Exam Corner

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MCQs – Single Best Answer

1. A 26-year-old male has been diagnosed with a median nerve injury following a stab injury to the proximal forearm. What muscles will he lose power in as a result of this injury?
   Answer: b. First two lumbricals and abductor pollicis brevis
   In the cubital fossa, the median nerve supplies pronator teres, palmaris longus, FCR, FDS. Occasionally PT is supplied above the elbow. In the forearm it gives off the anterior interosseous nerve which supplies FPL, PQ and usually the radial half of FDP (index and middle). In the hand the median nerve gives off the recurrent motor branch supplying APB, FPB and opponens pollicis muscles. The palmar digital branches supply the two radial lumbricals.

2. In the dorsum of the ankle which one of the following statements is true about the anatomical relationship of various structures?
   Answer: e. Deep peroneal nerve is between the extensor hallucis and extensor digitorum longus

3. All of the following statements are true about the flexion tear drop fracture of the cervical spine except:
   Answer: d. Sagittal body and laminar fracture are unusual
   Its name is derived from the characteristic triangle-shaped fragment that fractures from the anteroinferior corner of the vertebral body, resembles a drop of water dripping from the vertebral body. Characteristically there is posterior displacement of the upper column of the divided cervical spine. The injury is frequently associated with sagittal body and laminar fractures. The most common level is C5 and anterior cord syndrome is the characteristic neurological injury pattern.[1]

4. Which one of the following is the primary stabiliser of the elbow joint during valgus stress?
   Answer: b. Anterior oblique ligament
   Valgus stability is equally divided among the medial collateral ligament, anterior capsule, and bony articulation in full extension; whereas, at 90° of flexion the contribution of the anterior capsule is assumed by the medial collateral ligament which provides approximately 55% of the stabilising contribution to valgus stress.[2]
   The anterior band of the medial collateral ligament is the primary stabiliser of the elbow joint to valgus stress after around 25° of flexion, when the ulno-humeral joint becomes unlocked. The radiocapitellar joint is a secondary stabiliser.[3]

5. All of the following statements are true about Type I collagen except:
   Answer: c. Left-handed triple helical structure
   The structure is a right-handed triple helix.

6. Which of the following statements is true for Pemberton's pelvic osteotomy used for the treatment of developmental dysplasia of the hip (DDH)?
   Answer: e. The osteotomy hinges at the triradiate cartilage.
   This reduces the acetabular volume. It is indicated for correcting residual acetabular dysplasia in six- to seven-year-olds with DDH. The advantages of the procedure are the ability to perform bilateral osteotomies at the same sitting, no need for internal fixation and a greater capacity for correction. The disadvantage is the alteration of the shape of the acetabulum, which requires the procedure to performed early enough in childhood to allow time for remodelling of the acetabulum to the shape of the femoral head.

Vivas

Adult Pathology

A 34-year-old male presents with a two-week history of sudden onset of pain while playing football. He has also noticed a lump around his right groin. The radiographs and the axial CT scan obtained at the time of his visit are shown below (Figs 1a & 1b). He had been completely asymptomatic prior to this incident.

1. Describe the radiograph and the CT scan.
   Answer: The radiograph is an AP pelvis showing a pedunculated lesion superior to the right acetabulum. There is an inhomogeneous

Fig. 1a

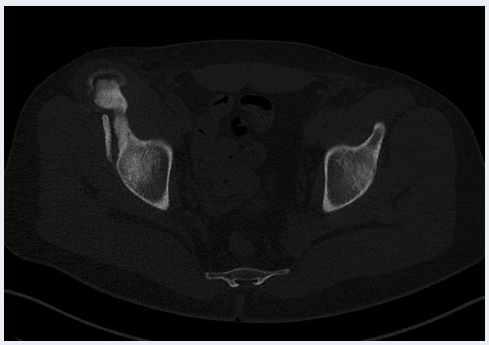

Fig. 1b

appearance of the stalk, which is arising from the ilium. There is a mineralised appearance at the distal lesion. The CT image demonstrates that the cortices of the lesion are continuous with the cortices of the pelvis. The medullary cavity of the pelvis and lesion are also continuous. There is a soft-tissue "cap" with some mineralisation. The bone of the lesion is inhomogeneous. The overlying muscle is obviously displaced by the lesion. The CT and radiograph also suggest a second smaller lesion posterior to the main large lesion.

2. What is the differential diagnosis?
   Answer: The most likely differential diagnoses consist of osteochondroma and secondary malignant change in an osteochondroma (secondary chondrosarcoma). The sudden onset of pain while playing football suggests the possibility of mechanical trauma, contusion, muscle irritation, an inflamed bursa over the lesion or fracture of the osteochondroma, although not obvious on the imaging. This could also suggest an old rectus femoris avulsion fracture.
   Other lesions commonly found in the pelvis consist of chondroblastoma, chondromyxoid fibroma, dedifferentiated chondrosarcoma, malignant fibrous histiocytoma, lymphoma and Ewing tumour.

3. What are the unusual radiological changes that would make you feel concerned about this abnormality?
   Answer: There is a thick calcified soft-tissue cap. A thickness > 1 cm suggests malignant change in the cap and therefore should be investigated with an urgent MRI scan. Mineralisation of a soft-tissue mass, an inhomogeneous appearance and destruction of the subchondral bone are all radiographic signs of malignant transformation.

4. How would you manage this patient?
   Answer: I would assess the patient as for any bone lesion. I would take a history and perform a clinical examination bearing in mind the possibility of this being a secondary lesion or the possibility of multiple lesions. It is important to enquire about a family history of bone lesions, as there is a possibility that the patient could have multiple hereditary osteochondromas, an autosomal dominant condition.[4,5]
   I would assess the patient with further blood tests and imaging, consisting of an urgent MRI scan and a whole body nuclear bone scan to look for other lesions. I would discuss the images with a bone tumour unit, as this is a possibly malignant lesion requiring excision.

Trauma

A nine-year-old boy presented to the A&E with a history of a fall leading to an injury to his elbow. These are the radiographs obtained in A&E (Figs 2a & 2b).

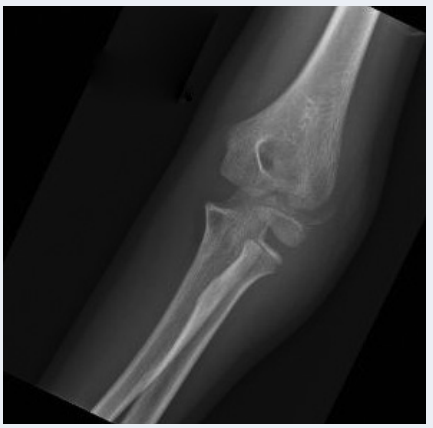

Fig. 2a

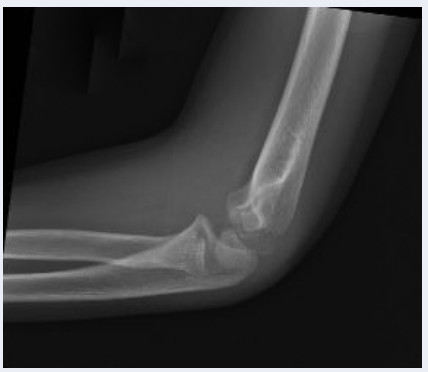

Fig. 2b

1. What is the diagnosis?
   Answer: The radiographs show a lateral condyle fracture of the distal humerus that is displaced. There is also lateral soft-tissue swelling.

2. How do you classify these injuries and which category would you place this individual's injury in?
   Answer: These injuries are classified according to the Milch classification. Milch[6] defined fractures that exited through the trochleocapitellar groove as type I and those that exited through the trochlea as type II. A true Salter-Harris type IV injury (Milch I) through the ossific nucleus of the lateral condyle is rare. This radiograph shows a Milch II.

3. What is the mechanism of injury and the displacing force?
   Answer: Two mechanisms have been suggested: a push-off and a pull-off.
   Pull-off: the injury has been reproduced in cadaveric studies by adducting the extended elbow with the forearm supinated. The fracture line begins between the origin of the brachioradialis and ECRL. The ECRL and ECRB along with lateral collateral ligament are attached to the fracture and are the major deforming force.
   Push-off: the injury can be produced by applying a sharp blow to the palm of the hand with the elbow flexed. Others have speculated that because the forearm goes into valgus when extended, the radial head can push off the lateral condyle or that the injury can result from a direct blow to the olecranon.
   The more common type of fracture, which extends to the apex of the trochlea, is probably a result of avulsion forces on the condyle, with the olecranon's sharp articular surface serving to direct the force along the physeal line into the trochlea. When a child falls forward on his or her palm

with the elbow flexed, the radial head is forced against the capitellum and may cause the less common Milch type I physeal fracture.[7]
Displacement has been described as occurring in three stages. In the first stage, the fracture is relatively undisplaced, and the articular surface is intact. Because the trochlea is intact, there is no lateral shift of the olecranon. In the second stage, the fracture extends completely through the articular surface. This allows the proximal fragment to become more displaced and can allow lateral displacement of the olecranon. In the third stage, the condylar fragment is rotated and totally displaced laterally and proximally, which allows translocation of both the olecranon and the radial head.

4. How would you treat this patient?
Answer: Fractures involving the lateral condylar physis can be treated with cast immobilisation alone, closed reduction and percutaneous pinning, or open reduction and internal fixation.
In this case the fracture line appears to enter the joint line at the lateral crista of the trochlea and there is lateral displacement of the lateral condyle fragment > 2 mm. There is also marked lateral soft-tissue swelling, indicative of internal soft-tissue injury. This is likely to be an unstable fracture and therefore I would perform an open reduction through a lateral approach, avoiding posterior tissue stripping to protect the blood supply of the lateral condyle. I would use an open reduction to ensure anatomical alignment of the articular surface. I would hold the reduction with two buried smooth K-wires, which I would remove at around four to six weeks. The ideal place for the pins is in the metaphyseal fragment. If the metaphyseal fragment is too small the wires can be placed across the physis. The wires should diverge as much as possible to enhance the stability of fixation.

5. What is the expected prognosis?
Answer: The possible late complications of displaced lateral condyle fractures are many. These include delayed union, nonunion, cubitus valgus, tardy ulnar nerve palsy, lateral spur formation (overgrowth), cubitus varus, fishtail deformity, osteonecrosis and premature physeal arrest. Some of these may be due to the injury itself or some related to the treatment (ie: osteonecrosis).
In fractures that are undisplaced or displaced < 2 mm treated non-operatively, Bast et al[8] reported further displacement requiring operative treatment of only two of 95 fractures. Good results have been reported with the use of open reduction and internal fixation with 4 mm AO screws. In 37 fractures displaced more than 2 mm, painless full range of movement was obtained in 36. Only one case had a delayed union with a loss of 10° of motion. Nonunion, AVN or premature physeal fusion was not observed.[9] Studies have reported equivalent results with K-wire or screw fixation,[10] although Hardacre et al[11] stressed that the key to a good result is in achieving an anatomical reduction. The results of closed reduction and percutaneous K-wire fixation of fractures displaced > 2 mm with an arthrographically congruent joint surface have been reported as excellent. The authors recommended that closed reduction be considered in these selected cases.[12] A normal range of movement and complete healing was reported in all the 12 cases.

Hands

An 80-year-old woman with known history of rheumatoid arthritis presents with a painful right index finger recalcitrant to corticosteroid injections and conservative management. These are her radiographs (Fig. 3).

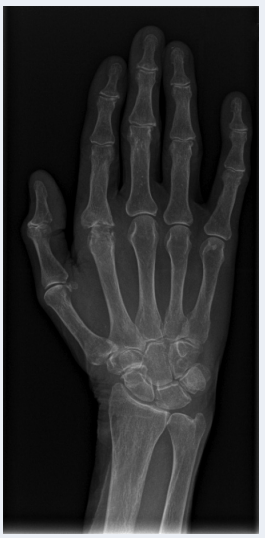

Fig. 3

1. What is your diagnosis?
Answer: The index finger MCPJ shows degenerate changes with joint space obliteration and deformity, cysts, sclerosis and periarticular erosions. There are also small phalangeal osteophytes. The disease is affecting both sides of the joint. This is consistent with arthrosis of the index MCPJ. The differential diagnosis includes RA, OA, CPPD, septic arthritis/OM and AVN (Dietrich disease) secondary to steroid use, which has gone on to secondary OA of the whole joint.

2. What is unusual about this presentation?
Answer: This is an unusual presentation in a patient with RA because the disease is monoarticular with sparing of the other MCPJs. The radiocarpal and DRUJ joints are also relatively well preserved and none of the characteristic rheumatoid hand deformities are present.

3. What is your preferred choice of treatment for this condition?
Answer: If the condition is recalcitrant to non-operative treatments I would offer the patient an operative procedure. The most common options are arthrodesis or arthroplasty. In the index finger stability of the MCPJ is extremely important for lateral pinch. Anatomical or silastic arthroplasty of the MCPJ has good results in terms of pain relief and retaining movement, however this would be better tolerated in the middle, ring or little fingers. Arthroplasty procedures are prone to more long term complications. Subluxation or dislocations of the unconstrained components, loosening of the implants, implant fracture and joint stiffness have all been described. Implant subsidence has also been described in rheumatoid patients.[13]

4. What other modality of treatment is the mainstay of MCP joint problems in patients with rheumatoid arthritis?
Answer: The mainstay of MCP joint problems in patients with rheumatoid arthritis has been the silastic MCP joint replacement. These are flexible hinged prostheses made from silicone. Outcomes have shown good improvements in pain and function. Complications include implant fracture, infection, silicone synovitis, loosening and dislocation. Trail et al[14] reported 63% survivorship at 17 years, with two thirds of implant seen to be broken on radiographs.

Children's Orthopaedics

Here is the radiograph and MRI of a ten-year-old boy who developed an enlarging, painless swelling on the outer side of his right knee (Figs 4a & 4b).

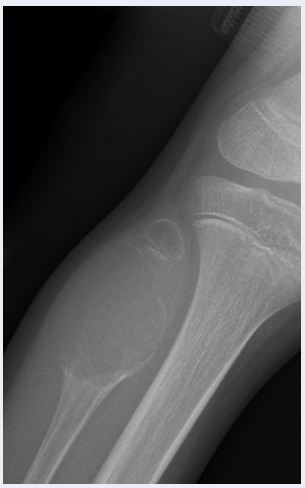

Fig. 4a

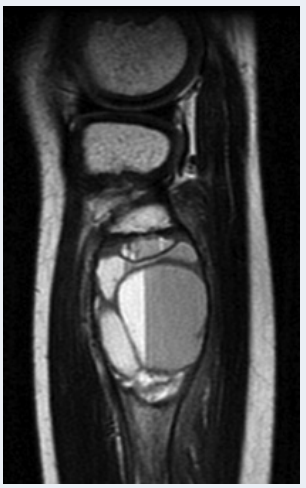

Fig. 4b

1. Describe the features of both images. What is the likely diagnosis and how would you treat the condition?
   Answer: This is a radiograph of the proximal tibia and fibula in a skeletally immature individual with open physes. There is an expansile lesion in the metaphysis of the fibula which has a homogeneous soap-bubble / cystic type appearance. The lesion has thinned the cortex and there is periosteal reaction. There is a narrow zone of transition and the lesion is encroaching on the physis. The MRI image is from a T2 weighted scan. It shows multiple cystic areas containing fluid levels. The lesion is not invading the surrounding soft tissues or crossing the physis in this image.
   The likely diagnosis is aneurysmal bone cyst (ABC), for which these appearances are characteristic. Telangiectatic osteosarcoma and giant cell tumour can mimic an ABC, so this should be borne in mind. ABC can also be found in association with these and other bone lesions.
   The ABC is a benign tumour-like lesion. They can be a rapidly growing and destructive bone lesion. The expansile nature of the lesions can cause pain, swelling, deformity, disruption of growth plates, neurologic symptoms (depending on its location), and pathologic fracture.
   Because of the incidence of other benign and malignant lesions that can occur with ABCs it is wise to refer the patient for biopsy and definitive treatment in a bone tumour centre. This lesion is also in very close proximity to an open physis, therefore there is potential for operative treatment to cause growth disurbance.
   Treatments may consist of intralesional curettage, intralesional excision or *en-bloc* resection (these may vary with the Enneking stage I-III). These may be accompanied by adjuvants such as phenol, PMMA or liquid nitrogen. Bone grafting may be used, but reconstructive surgery is not necessary in the fibula.
   Newer adjuvant techniques include selective arterial embolisation and Argon beam therapy.
   Local recurrence is a recognised complication and the patient should be monitored regularly for at least five years and until skeletal maturity.

Here is a photograph of the forearm and hand of a twelve-year-old boy (Fig. 5a).

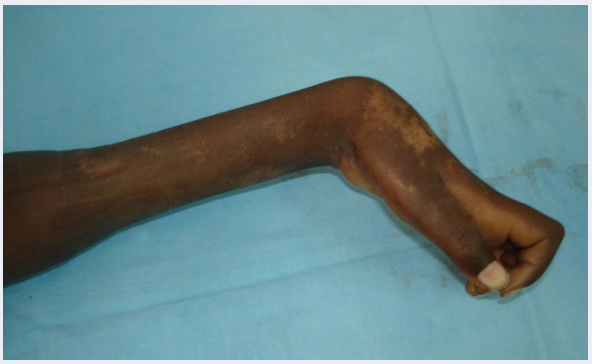

Fig. 5a

2. What is this condition?
   Answer: The diagnosis is Volkmann's ischaemic contracture.

3. What is the likely cause?
   Answer: The photograph was taken eight months after treatment of a forearm fracture with compressive bandaging.

4. How would you treat it?
   Answer: The condition was treated by lengthening of all the flexor structures in the forearm. The median and ulnar nerves were also involved.
   Fig. 5b shows the immediate post-operative position which was maintained.
   The boy recovered limited active flexion from the surviving muscle above the compressed area and there was subjective improvement in median nerve sensory function.

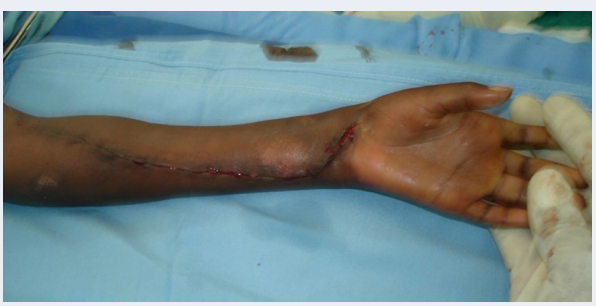

Fig. 5b

Basic Science

1. Compare and contrast metal-on-polyethylene and metal-on-metal as a bearing couple in total hip arthroplasty.
   Answer: Metal on ultra-high-molecular-weight polyethylene (MOP) *vs* Metal on metal (MOM) see table:

Property	MOP	MOM
Surface roughness	0.25-2.5 µm (poly)	0.025 µm
Coefficient of friction	0.02 μ_f	0.8 μ_f (dry)
Linear wear	150-200 µm/yr	5-10 µm/yr
Volumetric wear	40-80 mm^3/yr	0.1-1.0 mm^3/yr
Particle numbers	$7x10^{11}$	$4x10^{12}$-$2.5x10^{14}$
Particle size	0.5-100 µm	0.05-0.5 µm

Factors that affect MOP and MOM bearings in THR:

Surface roughness:
Damaged femoral heads have a higher volumetric wear rate, penetration and total number of particles produced over the lifetime of the prosthesis.
Damaged heads in MOP bearings produce increased numbers of small, more biologically active particles (< 10 μm). However, MOM bearings have the ability to self-heal (polish out isolated surface scratches caused by third body particles). Metals (MOM) have good fracture toughness and so resist abrasive wear well. In order to overcome abrasive wear the hardness is increased by using alloys such as CoCrMo and by increasing the carbide content. The linear wear rate is therefore much lower than MOP. There is a bedding-in period in the first two years, when MOM linear wear is 10 to 20 μm. The rate then stabilises thereafter due to surface polishing.

Particle size
Particle size is much smaller in MOM bearings in comparison with those that activate macrophages (0.5-1.0 μm) and so do not stimulate such an inflammatory response. Although they are small, more particles/year are produced by MOM bearings. However, osteolysis is rarely seen.

Thickness of UHMWPE
Should be at least 8 mm, as contact stress, wear and amount of creep increase dramatically when thickness of PE falls below this level.
In a 40 mm UHMWPE cup this thickness can only be achieved by down-sizing the head to 22 mm. In MOM bearings the components can be much thinner and therefore larger head sizes are possible.

Type of metal
Cobalt chrome heads in MOP has excellent properties, particularly if it is cold worked, because it is hard, resistant to corrosion and resistant to fatigue.
Stainless steel is cheaper, but easily scratched.
Titanium alloys have poor wear characteristics and a high coefficient of friction compared to cobalt-chrome. They are also sensitive to surface flaws and scratching. Their use as a bearing surface has been abandoned.

Head size
The larger the head size, the greater the sliding distance and volumetric wear.

Modularity
In MOP bearings there is increased wear in both cemented and uncemented metal backed cups due to the decreased UHMWPE thickness and increased peak stresses.
Backside wear occurs from relative movement between liner and shell. It is worse if there is a poor locking mechanism of screw holes with sharp unpolished edges. Settling of the cup may lead to prominence of the screws and gaps between screw and cup. UHMWPE wear particles may pass through these gaps and unused screw holes.

Third body wear
Third body wear is a problem in MOP bearings. As above, MOM bearings self-heal.

Decreased offset of the prosthesis
Decreased offset of the prosthesis is possible in MOP due to higher joint reaction forces that are created.

Production of UHMWPE
Ram extrusion produces linear wear of about 0.11 mm/year, whereas compression moulding produces rates of around 0.05 mm/year.

Gamma sterilisation in air
Causes oxidation of UHMWPE leading to increased crystallinity and reduction in fatigue strength.

Lubrication
MOP bearings are lubricated predominantly by boundary lubrication. In MOM bearings the mode of lubrication is mixed. True fluid film (hydrodynamic) lubrication can occur in larger head diameters, along with boundary lubrication.

2. How would you investigate a patient who presents to you with a painful resurfacing done a year ago and has normal radiographs?
Answer: I would take a history and perform a clinical examination, as well as performing blood tests (FBC, ESR and CRP) to rule out infection. I would be most concerned about an adverse reaction to metal debris (ARMD). Pertinent information would include the make and model to the hip resurfacing, the head size and the gender of the patient. I would also want to know about the characteristics of the pain and any systemic symptoms of infection. In the examination I would pay particular attention for any lymphadenopathy and swellings, as well as the hip range of motion, pain and limping.

   I would follow the MHRA guidelines for the investigation of MOM hip replacements.[15]
   For a symptomatic MOM resurfacing:
   MARS MRI or USS imaging in all cases.
   Blood Co and Cr ion levels. (Blood metal ion levels > 7 ppb indicates potential for a soft-tissue reaction).
   Second blood test for metal ion levels three months after the first test if levels > 7 ppb (Blood metal ion levels > 7 ppb indicates potential for a soft-tissue reaction, especially if higher than first test).
   Consider revision if imaging is abnormal or the metal ion levels are rising.

   MHRA guidance notes on the above:
   MARS MRI scans (or ultrasound scans) should carry more weight in decision making than blood ion levels alone. Patients with muscle or bone damage on MARS MRI are those of most concern. A fluid collection alone around the joint in an asymptomatic patient, unless it is very large can be safely observed with interval scanning.

3. What is the characteristic response produced by the metal ions in the peri-prosthetic tissues that may lead to failure of the implant?
Answer: The deposition of cobalt-chrome wear particles in peri-prosthetic tissues induces a spectrum of necrotic and inflammatory changes. Periprosthetic soft-tissue lesions have been described as metallosis, aseptic lymphocytic vasculitis-associated lesions (ALVAL), adverse reaction to metal debris (ARMD) and pseudotumours. Metallosis is the macroscopic staining of the soft tissues and is associated with abnormal wear, usually of the bearing surface or taper junction. The histological appearances of ALVAL may occur with a range of changes from when metallosis is not evident to when there is an effusion or soft-tissue necrosis and pseudotumour formation. Pseudotumour describes a mass, which may be cystic or solid or a combination. The diagnosis

is based on cross-sectional imaging or operative findings. Pseudotumours are usually, but not always, symptomatic, and histology tends to show ALVAL and tissue necrosis. The term ARMD is an umbrella term including metallosis, ALVAL and pseudotumours. It is possible to progress through all three stages. There appears to be no clear consensus in the literature defining the boundaries of each term, or that all metallosis develops into pseudotumours, or that ALVAL is necessarily present. It has been suggested that these abnormal soft-tissue reactions may be attributed to two aetiologies: wear-related cellular cytotoxicity and hypersensitivity.[16]

4. Which specific type of resurfacing had the highest rate of revision on the most recent UK National Joint Registry and why?
   Answer: In the 9th annual report of the National Joint Registry (NJR) 2012,[17] the DePuy ASR resurfacing had a revision rate of 24.22% at seven years. This is thought to be a design issue related to the lower diametrical clearance and the sub-hemispherical acetabular design of this implant, which might give rise to edge loading and increased wear.[17]

5. What do you understand by the term 'specific biological activity'?
   Answer: Biological activity describes the beneficial or adverse effects of a substance on living matter.

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