Exam Corner

November 2013 - Answers

The FRCS (Tr & Orth) examination has three components: MCQs, Vivas and Clinical Examination. The Vivas are further divided into five sections comprising Basic Science, Adult Pathology, Hands, Children's Orthopaedics and Trauma. The Clinical Examination section is divided into upper- and lower-limb cases. The aim of this section in the Journal is to focus specifically on the trainees preparing for the exam and to cater to all the sections of the exam every month. The vision is to complete the cycle of all relevant exam topics (as per the syllabus) in four years.

Vikas Khanduja,
MSc, FRCS (Orth)
Consultant Orthopaedic Surgeon,
Addenbrooke's - Cambridge University Hospital NHS Trust, Cambridge
CB2 0QQ, UK.
Associate Editor, *The Bone & Joint Journal*
e-mail: vk279@cam.ac.uk

Contributors:
Mr Emmet Griffiths, Specialty Registrar, East of England Rotation

MCQs and EMQs – Single Best Answer

1. Thermoregulation is substantially impaired in patients with complete spinal cord injuries above which level?

   Answer: a. T6

   A spinal cord injury above the major splanchnic sympathetic outflow (T4-T6), causes a lack of hypothalamic control over the sympathetic nervous system.[1] This impairment occurs because of the interruption of neuronal pathways between the periphery and the hypothalamus. This results in the inability to shiver when it is cold and the lack of proper blood vessel vasodilation or vasoconstriction to certain environmental. The lack of hypothalamic control results in depressed heat regulation, accounting for only a 10% to 15% increase in core temperature compared to a normal increase of 200% to 500%.[2]

2. Hypercalcaemia can be caused by all of the following conditions except:

   Answer: d. Bisphosphonate usage

   Hyperthyroidism, multiple myeloma, Vitamin D intoxication and tertiary hyper-parathyroidism are all associated with increased serum calcium.[3] Bisphosphonates are used in the acute management of hypercalcaemia.[4]

3. What is the single most specific option to describe the nerve supply to each of the following structures in the hand?

I. Pronator quadratus. *Answer:* **b**
II. Abductor pollicis brevis. *Answer:* **e**
III. Extensor carpi radialis brevis. *Answer:* **f**

a. Suprascapular nerve
b. Anterior interosseous branch of median nerve
c. Palmar digital branch of ulnar nerve
d. Posterior antebrachial cutaneous nerve
e. Recurrent motor branch of median nerve
f. Posterior interosseous nerve
g. Radial nerve
h. Dorsal digital branch of ulnar nerve
i. Palmar cutaneous branch of median nerve
j. Ulnar nerve

Pronator quadratus, flexor pollicis longus and the radial half of flexor digitorum profundus are supplied by the anterior interossous nerve. Abductor pollicis brevis is supplied the recurrent branch of the median nerve which also supplies the lateral 2 lumbricals, opponens pollicis brevis and flexor pollicis brevis. Extensor carpi radialis brevis is supplied by the posterior interosseous nerve (the deep branch of the radial nerve as it crosses the supinator). The only muscles of the posterior compartment to receive innervation from the radial nerve itself are triceps, brachiordaialis, anconeus and ECRL.

4. Which ligamentous structure is the primary restraint to inversion when the ankle joint is in a dorsiflexed position?

   Answer: e. Calcaneofibular ligament

   Inversion is resisted by the lateral ligament complex. In dorsiflexion the calcaneofibular ligament seems to be the main restraint whereas in plantar flexion ATFL is more important.[5]

5. Which of the following is an absolute indication for replacement of the radial head?

   Answer: b. Essex–Lopresti pattern of injury with a positive radial pull test

   Mason type 3 fractures (comminuted radial head fractures not associated with elbow dislocation) represent a challenging problem. The management consists of open reduction internal fixation if possible, radial head replacement or excision of the radial head (either early or delayed). The outcome following excision is variable with a significant proportion of patients reporting significant symptoms.[6] All of the above are relative indications to consider arthroplasty but the presence of an Essex-Lopresti lesion is an absolute indication.[7]

6. Peri-prosthetic fractures of the distal femur around a knee replacement have been classified according to which of the following classification systems?

   Answer: b. Lewis and Rorabeck classification

   The Lewis and Rorabeck classification[8] relates to peri-prosthetic fractures of the distal femur around a knee replacement.

Lewis and Rorabeck Classification	
Type I	Nondisplaced; component intact
Type II	Displaced: component intact
Type III	Displaced; component loose or failing

The Vancouver classification relates to femoral periprosthetic fractures around a hip replacement.[9] The Euler and Ruedi classification relates to scapular fractures, Ideburg classifies glenoid fractures and Rowe classified calcaneal fractures.

References
1. **Khan S, Plummer M, Martinez-Arizala A, Banovac K.** Hypothermia in patients with chronic spinal cord injury. *J Spinal Cord Med* 2007;30:27-30.
2. **Downey JA, Lemons DE.** Human thermoregulation. In: Downey JA, Myers SJ, Gonzalez EG, Lieberman JS, eds. *The Physiological Basis of Rehabilitation Medicine*. Second ed. Stoneham, MA: Butterworth-Heinemann; 1994: 351-63.
3. **Miller MD.** *Review of Orthopaedics.* Sixth ed. Elsevier 2012;28.
4. **Saunders Y, Ross JR, Broadley KE, Edmonds PM, Patel S.** Systematic review of bisphosphonates for hypercalcaemia of malignancy. *Palliat Med* 2004;18:418-31.
5. **Renstrom P, Wertz M, Incavo S, et al.** Strain in the lateral ligaments of the ankle. *Foot Ankle* 1988;9:59-63.
6. **Leppilahti J, Jalovaara P.** Early excision of the radial head for fracture. *Int Orthop* 2000;24:160-2.
7. **Wegmann K1, Dargel J, Burkhart KJ, Brüggemann GP, Müller LP.** The Essex-Lopresti lesion. *Strategies Trauma Limb Reconstr* 2012;7:131-9.
8. **Rorabeck CH, Angliss RD, Lewis PL.** Fractures of the femur, tibia, and patella after total knee arthroplasty: decision making and principles of management. *Instr Course Lect* 1998;47:449-58.
9. **Brady OH, Garbuz DS, Masri BA, Duncan CP.** Classification of the hip. *Orthop Clin North Am* 1999;2:215-20.

Vivas

Adult Pathology

A 25-year-old footballer was involved in a tackle and sustained an injury to his knee joint. It was acutely swollen at the time of injury and an urgent MRI scan revealed an injury to his posterolateral corner.

1. What structures form the posterolateral corner of the knee joint?
   Answer: The postero-lateral corner consists of the arcuate ligament, popliteus, lateral collateral ligament, popliteofibular ligament, lateral head of gastrocnemius and the lateral capsule.[1]

2. How do you assess the knee joint for integrity of the posterolateral corner?
   Answer: The dial test at 30° of flexion assesses the posterolateral corner. It should be compared with the contralateral side and a difference of more than 10° is significant.

3. Describe the surgical approach to the posterolateral corner of the knee joint.
   Answer: The surgical approach is based on the ilio-tibial band. A lateral incision is made distally based on Gerdy's tubercle and the iliotibial band is identified. The internervous plane lies between the ITB (superior gluteal nerve) and biceps femoris (sciatic nerve). This interval protects the common peroneal nerve which runs posterior to biceps femoris and provides access to the lateral collateral ligament. However depending on the exact pathology of the PLC injury other intervals may be required. An interval anterior to the ITB may be used for exposure of the femoral origins of the LCL and popliteus. A posterior interval between lateral head of gastrocnemius and biceps femoris provides better exposure for the tendon of popliteus, the arcuate ligament and the posterior aspect of the fibular head. If the posterior interval is required the common peroneal nerve is at risk and it is recommended that it is dissected out and protected.

4. What is the relation between the insertion of the popliteus and the insertion of the lateral collateral ligament at the lateral femoral condyle?
   Answer: Popliteus inserts on to the femur inferior and distal to the lateral collateral ligament at a distance of 18 mm.

5. What reconstruction techniques are you aware of in terms of reconstruction of the posterolateral corner of the knee joint? Describe them in detail.
   Answer: Reconstructive procedures can be divided into those that attempt to restore the normal anatomy of the PLC and those that non-anatomically stabilise the PLC by tightening specific structures. Depending on what is deficient, anatomic reconstructions seek to recreate the LCL for varus stability and the popliteus and/or popliteofibular ligament for stability in external rotation.
   In anatomic reconstructions, grafts are classically passed from: 1) the fibular head to the lateral femoral epicondyle (LCL or popliteofibular ligament reconstructions) or 2) the posterolateral proximal tibia to the lateral femoral epicondyle (popliteus reconstruction), depending on what structures are deficient. Care must be taken to protect the common peroneal nerve during isolation and advancement of the biceps tendon as excess traction on the nerve may result in iatrogenic injury.

6. What are the long-term results of posterolateral reconstruction of the knee joint?
   Answer: A study by Geeslin and LaPrade indicated that patients reported positive outcomes in 94% of cases following a mix of repairs and reconstructions for with acute posterolateral knee injuries.[2] Recent studies have reported failure rates between 37% and 40% for primary repairs of the main PLC structures.[3] Studies have shown that patients who undergo successful surgical repair of posterolateral knee injuries reported increased objective knee stability and better subjective outcomes than those who undergo reconstruction.[4]
   Anatomic techniques aim to restore normal function of the knee's important static stabilisers and are recommended for patients with these types of injuries to provide the best outcomes.

Trauma

A 56-year-old man fell on his dominant right elbow on a rocky beach whilst fishing. He sustained a transverse open wound on the anteromedial aspect of his elbow, through which the distal end of the humerus was protruding. He also had paraesthesia in the ulnar nerve territory. These are his radiographs (Figs 1a & 1b).

1. Describe the radiographs.
   Answer: These radiographs show a posterolateral dislocation of the elbow. There is air visible in the soft tissues consistent with this injury being open. There is no obvious bony injury and therefore this may be described as a simple dislocation. I would like further imaging to confirm this, particularly the integrity of the coronoid process and the radial head.

2. What are the structures at risk?
   Answer: Open dislocations may be associated with brachial artery injury. Arterial injury has been reported with closed

Fig. 1a

Fig. 1b

dislocations but is extremely rare.[5] Neurapraxia occours in approximately 20% of elbow dislocations and is most commonly the anterior interosseous nerve or the ulnar nerve. Other structures that are at risk are the flexor-pronator mass; medial collateral ligament; brachialis; and the capsule.

3. How would you assess and manage this patient?
   Answer: Following assessment and resuscitation there are several parts to the acute orthopaedic management of this patient. He requires the open dislocation to be washed out, reduced and the stability of the joint to be assessed. The initial management of this open dislocation would be similar to the management of open fractures.[6] I would ensure that tetanus prophylaxis is up to date and administer intravenous antibiotics. These should be broad spectrum and in line with local hospital guidelines and should include sufficient gram negative cover (in light of potential atypical organisms from the sea) for example Co-amoxyclav 1.2 grams and gentamycin 1.5mg/kg. I would perform lavage of the open wound in A+E, dress the wound with saline soaked gauze and arrange for the patient to be transferred urgently to theatres for formal washout of the joint, reduction of the dislocation and examination under anaesthesia. I would assess the stability of the joint both clinically and radiologically using an image intensifier. Following reduction I would explore and decompress the ulnar nerve at the elbow to ensure its continuity. Assuming no tissue loss, no significant instability and no associated fractures I would repair the capsule and aim to achieve closure primarily.

4. What are the primary and secondary stabilisers of the elbow joint?
   Answer: The MCL is the primary stabiliser of the elbow to valgus loads.[7] The anterior oblique fibres of the anterior band are the most important. The major secondary stabilisers to valgus stress is the radial head which provides approximately a third of the valgus stability particularly in pronation and the first 30° of flexion.
   The primary stabiliser to varus loads is the lateral collateral ligament and the ulno-humeral articulation. The coronoid process is a vital component (at least 50% intact) and the olecranon fossa (at least 33%) also plays a role. The lateral capsule and anconeus provide a small amount of additional support.
   In extension the capsule is the primary stabiliser.
   Secondary stabilisers include:
   - radiohumeral articulation (most important)
   - capsule: greatest role in extension of elbow, insignificant role (< 10%) in flexion
   - musculature (dynamic)

5. When would you commence range of movement exercises following treatment?
   Assuming that the reduction was congruent and the elbow was stable I would commence range of movement in a hinged brace at two weeks to allow the soft-tissue wound to heal.

Hands

A 34-year-old woman presents with persistent pain over the radial aspect of her left wrist, which worsens when she does house work, particularly the heavier aspects. The symptoms persist after a course of anti-inflammatory medication and splintage. She notices it when she lifts heavy files. On physical examination, she has tenderness on the radial border of the wrist and has pain with ulnar deviation of the wrist with the thumb clenched within a fist. This is the clinical photograph obtained in clinic (Fig. 2).

1. What is the likely diagnosis?

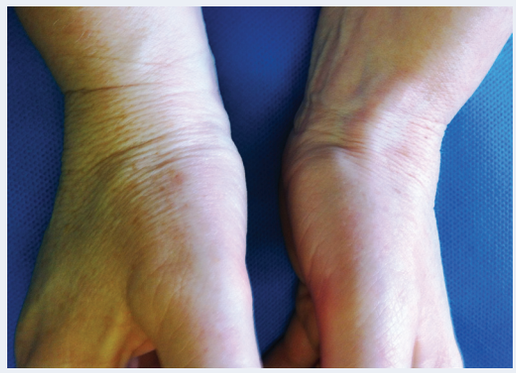

Fig. 2

   Answer: De Quervains Tenosynovitis.

2. What are the other likely findings on physical examination?
   Answer: There may be palpable thickening of the tendons of the first extensor compartment. The sharp pain over the first extensor compartment may be present on resisted extension/abduction of the thumb in addition to Finklestein's test as described above. Additionally there would be an absence of clinical signs of other differentials for example no discomfort on axial loading or CMCJ grind test.

3. What is the aetiopathogenesis of this condition?
   Answer: This represents a stenosing tenosynovitis of the first extensor compartment

4. What are the options of management?
   Answer: The initial management is non-surgical with a trial of splintage and steroid injections into the 1st extensor compartment. If this fails then surgical decompression may be considered.

5. What is the surgical treatment of the above condition?
Answer: Surgical management consists of decompressing the first extensor compartment. This may be preformed through a transverse or longitudinal incision. The main structure at risk is the superficial radial nerve (painful neuroma may result). The extensor compartment must be opened fully and care must be taken to release all slips of APL (there may be several sub-compartments). Subsequently the stability of the tendons may be assessed and if the tendons sublux with wrist movements the retinaculum may be loosely opposed. To facilitate this it may be necessary to incise the retinaculum in a zig-zag fashion which allows the retinaculum to be repaired in a looser position.

Children's Orthopaedics

Here is a radiograph (Fig. 3a) of a four-year-old girl who sustained this fracture four days earlier in a low-energy injury. She is currently on traction.

Fig. 3a

Fig. 3b

1. How would you manage the case?
Answer: This is a pathological fracture by way of its configuration and osteopaenic texture of the femur. The diagnosis is osteogenesis imperfecta. The child should be treated operatively. The principles of the stabilisation of soft bone are;
    - Use intramedullary fixation with wires or rods
    - Avoid heavy metal
    - Augment the fixation with a splint or cast according to the bone quality and mobility of the child
    - Mobilise early

    In this case the child was treated successfully with retrograde flexible nails (Fig. 3b) but an antegrade Rush nail or a telescopic rod could also be justified.

2. In terms of diagnosis and treatment, what might you reasonably infer from the radiograph of this child (Fig. 4)?
Answer: The diagnosis is tuberculosis. There are destructive and sclerotic changes in the lumbar spine and left hip, along with calcification in a psoas abscess. The disease is in its late or burnt-out stage. In the early active stages there would be significant osteoporosis. There is a pelvic tilt and and a clear view of the pelvic brim, both indicating limb shortening and a flexion deformity at the hip. There is not much of a lumbar scoliosis and the pelvic deformity is largely absorbed by the lumbosacral joint. With regard to treatment, the nutritional state of the child must be addressed. The hip and spine are likely to be ankylosed and painless and the need for antitubercular drugs may have passed. There does not appear to be sufficient deformity at the hip to indicate operative treatment at that level but the lower limb discrepancy is likely to progress.

Fig. 4

Basic Science

1. Describe the Smith–Peterson approach to the hip joint.
Answer: The Smith-Peterson approach to the hip utilises the internervous plane between the femoral nerve and the superior gluteal nerve.[8] The patient is positioned supine. The skin incision is traditionally from the anterior half of the iliac crest to the anterior-superior iliac spine then 10 cm inferiorly in the direction of the patella. Often however this incision is adjusted to a 'bikini' type incision which has favourable cosmesis. The fascia over Sartorius is split in the line of its fibres but care must be taken to identify and preserve the lateral femoral cutaneous nerve found approximately 2.5 cm inferior to the ASIS superficial to the fascia. The approach is a true internervous one, initially between Sartorius (femoral n) and tensor fascia lata (sup. Gluteal nerve) and then between rectus femoris (femoral n) and gluteus medius (sup gluteal n.). The ascending branch of the lateral femoral cirumflex artery is found deep to Sartorius in the internervous plane with TFL and may require ligation. The anterior joint capsule is found deep to the interval between rectus femoris and gluteus medius. To expose the hip more fully the rectus femoris may be detached from its origins (the superior lip of the acetabulum and the anterior inferior iliac spine)

2. Describe the anterolateral approach to the distal tibia for fixation of distal tibial fractures.
Answer: The anterolateral approach to the distal tibia uses the intermuscular plane between the extensor halluces longus and extensor digitorum longus. They are both supplied by the deep peroneal nerve superior to the extent of the dissection and thus this is not a true internervous plane. The patient is positioned supine, the foot is partially exsanguinated and a tourniquet inflated. The partial exsanguination allows the easier identification of neurovascular structures. The skin incision is based on the mid point of the ankle and extended 10 cm to 15 cm proximally. The superficial peroneal nerve is found in the lateral skin flap but it may be identified prior to making the incision by placing the foot in plantar-flexion and inversion. The fascia overlying the extensor retinaculum is divided in the line of its fibres and extensor tendons may be retracted

medially. The neurovascular bundle (Deep peroneal nerve and anterior tibial artery) between EDL and EHL is identified and protected.

3. Describe the surgical approach to the radial head.
   Answer: The surgical approach to the radial head uses the internervous plane between anconeus (radial nerve) and extensor carpi ulnaris (posterior interossoeus nerve). The patient is positioned supine with the arm over the chest. A high arm tourniquet may be used. A 5 cm longitudinal incision starting at the lateral humeral epicondyle is made. The superficial fascia is incised in line with the skin incision. The interval between anconeous and ECU is easier to identify distally and the interval can then be extended proximally. The forearm should then be fully pronated to move the posterior interosseous nerve away from the surgical field and the capsule over the joint may then be incised to expose the capitellum, radial head and annular ligament. The capsule should not be incised too far anteriorly (radial nerve) and the annular ligament should not be incised or retracted too vigourously (PIN).

4. Describe the posteromedial approach to the knee joint with a view to fixation of a tibial plateau fracture (depressed posteromedial fragment).
   Answer: There is no internervous plane for this approach. The patient is positioned supine on a radiolucent table with a sand-bag under the contralateral buttock. The limb may be exsanguinated and a tourniquet used. A skin incision over the posteromedial tibia is made and the saphenous vein and nerve are found anterior to the incision. The Pes Anserinus is identified and its anterior border is partially resected and reflected posteriorly. The epi-periosteal plane between the pes and the medial head of gastrocnemius is developed to allow access to the postero-medial tibial plateau.

5. Describe the surgical approach to the anterior aspect of the cervical spine with a view to C5-C6 discectomy.
   Answer: The patient is positioned supine with a sandbag between the shoulder blades. The table is positioned at 30° head up and the face turned away from the side of the planned incision. Left sided approaches are often preferred due to the right recurrent larangeal nerve ascending into the neck at a higher level and crossing the operative field at the level of the thyroid gland. The C6 level is level with the carotid tubercle and a transverse incision is made at this level. The fascia is also incised in the same manner. The platysmus muscle (facial nerve CN VII) is encountered and split longitudinally. The sternocleidomastoid muscle is identified and the fascia immediately anterior to it is incised. The SCM is retracted laterally and the sternohyoid and sternothyroid muscles may be retracted medially, along with the underlying trachea and oesophagus. This exposes the carotid sheath and the pretracheal fascia is then incised on its medial border. Blunt dissection medially behind the oesophagus then exposes the cervical vertebrae behind the longus coli and the pre-vertebral fascia. The anterior longitudinal ligament is visible in the midline. The appropriate vertebral level may then be checked with an image intensifier before the longus coli muscle is split using diathermy over the midline and dissected sub-periostally to finally expose the vertebral body.

References

1. **Miller MD.** *Review of Orthopaedics.* Sixth ed. Elsevier 2012;200-1.
2. **Geeslin AG, LaPrade RF.** Outcomes of treatment of acute grade-III isolated and combined posterolateral knee injuries: a prospective case series and surgical technique. *J Bone Joint Surg [Am]* 2011;93-A:1672-83.
3. **Stannard JP, Brown SL, Farris RC, McGwin G,Jr, Volgas DA.** The posterolateral corner of the knee: repair versus reconstruction. *Am J Sports Med* 2005;33:881-8.
4. **Laprade, RF, Johansen S, Agel J, et al.** Outcomes of an anatomic posterolateral knee reconstruction. *J Bone Joint Surg [Am]* 2010;92-A:16-22.
5. **Slowik GM, Fitzimmons M, Rayhack JM.** Closed elbow dislocation and brachial artery damage. *J Orthop Trauma* 1993;7:558-61.
6. **No authors listed.** BAPRAS. The voice of plastic surgery. http://www.bapras.org.uk/resources/clinical_guidance/open_fractures_of_the_lower_limb/short_guide (date last accessed 20 May 2014).
7. **Morrey BF, An KN.** Articular and ligamentous contributions to the stability of the elbow joint. *Am J Sports Med* 1983;11:315-19.
8. **Hoppenfeld S, Deboer P, Buckley R.** *Surgical Exposures in Orthopaedics.* Fourth ed. Lippincott Williams and Wilkins, 2009;405.