Exam Corner

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MCQs – Single Best Answer

1. An 11-year-old boy presents to the outpatient clinic with a congenital leg length discrepancy of 3 cm resulting in lower back pain. Which one of the following would be the most appropriate and definitive treatment?
   Answer: b. Epiphyseodesis
   Growth continues until around 16 years in males and 14 years in females. The leg grows around 23 mm/yr, with 15 mm/yr occurring at the knee (proximal femur; 3 mm/yr, distal femur; 9 mm/yr, proximal tibia; 6 mm/yr, distal tibia; 5 mm/yr). A limb length discrepancy of 3 cm in an 11 year old male would be most appropriately managed definitively by epiphyseodesis about the knee of the long leg.[1,2]

2. While commencing treatment on a child with congenital muscular torticollis, it is important to look for the following associated conditions, except:
   Answer: c. Congenital pseudoarthrosis of the clavicle
   Dysplasia of the hip (5% to 20%), metatarsus adductus, atlanto-occipital abnormalities and craniofacial deformities are all known associations of congenital muscular torticollis.[3]

3. Which muscle is typically responsible for a good quality flap coverage during hindquarter amputations?
   Answer: b. Gluteus maximus
   The standard hemipelvectomy employs a posterior or gluteal flap and disarticulates the symphysis pubis and sacroiliac joint. Anterior flap hemipelvectomy has been described where posterior cover is not possible i.e. lesions of the buttock. Here the posterior defect is covered by a myocutaneous flap maintained by the superficial femoral artery.

4. In the treatment of aneurysmal bone cysts, which therapy has the lowest rate of recurrence?
   Answer: a. Open curettage and cryotherapy
   The addition of cryotherapy has been reported to reduce the recurrence rate of ABC. In a review of studies of ABC treatment, the average recurrence rates for each modality were; irradiation 11.8%, curettage and irradiation 14.2%, curettage and bone graft 30.8%, curettage and cryotherapy 12.8%, marginal resection 7.4% and wide resection 0%.[4]

5. Which of the following statements are true about adductor tenotomy in a child with cerebral palsy?
   Answer: a. Usually involves division of adductor longus
   Damage to the anterior branch of the obturator nerve should be avoided, as this leads to iatrogenic hip abduction contracture. If further correction is required then the anterior half of adductor brevis can be released. The ideal candidate for lengthening is a child < eight years of age with hip abduction < 30° and a migration index of 25% to 60%.[5]

6. Which of the following factors below does NOT contribute to catastrophic wear in a total knee replacement?
   Answer: d. Irradiation of PE in a vacuum
   Factors contributing to catastrophic wear include: PE thickness < 8 mm, flat tibial PE, recreation of femoral rollback in PCL retaining designs on a flat PE, PE sterilisation in air, PE machining.[6]

Vivas

Adult Pathology

A 22-year-old man presents with a 18-month history of left hip pain. This is his radiograph (Fig. 1).

Fig. 1

1. What is the diagnosis?
   Answer: This is an AP radiograph of the left hip which shows and osteochondral defect (osteochondritis dissecans) in the superior aspect of the femoral head.

2. Describe the epidemiology of this condition.
   Answer: Osteochondritis dissecans of the hip occurs most commonly after Legg-Calvé-Perthes disease, it rarely occurs as an isolated entity.

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Rowe et al[7] reported osteochondritis dissecans occurring in between 2% and 4% of Legg-Calvé-Perthes disease, with a higher incidence in disease with a worse prognosis. OCD in the hip has a male preponderance of 2:1, mainly occurs in two age groups; juvenile OCD (12 yrs) and adult OCD (17 to 36 yrs) however, 75% of these cases affect the knee.
Other reported causes are sickle cell osteonecrosis, multiple epiphyseal dysplasia, idiopathic osteonecrosis, Gaucher disease and occult trauma.

3. What are the stages of this condition?
   Answer: Stage I – compression of the subchondral bone
   Stage II - partial radiographic separation
   Stage III – complete radiographic separation of the fragment
   Stage IV – escape of fragment from the joint surface

4. What other imaging may be helpful and why?
   Answer: AP pelvis and frog leg lateral radiographs should be performed in all cases. A CT scan would give further information about location, extent of involvement, stability of the fragment and degree of healing.[7] Additionally, an MRI scan would also give information about fluid or oedema around the lesion (high signal intensity on T2 being indicative of an unstable lesion). Both modalities would visualise any loose bodies within the joint (rare in osteochondritis dissecans of the hip).

5. What are the surgical treatment options for this condition?
   Answer: Surgical treatment is reserved for severe lesions with disabling symptoms. Choice of surgical procedure depends on the location and extent of the lesion, the age and activity expectations of the patient and the presence of degenerative joint changes.
   Options include:

- Excision of the fragment and drilling or curettage of the lesion +/- packing the lesion with graft.
- Internal fixation of the fragment with surgical dislocation of the hip.[8]
- Hip arthroscopy can be used to treat some lesions, dependent on their location.
- Valgus or intertrochanteric osteotomy.[8]
- Partial head resurfacing.

Trauma

A 26-year-old man presented to A&E following a fall from his motorbike at low speed. He sustained an injury to his right knee and these are his radiographs (Fig. 2).

Fig. 2a

Fig. 2b

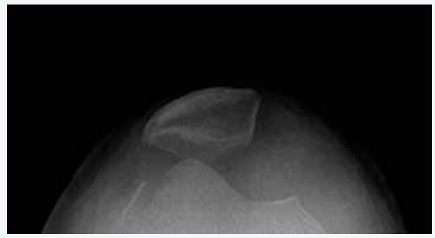

Fig. 2c

1. Describe the radiographs.
   Answer: These are AP, lateral and skyline views of the knee. They show that the patella is subluxed laterally with a bone fragment present in the lateral gutter of the knee. There is a haemarthrosis visible.

2. What is the immediate management of this patient in A&E?
   Answer: I would manage this patient according to ATLS principles. After the primary survey I would address the knee and any other injuries of the limbs. I would have one attempt at reducing the patella in the emergency department, using adequate analgesia. After checking the neurovascular status of the limb, the gross ligamentous stability and the condition of the skin over the knee I would apply a splint to the knee. Acute aspiration of the haemarthrosis using an aseptic technique should be considered for pain relief.

3. What other investigations would you like to perform?
   Answer: I would perform a CT scan of the knee to identify the nature of the bone fragment and its origin. An MRI scan would give additional information about the cartilage surfaces and soft tissues, in particular the MPFL.

4. How would you further manage this patient?
   Answer: I would assess the knee arthroscopically, with a view to performing open or arthroscopic reduction and internal fixation of the osteochondral fracture. It is likely that this is an osteochondral fracture from either the medial facet of the patella or the lateral femoral condyle. If the fragment cannot be fixed then I would remove it and perform microfracture.
   Management of the medial soft-tissue injury is controversial. The factors that I would take into account include the patients expectations and activity levels, co-morbidities (including connective tissue disorders and previous patellar dislocations), patient compliance and motivation and the presence of any abnormal anatomy that may predispose to further dislocations (i.e. trochlear dysplasia, tibial tubercle trochlear distance, patella alta, Q angle, femoral version, tibial torsion).
   It is likely that there is disruption of the MPFL judging by

the amount of lateral patellar subluxation that is present on this radiograph. This would be confirmed by an MRI scan. As there is static subluxation of the patella after relocation has been performed I would recommend repair or reconstruction of the MPFL. During the procedure I would explore the MPFL and vastus medialis obliquus (VMO) muscle. The MPFL most commonly tears from its femoral insertion, and the vastus medialis can tear from the adductor magnus tendon. As the MPFL is the main static stabiliser of the patella on the medial side of the knee I would repair any mid-substance tear with non-absorbable sutures, or repair the tendon back to the femur with a suture anchor if it is avulsed. MPFL reconstruction using a tendon graft is also an option if repair is not possible. I would also repair any damage to the VMO and medial retinaculum.

I would use an accelerated rehabilitation regime to avoid knee stiffness post-operatively.

5. What is the evidence in support of your chosen modality of treatment?
   Answer: In a recent Cochrane review there was no significant difference between surgical and non-surgical management of primary (first-time) patellar dislocation in the risk of recurrent dislocation, Kujala patellofemoral disorder scores, nor the requirement for subsequent surgery. This was derived from the results of five trials. The review concluded that "there is insufficient high quality evidence to confirm any significant difference in outcome between surgical or non-surgical initial management of people following primary patellar dislocation".[9]

   In this case the patient has an osteochondral fracture, which is an indication for surgical treatment. The patient does not appear to have trochlear dysplasia or patella alta, however there remains significant lateral patellar subluxation on the radiograph. I would therefore recommend a repair / reconstruction of the MPFL during the same procedure, after counselling the patient appropriately.

Hands

This is a clinical photograph of a 68-year-old man with a two-year history of this deformity (Fig. 3).

Fig. 3

1. What is this deformity?
   Answer: The photograph shows swan-neck deformities of all four fingers (hyperextension at the proximal interphalangeal joints and flexion at the distal interphalangeal joints). This can occur due to over-activity of the intrinsics and or volar plate laxity.

2. What is the classification system associated with this deformity?
   Answer: Swan-neck deformity in a Rheumatoid hand are classified as follows according to PIPJ mobility and radiographic appearances:[10]

- PIP joint flexible in all positions.
- PIP motion limited only by tenodesis effect (tight intrinsics).
- Fixed PIP joint contracture, X-ray – preserved joint space.
- X-ray – arthritic changes with loss of active and passive motion at PIPJ.

3. What are the causes of this deformity?
   Answer: Swan-neck deformity has several different causes: The primary lesion is a lax volar plate, this may be caused by rheumatoid arthritis, trauma or generalised ligament laxity. The secondary lesion is an imbalance of forces acing on the PIPJ. This may occur at different sites:
   Mallet injury - DIPJ. The DIPJ extension force is transferred to the PIPJ central slip.

   FDS rupture – PIPJ. There is un-opposed PIPJ extension. Intrinsic contracture. Tethering of the lateral bands by the transverse retinacular ligament as a result of PIPJ hyperextension. The excursion of the lateral bands is restricted, therefore the extension force is not transmitted to the terminal tendon. The extension force is instead transmitted to the PIPJ.

   Volar subluxation of the MCPJ. As seen in RA. Intrinsic and central tendon tightness leads to volar subluxation and flexion at the MCPJ.

4. What is the preferred surgical treatment?
   Answer: The surgical treatment depends upon the site of the lesion (DIPJ, PIPJ or MCPJ) where the deformity originated and whether the deformities are fixed or flexible. In general, flexible deformities can be treated with soft-tissue procedures, whereas fixed deformities require bony procedures such as arthrodesis or arthroplasty. The patient's hand function and expectations must also be taken into consideration.

   In this 68-year-old patient with multiple swan-neck deformities it is likely that the cause is RA. If the deformities have been present for two years it is likely that there will be an element of fixed contracture.

   Addressing the primary pathology is imperative in the management of the swan neck deformity.
   Problems with the DIP joint can be addressed with dermadesis or DIP fusion.

   MCP joint problems can be addressed with synovectomy and MCP arthroplasty.

   For the PIP joint a FDS tenodesis can be performed in this a slip of the FDS is then passed around the A2 pulley and sown to itself holding the PIPJ flexed. This position can be maintained with a temporary K-wire.
   A dorsal release can be performed using a curvilinear incision over the PIP joint. The extensor expansion including lateral bands and collateral ligaments are released with removal of osteophytes and with a synovectomy if required ensuring full PIPJ range of movement. Particular attention should be paid to the central slip to ensure that it is not damaged during surgery.

   A lateral tenodesis can be performed using the ulnar lateral band which is mobilised at MPJ level. The band is passed volar to Cleland's ligament and fixed to itself around the A2 pulley attachment (as for the FDS tenodesis).[11]

5. What are the complications of surgery?
   Answer: Complication may be those related to the actual surgical procedure, those related to the systemic disease of rheumatoid arthritis, or those related to anti-rheumatoid medications.

Complications related to surgery:
Soft-tissue procedure – infection, wound breakdown, failure to correct deformity, recurrence of deformity, over-correction of deformity, neurovascular damage, scar pain, CRPS, stiffness.
Arthrodesis procedure – additionally to the above risks: nonunion, malunion, implant failure or prominence of metalwork.
Arthroplasty procedure – implant failure, fracture, dislocation, loosening, stiffness, osteolysis, tendon / ligament damage, failure to relieve symptoms.
Complications related to systemic disease:[12]
Cervical spine – cervical spine disease is common in patients with RA. This must be fully assessed clinically and radiologically pre-operatively. Atlanto-axial subluxation or basal invagination is a possible complication of RA and the C-spine should be handled with care during any anaesthetic.
Airway disease – along with C-spine pathology, cricoarytenoid RA and laryngeal oedema can make management of the airway difficult.
Lung disease – may consist of pleurisy, pleural effusions, rheumatoid nodules, and mild fibrosing alveolitis. More severe lung disease such as interstitial pneumonitis or fibrosis and bronchiolitis can affect operative risk. These may be secondary to rheumatic drug therapy such as gold, penicillamine, or methotrexate.
Bone disease – this can lead to severe osteoporosis and care should be taken when handling these patients.
Vasculitis – can lead to non-healing ulcers and neuropathy.
Cardiac disease – mostly not related to RA, but some cardiac disease can be secondary to RA such as pericarditis, conduction blocks secondary to granulomas or nodules, left sided heart failure and disease of the myocardium or valves.
Renal disease – the kidneys may be affected by vasculitis or amyloidosis (chronic disease). Pharmacological treatments may also damage the kidneys.
Haematological – RA patient may have anaemia or neutropenia (Felty's syndrome).
Ocular disease – episcleritis or scleromalacia may be present. Patients with RA also may suffer with dry eyes and mouth (keratoconjunctivitis sicca), so eye care is important during anaesthesia.
Infection – patients with RA may have an increased susceptibility to infection post-operatively. This may be related to the disease process or secondary to medications (i.e. anti-TNFα).
Medication related – Medications should be managed in conjunction with a rheumatologist. Patients taking corticosteroids undergoing surgery may need corticosteroid coverage peri-operatively. Coverage should be provided if the patient has been on 10 mg of prednisone per day for one week or more within the last six months. This is usually given in the form of hydrocortisone IM or IV. The exact regime depends upon the amount of surgical stress expected. Aspirin / NSAID use affects platelet function and bleeding and is generally stopped prior to surgery. NSAIDs can also increase the risk of GI bleeds and renal impairment peri-operatively.

It is considered safe to continue methotrexate during the operative period, with most studies showing no increase in infection rates.[13,14]

The current British Society for Rheumatology (BSR) anti-TNFα guidelines recommend stopping treatment with these agents prior to surgical interventions. There are specific timings (three to five times the half life of the specific drug before surgery) given for stopping each of the different agents. They recommend restarting treatment when wound healing is satisfactory and there are no signs of infection.[15] These recommendations are supported by the BSR biologics register data, that revealed four times the risk of skin and soft-tissue infections with the use of biological agents in a cohort of 7664 RA patients.[16]

Children's Orthopaedics

1. This is the radiograph of an eight-year-old boy, previously able to walk independently, who now requires crutches (Fig. 4a). What is the underlying cause of this deformity, how are the radiological changes explained and how would you treat the child?

Fig. 4a

Fig. 4b

Answer: The diagnosis is osteogenesis imperfecta. Bone thickness is less because of reduced periosteal bone formation. Trabeculae are fewer and thin. Although individual osteoblasts produce less bone than normal, the overall formation rate of trabecular bone is increased because the number of osteoblasts is raised. However, this does not lead to a net gain in trabecular mass because bone resorption is also increased.

The child was treated by corrrective osteotomy and intramedullary stabilisation with a telescopic rod (Fig. 4b) Other forms of intramedullary stabilisation, such as Rush nail or elastic nails, would also be acceptable but a telescopic system is preferable.

2. This is the radiograph of a ten-year-old girl who has no pain but is walking with difficulty (Fig. 5). What is the underlying cause of these deformities, how are the radiological changes explained and how would you treat the child?

Fig. 5

Answer: The diagnosis is osteopetrosis and the radiographic appearances are due to a failure of osteoclasis. Although the number of osteoclasts may be reduced, normal or increased, they are dysfunctional. This is largely due to a lack of carbonic anhydrase, which is required for the dissociation of calcium hydroxyapatite from bone matrix. Hence, resorption fails while formation continues.

The correction of the extreme bilateral coxa vara in this case would pose great technical difficulty with a high risk of complications and therefore operative treatment was not advised. There is limited scope for medical treatment, which should be advised and supervised by a metabolic physician.

Basic Science

1. Describe the principle of a dynamic compression plate with an illustration.
Answer: Compression plating provides fixation with absolute stability for two-part fracture patterns, where the bone fragments can be compressed. The objective of compression plating is to produce absolute stability, eliminating all interfragmentary motion.
The screw holes in the dynamic compression plate (DCP) are best described as a portion of an inclined cylinder and a portion of a horizontal cylinder (its length running along the length of the plate). If a screw is placed eccentrically in the hole, then upon contact with the plate, the screw head slides down the inclined shoulder of the screw hole. This applies a longitudinal force to the plate as the screw is driven home, moving the plate. If the plate is already fixed to the bone with a screw at its other end (distal to the fracture), then this longitudinal force moves the plate and moves the fracture ends towards each other. If the fracture ends are in contact then this produces tension within the plate and compresses the fracture ends.

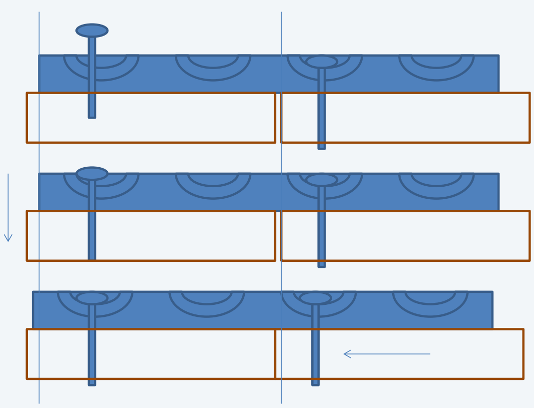

Diagram 1

2. Describe the principle of tension band wiring with an illustration.
Answer: The principle of tension band wiring evolved from the observation that a curved, tubular structure under axial load always has a compression side as well as a tension side. A tension band converts tensile force into compression force at the opposite cortex. This is achieved by applying a device eccentrically, on the convex side of a curved bone.
In fractures where muscle forces distract the fragments, such as fractures of the patella or the olecranon, the application of a tension band will neutralise these forces and convert them into compression when the joint is flexed.
In diagram 2a, an eccentrically loaded fractured bone has tension and compression sides. The application of a tension band in diagram 2b prevents distraction and converts tension into compression at the opposite cortex.

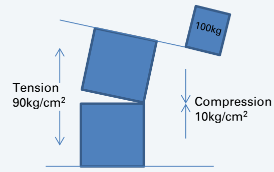

Diagram 2a

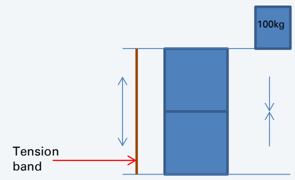

Diagram 2b

3. Describe why an intramedullary device is biomechanically superior to a plate in the fixation of a long bone fracture.
Answer: An Intramedullary (IM) nail is a load sharing device, acting as an internal splint and allowing the bone to bear some of the load. Therefore, during weight bearing, physiological loading occurs at the fracture site (torsion, compression, tension and bending). This stimulates indirect (secondary) fracture healing. If cortical contact is achieved, then most of the load is born by the bone.
Due to the mechanical properties of IM nails, they provide less rigid fixation (relative stability) than plates (with the exception of bridge plating). IM nails therefore allow higher strain at the fracture site, encouraging healing by callus (secondary healing). This allows larger fracture gaps to be bridged.
Several factors contribute to the overall biomechanical profile of the nail, including: material properties, cross-sectional shape, diameter, solid or hollow nail, radius of curvature, length, working length, and design of the nail's extreme ends.
Because a nail is placed within the bone it may be subject to a lower bending moment force than a plate that is placed on the outer cortex of the bone on the tension side. The bending moment is equal to force multiplied by distance (M = FxD). Therefore in a femoral fracture model, D (the perpendicular distance between the nail or plate and the mechanical axis) is smaller for a nail (See Diagram 3). Therefore the bending moment acting on the implant is lower for a nail compared with a plate. This may have implications for fatigue failure of the implants.
A plate is a load bearing device that is most effective when placed on the tension side of a long bone fracture. Plate fixation will usually produce a stiffer fixation at the fracture site with lower strain. Because the plate is load bearing, it may be more likely to fatigue fail than an IM nail.
A plate that has been used to provide absolute stability will lead to low strain at the fracture site (according to Perren's strain theory of fracture healing), therefore inhibiting callus formation. This leads to direct (primary) Haversian remodelling. If a gap is present at the fracture site the cutting cones may not be able to bridge the fracture, leading to nonunion.

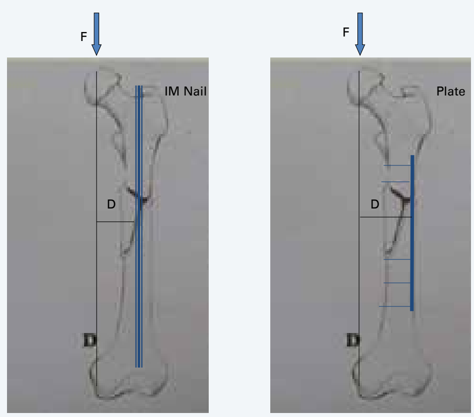

Diagram 3

Stress concentration at open screw holes can lead to implant failure. Plates are also prone to stress risers occurring at their ends, leading to a risk of periprosthetic fractures.

4. What do you understand by relative and fixed rigidity?
Answer: Rigidity refers to a structures ability to resist deformation.

5. What do you understand by the term 'working length'?
Answer: Working length is the length of an implant that transmits load from one main fragment to the other. Working length in a plate model is defined as the length from the fracture to the closest screw on either side of the fracture. In an IM nail for a very comminuted fracture, the working length may be the length between the proximal and distal locking screws. In a transverse midshaft fracture where the nail has an isthmic fit, the working length is much shorter. Decreasing the working length increases the stiffness of the fixation construct.

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