Exam Corner

The Bone & Joint Journal

July 2014 • Answers

Authors: Mr. Emmet Griffiths and Mr. Vikas Khanduja
SpR, East of England

MCQs and EMQs

1. With regards to the toe region noticed in a stress-strain curve which of the following statements is FALSE?
   Answer: c. The toe region of the stress strain curve is seen predominantly in ligaments and tendons. It denotes a non-linear elastic phase, which is seen as the crimped fibres straighten out hence a large distance (strain) is travelled under minimal stress. Tendons recruit fibres quickly hence they have a shorted toe region compared to ligaments.

2. Which synovial cells produce synovial fluid?
   Answer: b. Synovial fluid is a dialysate of plasma. It contains Type A cells, which are phagocytic, Type B which produce synovial fluid and Type C cells do not have a known function but are thought to be precursors to A and B cells. The main acellular constituents of synovial fluid are hyaluronin and lubricin.

3. A 30-year-old male presents with a history of intermittent knee pain and swelling. He requires occasional injections of Factor VIII. Joint aspirate reveals a bloody effusion. A synovial biopsy shows the following features - brown colour of synovial sample, villous projections lined with cuboidal haemosiderin-laden synovial cells, haemosiderin-laden macrophages in the sub-synovial connective tissue. No foam cells, mononuclear cells or giant cells are noted. What is the diagnosis?
   Answer: b. Factor VIII deficiency is haemophilia A. Recurrent haemoarthroses seen in Haemophilia can predispose to Haemosiderotic synovitis. Microscopically it looks similar to PVNS but the lack of giant cells excludes PVNS from this diagnosis. Foam cells are fat laden macrophages, which are seen in PVNS. Giant cell tumours have a predominance of multinucleated giant cells and mononuclear cells.
   Synovial chondromatosis is the proliferation of hyaline cartilage within the synovium.
   Villous lipomatous proliferation of synovial membrane is a rare lipomatous condition of the joint. It is characterised histologically by hypertrophic villous projections of fat lined by synovial cells with scattered inflammatory cells.

4. Which one of the following factors would be associated with a poor prognosis in Perthe's disease?
   Answer: d. Gage's sign is a V shaped radiolucency within the lateral epiphysis. It is included in Catterall's head at risk signs (others include: calcification lateral to the epiphysis, lateral subluxation of the femoral head, horizontal proximal femoral physis and a later addition is metaphyseal cysts).
   Patients above eight years at presentation have a poor prognosis than those < 6 years old.[1]
   Herrings sign does not exist.

5. For each of the following scenario choose from the list below which type or cause of shock is the most likely diagnosis?
   Answer:
   a. Class IV hypovolaemic shock.
   b. Cardiogenic shock (normal cardiac output is 5.25L/min and stroke volume is 70mls, therefore in this case the low blood pressure is a result of the bradycardia – seen in cardiogenic shock, usually as a result of a myocardial infarction).
   c. Class II hypovaelmic shock (blood pressure preserved but pulse and resp rate increased).

Vivas

Adult Pathology

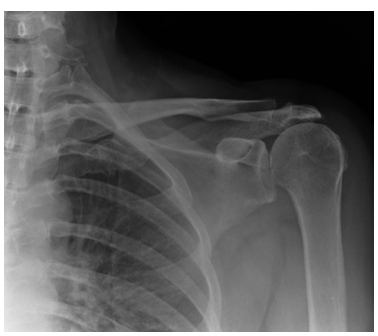

Fig. 1

1. What is the diagnosis (Fig. 1)?
   Answer: AP radiograph of the left shoulder. The humeral head is superiorly displaced with incongruence of the glenohumeral joint and acetabularisation of the acromium. This would be in keeping with a rotator cuff deficient shoulder resulting in arthritic change, also known as a rotator cuff arthropathy.

2. What investigations are required?
   Answer: The radiograph clearly demonstrates a chronically cuff deficient shoulder. MRI can be helpful at demonstrating the degree of deficiency and fatty changes within the supra and infraspinatus which are considered poor prognostic factors for a repair.
   CT scan delineates the bony anatomy, including glenoid version and bone stock, which is essential for pre-operative planning if a replacement is being considered.

3. What are the treatment options?
   Answer: Options are non-operative and operative.
   Non-operative options include:
   a. Eccentric deltoid rehabilitation – recruiting deltoid to act as shoulder stabiliser and initiate abduction.
   b. Steroid injections and analgesics.

   Operative options include:
   a. Orthospace (this is a biodegradable balloon placed in the subacrominal space to depress the humeral head, helping function the deltoid).
   b. Tendon transfers (pectoralis major and Latissimus dorsi).
   c. Hemiarthroplasty of the shoulder joint.
   d. Reverse total shoulder replacement (medialises centre of rotation, increasing the lever arm of deltoid).

4. How would you manage this patient?
   Answer: History and examination. History including age,

functional requirements, arm dominance, work/hobbies.
Assess degree of deficit and duration of symptoms.
Detailed examination to include passive and active shoulder movements and assessment of deltoid function.
In a sedate older patient consider a reverse Total Shoulder Replacement, in a young and active with debilitating symptoms, consider tendon transfer.[2]

Trauma

A 58-year-old man presented with history of a fall from a ladder of about 10 feet in height. He sustained a closed injury to his left ankle and these are the radiographs obtained at the time of injury (Fig. 2a & 2b).

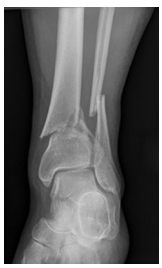

Fig. 2a

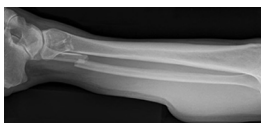

Fig. 2b

1. Describe the radiographs and how would you classify this injury?
   Answer: AP and lateral plain radiographs of left ankle. There is a distal tibial fracture transversely across the metaphysis with extension into the joint consistent with a pilon fracture. The fracture is displaced in valgus. There is an associated distal fibula fracture above the level of the syndesmosis. AO classification – Type A3; but may be a C1 if there is intra-articular extension.

2. How will you assess the soft tissues?
   Answer: Pilon fractures often have significant soft tissue compromise. Care must be taken to assess the skin circumferentially around the ankle. The soft tissue can be assessed by looking for bruising, abrasions, blisters and the wrinkle test. The Tscherne classification can also be used. The fracture must be reduced urgently if there is tenting or skin compromise. Neurovascular status should be carefully assessed and documented.

3. What is a Chaput fragment, what is attached to it and what are the other commonly seen avulsion fractures?
   Answer: Pilon fractures often have certain reliable fragments. A chaput fragment is the anterolateral joint fragment, which is attached to the anterior inferior tibiofibular ligament. The other two common fragments are medial malleolar (attached to the deltoid ligament) and posterolateral/Volkmann fragment (posterior inferior tibiofibular ligament).

4. How would you manage this patient?
   Answer: The principles of "Span, Scan and Plan" are utilised with fixation plan dependent on soft tissue integrity and within two to three weeks if possible.
   Ruedi and Allgower described the schematic to surgical management:
   1) Reduction and restoration of fibula length and fixation.
   2) Anatomical reduction and fixation of tibial articular surface with absolute stability. Reduce the anterolateral and posterior fragments initially.
   3) Bone grafting of metaphysis to prevent collapse.
   4) Medial buttress plating to prevent varus deformity.[3]

5. What are the complications of this injury and how can you avoid them?
   Answer: Complications include: infection and wound breakdown (10% to 20%), nonunion, varus Malunion, post-traumatic arthritis and stiffness.
   Poor results are associated with high grade soft tissue injury, > 2 mm articular incongruency and malalignment of the mechanical axis > 5°.[4]

Hands

A 45-year-old housewife presents to the general orthopaedic clinic with worsening pins and needles and numbness in the ring and little fingers of her left hand of four-month duration. She gives no history of neck pain or injury to the ipsilateral upper limb. She has noticed difficulty in grasping small objects and in fine movements of the hand.

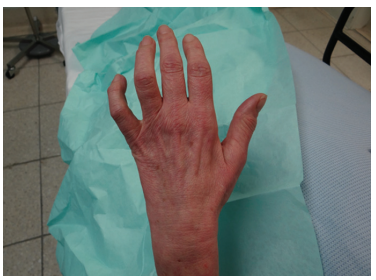

Fig. 3a

1. Please describe the clinical photograph (Fig. 3a) presented to you and what is your provisional diagnosis?
   Answer: This is a clinical photograph of the dorsum of the left hand showing 'ulnar guttering' indicating wasting of small muscles of the hand. There is also marked wasting of the dorsal interossei. In addition, there is pronounced clawing of the ulnar two digits. No obvious scars or trophic changes of the skin are noted. The provisional diagnosis would be an ulnar nerve compression neuropathy either at the cubital tunnel or at the Guyon's canal.

2. How would you clinically differentiate between a high and a low lesion? How would you confirm your diagnosis?
   Answer: Pronounced clawing ('ulnar paradox'), absence of numbness on the dorsum of hand (dorsal branch of ulnar nerve exits above the wrist joint hence not involved in low lesions) and absence of muscle wasting of forearm muscles will indicate a distal compression of ulnar nerve at the wrist. A nerve conduction test will confirm the site of compression, which in this case was at the Guyon's canal.

3. Detail the relevant surgical anatomy of the ulnar nerve compression at the wrist? Also please describe the zones of compression of the ulnar nerve at this site.
   Answer: The relevant surgical anatomy and the zones of compression of ulnar nerve in Guyon's canal as detailed below:

Boundaries of Guyon's canal	
Floor	Transverse carpal ligament, hypothenar muscles
Roof	Volar carpal ligament
Ulnar border	Pisiform and pisohamate ligament, abductor digiti minimi muscle belly
Radial border	Hook of hamate

Zones of Guyon's Canal		
Zone 1	Extends from the proximal edge of the palmar carpal ligament to the bifurcation of the ulnar nerve	Mixed motor and sensory symptoms
Zone 2	Extends from the bifurcation of the ulnar nerve just distal to the fibrous arch of the hypothenar muscles	Motor only
Zone 3	This zone contains the superficial sensory branch of the ulnar nerve	Sensory only

4. Please innumerate the possible causes for ulnar nerve compression at the wrist?
   Answer: The causes of entrapment of ulnar nerve in Guyon's canal (also sometimes referred as Ulnar Tunnel Syndrome) can occur from a variety of causes. Trauma on the ulnar border of the hand can lead to fracture of hook of hamate or pseudo-aneurysm of the ulnar artery causing compression of ulnar nerve. Benign tumours like ganglion from adjacent carpal joints (up to 80%), lipoma and neurilemmoma account for majority of non-traumatic causes. Less common causes are abnormal muscle bellies and congenital conditions (coalitions) affecting the carpal bones.

5. MRI of the wrist in this patient (Fig. 3b) noted a large ganglion arising from the triqueto-hamate joint compressing the ulnar nerve in the Guyon's canal. How would you manage this patient?

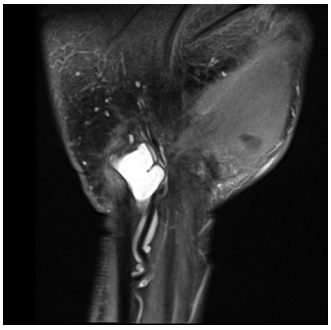

Fig. 3b

Answer: The management of this case would comprise of a referral to a specialist hand surgeon. In view of the worsening clinical picture, already present muscle atrophy and a MRI proven localised cause of compression of ulnar nerve in Guyon's canal, the treatment would be Guyon's canal release and excision of the ganglion. Favourable outcomes can be expected especially if pre-operatively motor involvement is present.[5]

Children's Orthopaedics

A 4-year-old boy presents with a history of limping and recurrent falls. These are the radiographs obtained at the time of admission in A & E (Fig. 4a & 4b).

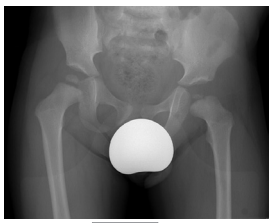

Fig. 4a

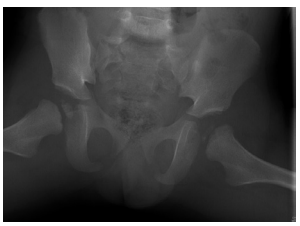

Fig. 4b

1. What are the differential diagnoses?
   Answer: AP and frog leg lateral demonstrating asymmetry of the left femoral epiphysis, there is fragmentation. There is lucency within the proximal metaphysis with blurring of the physeal plate. These findings are in keeping with Perthes' disease. Differential diagnoses include sickle cell disease, multiple epiphyseal dysplasia, Spondyloepiphyseal dysplasia, Gaucher disease, and chronic osteomyelitis.

2. What is the most likely diagnosis and how do you differentiate between the SED and Perthes' disease?
   Answer: Perthes' is the most likely cause of a unilateral AVN of the hip. Spondyloepiphyseal dysplasia (SED) is an inherited condition associated with short stature, cervical instability, coxa vara, kyphoscolosis, and genu valgum. SED is bilateral and symmetrical. Perthes' is sometimes bilateral but the stages of disease are not identical and the asymmetry is the best differentiation.

3. What are the options of treatment?
   Answer: Treatment options include; no treatment, bracing, range of movement exercises, femoral and pelvic osteotomy. The mainstay of treatment is containment of the hip in the acetabulum.
   Herring classification guides treatment modalities, A/B/C with the recent addition of B/C. Herring et al 2004 found that age at onset predicted outcome, with <6 yr old children having a good prognosis in A, B and B/C irrespective of treatment and > 8 requiring surgical intervention in B and B/C groups. Patients with Herring C have a poor outcome irrespective of age and treatment modality.[1]

4. How would you manage this patient?
   Answer: This is a 4-year-old with Herring C disease of the left hip. The mainstay of treatment would be containment of the hip and management of symptoms. There is no evidence to support any treatment to improve outcome.

5. What is the expected prognosis?
   Answer: Unfortunately the prognosis is poor with none of the Herring C patients have normal appearing hips at skeletal maturity.[6]

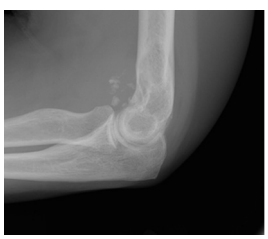

Fig. 5a

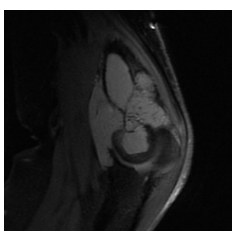

Fig. 5b

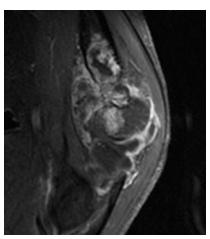

Fig. 5c

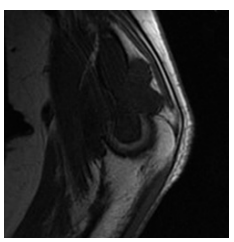

Fig. 5d

Basic Science

1. What are the differentials for soft tissue calcification seen on plain radiograph around the elbow (Fig. 5a)?
   Answer: Differentials for soft tissue calcification:

post-traumatic heterotrophic ossification, synovial chondromatosis, synovial chrondrosarcoma, osteochondromatosis, pigmented villonodular synovitis

2. What is magnetic resonance imaging and what are the three different scans shown here (Figs. 5b-d)?
   Answer: Magnetic resonance imaging is a technique that utilises a magnetic fields and radiowaves to create images of the body. Particularly useful when imaging soft tissue. It works by utilising a large magnet to align the proton from the water within a body, and then a pulsed magnetic frequency from a different plane rotates the protons. The radiofrequency created by the protons realigning themselves provides information on the tissue structure. MRI scans: 5b Gradient echo sequence 5c T2 Weighted image, 5d T1 weighted image.

3. What are the aims and principles of open biopsy?
   Answer: Open biopsy of any lesion where there is suspicion of malignancy should be undertaken by the surgical team who would perform the definitive procedure. The following guidelines should be followed:
   - Identify site of lesion in which to biopsy.
   - Plan biopsy tract to be within line of main incision to allow resection of tract on definitive procedure.
   - Aim to remain within a single fascial compartment.
   - Avoid proximity to neurovascular structures.
   - Maintain meticulous haemostasis, prevent collection of malignant cells in a haematoma.

4. How would you approach this lesion to achieve a biopsy?
   Answer: The lesion is predominantly anterior but does extend posteriorly. To avoid neurovascular structures I would approach posterolaterally.

5. What is the diagnosis?
   Answer: Synovial chondromatosis, this is a metaplasia of synovium characterised by multiple cartilaginous loose bodies (not all of them are ossified).

References

1. **Herring JA, Kim HT, Browne R**. Legg-Calve-Perthes disease. Part II: Prospective multicenter study of the effect of treatment on outcome. *J Bone Joint Surg [Am]* 2004;86-A:2121-2134.
2. **Khair M, Gulotta L.** Treatment of irreparable rotator cuff tears. *Curr Rev Musculoskelet Med* 2011;4: 208–213.
3. **Ruedi TP, Allgower M.** The operative treatment of intra-articular fractures of the lower end of the tibia. *Clin Orthop Relat Res* 1979;138:105-110.
4. **Topliss CJ, Jackson M, Atkins RM.** Anatomy of pilon fractures of the distal tibia *J Bone Joint Surg [Br]* 2005;87-B:692-697.
5. **Wang B, Zhao Y, Lu A, Chen C.** Ulnar nerve deep branch compression by a ganglion. *Injury* 2014 45:1126-1230.
6. **Canario AT, Catterall A, Lloyd-Roberts GC.** A controlled study of the results of femoral osteotomy in severe Perthes' Disease. *J Bone Joint Surg [Br]* 1980;62-B:438.