 2 mm in Zone I and associated with surrounding increased density superior to the lucency.

2. What further information would you like to obtain on history?

Answer: I would like to know the following:
a) Date of original hip replacement and indication
b) Immediate complications
c) Pre- and post-operative function
d) Systemic features of infection
e) Pain features: Presence of night pain, location of pain, radiation and precipitating/relieving factors
f) Past medical and social history

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3. What further investigations would you request?
Answer: I would request the following:
a) Full blood count
b) Erthrocyte sedimentation rate (ESR)
c) C-reactive protein (CRP)
While ESR and CRP are not specific they are sensitive for deep hip infection and it is suggested that a CRP < 20 mg/L and an ESR < 30 mm/hour is suggestive of aseptic loosening of a total hip replacement.[10] I would also further investigate with an image intensifier guided hip aspiration in theatre to allow joint fluid and synovial tissue to be sent for microscopy, gram stain and culture. I would consider a bone scan but it is often not necessary.

4. What is the likely diagnosis?
Answer: The likely diagnosis is aseptic loosening of the acetabular component.

5. How would you classify this condition at this stage?
Answer: I would classify this as a DeLee and Charnley[11] III loose acetabulum with osteolysis measuring over 1 mm involving all three acetabular zones.

6. What are the options of treatment at this stage?
Answer: The treatment options are to manage the patient conservatively with analgesia and a watchful waiting approach to allow time to observe radiological progression and clinical course. Operative options include single stage revision of acetabular +/- femoral components. I would decide during surgery whether to proceed with femoral revision according to evidence of loosening of the component. I would revise the acetabular component to an uncemented component with bone autograft on the acetabular floor if necessary and screws placed in the safe zone for additional support if a good rim fit is not obtained.

7. What treatment would you offer him? Why?
Answer: I would offer an aspiration of the total hip replacement with instillation of local anaesthesia in the first instance to exclude infection and elicit the source of pain. If pain is confirmed as the source I would offer a revision total hip replacement.

Trauma

A 13-year-old boy fell off his bicycle and sustained an injury to his right ankle. These are the radiographs obtained in A & E (Figs 2a and 2b).

Fig. 2a

Fig. 2b

1. Describe the abnormality in the radiographs.
Answer: The radiographs show a right ankle which is skeletally immature. A minimally displaced fracture of the distal tibia involving the physis is noted with an associated extra-physeal spiral fracture of the distal fibula. The AP radiograph appears to show a Salter–Harris 3 fracture whereas the lateral film appears to show a Salter–Harris 2 injury.

2. What is the diagnosis?
Answer: This is a triplane fracture of the ankle since the fracture is present within the sagittal, coronal and transverse planes and involves the distal tibial physis. This is a result of a combined plantar-flexion and external rotation injury.

3. Would you request any other investigation and if yes, why?
Answer: I would request a CT scan of the ankle to further define the fracture plane and articular incongruency.

4. What is the reason for the unusual pattern of this fracture?
Answer: The name triplane originates from the fact that the fracture exists in the frontal, lateral, and transverse planes. It is noted during a two-year window, prior to physeal closure. Distal tibial growth plate closure starts anteromedially, progresses posteriorly and laterally and finishes anterolaterally. This leaves the lateral side vulnerable to injury.[12]

5. What are the indications for surgical intervention in these fractures?
Answer: Surgical intervention is indicated where articular incongruency >1mm is present to ensure anatomical reduction of the joint and prevent late onset deformity and premature osteoarthritis. Other indications for operative management would include open fractures or significant neurovascular compromise.

6. How would you like to treat this patient?
Answer: A CT scan would help to plan management but I would advocate ORIF for this fracture. An anterolateral incision may be required for reduction of the anterolateral fragment and to ensure articular congruity. However, I would initially attempt to fix this fracture percutaneously following reduction and would then use two cannulated partially threaded cancellous screws. One screw would be directed from lateral to medial to stabilise the anterolateral epiphyseal fragment and the other screw from anterior to posterior to stabilise the metaphyseal fragment. A below-knee cast would then be applied and weight bearing commenced at six weeks.

Hands

A 10-year-old girl presented with a progressively worsening deformity of her wrist. There was no history of trauma or of recent infection. These are her clinical photographs (Figs 3a and 3b).

Fig. 3a

Fig. 3b

1. Describe the clinical photographs.
Answer: Figure 3a illustrates a prominent ulna styloid and radial inclination of the wrist. This prominence is highlighted in figure 3b as the carpus and radius appear subluxed in a volar direction.

2. What is the diagnosis?
Answer: A Madelung deformity.

3. What is the pathophysiology of this condition and what are the classical clinical findings?

Answer: The volar-ulnar portion of the distal radial physis is disrupted. There is excessive radial inclination and a radiopalmar tilt. There is also restricted forearm rotation.[13] The exact aetiology has not been determined but theories include abnormal radio-lunate tethering from the ligament of Vickers, vascular dysgenesis and hemiatrophy. Females are affected four times as often as males and it is inherited in an autosomal dominant fashion.

The deformity usually manifests in late childhood with decreased movement and minimal pain and is commonly bilateral.[13]

4. These are the radiographs of another patient with the same condition (Figs 3c and 3d). Describe the radiographs.

Fig. 3c

Fig. 3d

Answer: The radiographs show increased radial inclination. The radius has dorsal and radial convexity with a triangular distal radial epiphysis. Distal radio-ulnar diastasis is evident with dorsal subluxation of an enlarged ulnar head. The carpus has subluxed ulnarward and volarly into the distal radio-ulnar joint. The carpus also appears wedge shaped, with its apex proximal within the lunate.

5. How would you treat her?

Answer: I would manage this deformity conservatively with close observation provided the patient is pain-free. Pain associated with this condition usually subsides at skeletal maturity. Given that the deformity is significant at present and the deformity is likely to increase, in the future I would consider an extra-articular dorsal closing wedge osteotomy of the radius combined with an ulna-shortening procedure.[14]

6. What are the goals of surgical management of this condition?

Answer: The goals of surgical treatment are to provide a pain-free wrist. The pain of ulnar abutment can be reduced by shortening the ulna or excising the ulnar head. The reduced rotation of the wrist is unlikely to improve with surgical correction as the sigmoid fossa of the radius has a different shape to the head of the ulna as they have been persistently incongruous during development.

Children's Orthopaedics

Radiograph of a ten-year-old fit and well boy who has a painful right shoulder (Fig. 4). There is no history of injury and movements of the shoulder and elbow are normal.

1. What is the diagnosis?

Answer: A simple (unicameral) bone cyst.

2. Describe the radiological features.

Answer: The radiological features are:

a) Location; bone cysts are frequently found in proximal humerus or femur and central

b) Clear zone of transition

c) Uni or multi-locular

d) Radiolucent due to fluid content (serous)

e) 'Falling leaf' sign[15]

Fig. 4

3. What are the treatment options?

Answer: The treatment options are:

a) Observation; the cyst may heal spontaneously

b) Aspiration and injection with steroid or bone marrow

c) Disruption of the cyst membrane, with or without fixation with flexible nailing.

d) Bone grafting can also be considered.

In this case the boy was treated by flexible nailing and the cyst healed.

4. This four-year-old boy is standing only because he is leaning against a wall (Fig. 5). Why is this and what is the diagnosis?

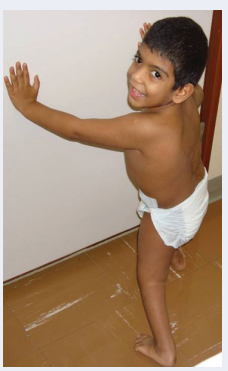

Fig. 5

Answer: He has active dorsiflexion and knee extension but cannot extend his hips or plantarflex his feet. The diagnosis is spina bifida. Note that he is incontinent and has the scar from the closure of his myelo-meningocele.

Basic Science

1. This is a photograph of two types of femoral stem used in a total hip replacement (Fig. 6). What are they called?

Fig. 6

Answer: The stem on the left is an Exeter. The stem on the right is a Charnley.

2. What are the characteristic features of both the stems?

Answer: The Exeter stem is a collarless, highly-polished, double-taper stem. The Charnley stem is a matt finished, monobloc, round back stem with a 22.225 mm femoral head.

3. Which material are they composed of and why?

Answer: The Exeter femoral stem is manufactured from a stainless steel alloy (Orthinox). This has high strength with ductility and a high corrosion resistance. The Charnley stem is also manufactured from a stainless steel alloy (Ortron) for the same reasons.

4. What is the engineering principle behind the success of each of these stems?

Answer: The Exeter stem depends on the taper slip engineering principle. Hoop stresses are transmitted to the femoral bone, which expands during loading of the component. The polished stem allows for subsidence within the cement mantle, which maintains stability of the implant and protects against loosening. The philosophy behind the design is that it anticipates stem-cement debonding, distributes the stresses evenly in the cement mantle and accommodates creep and stress relaxation in the cement mantle. The stem is known to subside into an air-filled centraliser, which leads to low shear stresses, high compressive stresses and almost no tensile stress. This in turn increases axial and torsional stability. This subsidence also seals off the stem-cement interface to prevent any fluid flow, which may lead to loosening.
The Charnley stem depends on the composite beam engineering principle. This depends on perfect bonding at the stem-to-cement interface and the cement must provide good support. The physiological load on the head of the prosthesis is transmitted through the metal stem to its tip and then to the cement and bone below it.[16]
Charnley was a pioneer in the field of hip arthroplasty through the concept of low frictional torque. It is based on the largest possible difference between the radius of the femoral head and that of the outer aspect of the acetabular component. As the movement takes place at the smaller radius (the articulation) the bone-cement interface is protected. This is achieved in clinical practice with the use of a 22.225 mm diameter head as part of a monobloc stem. Charnley's original flat-back design was polished and tapered in the anteroposterior dimension. In retrospect it was the progenitor of the taper-slip philosophy. Charnley perceived the subsidence he observed in his early series as undesirable, despite its low rates of loosening. Therefore, he introduced design features such as the Cobra flange and surface texturing to resist subsidence. This was the birth of the composite beam philosophy of cemented stems, which ultimately led to stems with design features and surface texturing specifically intended to not only resist subsidence, but to achieve fixation of the implant to the cement. To improve the fatigue strength Charnley increased the cross sectional area of the stem from a flat-back to a round-back stem in 1974. In 1975, the addition of anteroposterior flanges aimed to increase cement pressurisation. The strength of this implant-cement interface became critical, as it needed to resist the shear forces generated by weight bearing and loading of the prosthesis. Rupture of this interface defines loosening and failure of a composite beam stem, in contrast to the taper-slip stems that never achieve nor are meant to achieve true fixation at this interface.[19]

5. What are their long-term clinical results?

Answer: The results of both stems are excellent. The Exeter femoral stem has a 13-year survival of 94.4%[17], while the Charnley femoral stem has a 25-year survival of 86.5%.[18] Both the Exeter and the Charnley stems have a 10A ODEP rating.[20]

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