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Quiz

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- Which muscle is primarily responsible for the subluxation of first metacarpal in Fig. 1?
 - Extensor pollicis longus
 - Extensor pollicis brevis
 - Abductor pollicis longus
 - Abductor pollicis brevis
- Which type of bearing surfaces in total hip arthroplasty is associated with Aseptic Lymphocyte-dominated Vasculitis Associated Lesions (ALVAL)?
 - Metal on UHMWPE
 - Metal-on-metal
 - Ceramic on UHMWPE
 - Ceramic on ceramic
- Which one of the following statement is false about Floor Reaction Orthosis?
 - It is based on Newton's third law
 - It accentuates knee extension in midstance
 - It limits ankle dorsiflexion in single support
 - It improves gait in fixed flexion of hip & knee
- Which one of the following substance works as initiator of polymerization in bone cement?
 - Dibenzoyl peroxide
 - Zirconium dioxide
 - 2,5-dimethylhexane-2,5-hydroperoxide
 - Barium sulphate
- Which adverse effect is seen to be associated with the use of non-circumferential porous coating of femoral stem in total hip arthroplasty?
 - Increased rate of stress shielding
 - Increased rate of distal osteolysis and late femoral loosening
 - Increased rate of thigh pain
 - Increased rate of infection

Answers and explanations

- C – *Abductor pollicis longus*

Fig. 1 denotes partial intra-articular fracture of base of the first metacarpal that is also known as Bennett's fracture. It was first described by Bennett EH in 1882 as he presented five pathologic specimens of healed fracture of the palmar

articular surface of the base of the first metacarpal.¹ Bennett's fracture is actually a fracture-subluxation. This injury-pattern is caused by axial loading of first metacarpal in partially flexed position. The small volar-ulnar fragment is of variable size and is known as Bennett's fragment and is pyramidal in shape. It is held in place by the anterior oblique ligament which connects it to the trapezium. The rest of the metacarpal base subluxates radially, proximally, and dorsally. Fig. 2 shows displacement of Bennett's fracture that is primarily caused by the action of abductor pollicis longus and adductor pollicis resulting in flexion, supination, and proximal migration.

The goals of treatment are to: (1) restore stability of the CMC joint by rejoining the Bennett fragment (attachment of

Fig. 1 – Posteroanterior view of the thumb in skeletally mature individual.

Fig. 2 – Diagrammatic representation of Bennett's fracture showing the roles of adductor pollicis and abductor pollicis longus in the fracture displacement.

the anterior oblique ligament) to the thumb metacarpal and (2) restore articular congruity of the thumb metacarpal base.

Axial rotation is limited by the joint capsule, ligaments, extrinsic tendons, and geometry of the joint surfaces.² Joint stability is maintained by five ligaments: the anterior (volar) and posterior oblique ligaments, the anterior and posterior intermetacarpal ligaments, and the dorsal radial ligament. Joint compressive forces are high during simple pinch and grasp. Thus, significant loss of joint congruency, either secondary to an unreduced intra-articular fracture or from disruption of the soft tissue stabilizers, leads to post-traumatic arthritis. Bennett's fracture-subluxation is reduced under suitable anaesthesia by extending and pronating the thumb metacarpal while longitudinal traction and downward pressure are applied to the metacarpal base.

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2. B – Metal-on-metal

Joint replacements started with components using metal-on-metal (MOM) articulations. However, these components had a high failure rate and were deemed unsatisfactory. The early MOM prostheses gave way to polyethylene and ceramic based components. But lately, improvements in manufacturing and composition lead to the emergence of a second generation of

MOM implants that have improved wear properties. The metal components of these second generation MOM prostheses are alloys of cobalt, chromium, molybdenum or nickel.

Wear particles from second generation implants are smaller than those associated with first generation implants. The smaller size of particles and higher surface area of MOM debris particles facilitates their diffusion into surrounding tissues. A rare and novel complication has been described in association with these MOM bearings that is Aseptic lymphocyte-dominated vasculitis associated lesion (ALVAL).^{1,2} It has been postulated to be a local delayed-type metal hypersensitivity reaction leading to early prosthetic failure. It is hypothesized that metal ions are released due to normal wear and these metal ions combine with native proteins to form haptens that elicit a type IV hypersensitivity response.

Patients usually present around 2–3 years after surgery with complaints of hip or thigh pain, discomfort, palpable fullness. Plain radiographs reveal peri-implant lucency and osteolysis. MRI can further reveal soft tissue mass, effusions, capsular thickening and contrast enhancement. The characteristic histological features are a diffuse and perivascular infiltrate of plasma cells, T and B lymphocytes. Fibrin exudation, accumulation of macrophages with inclusion bodies and eosinophilic infiltrate will also be seen. This unique perivascular inflammatory infiltrate, in fact, is specifically referred to in the name of the syndrome (“vasculitis-associated lesion”).

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3. D – It improves gait in fixed flexion of hip & knee

The thermoplastic molded ankle-foot orthosis are frequently prescribed. There are 4 main types of below-knee orthotics:

1. UCBL (University of California Biomechanics Laboratory) – in-shoe plastic slipper
2. Leaf spring AFO – single piece short leg brace with ankle in 5° to 10° dorsiflexion
3. Rigid AFO – similar to leaf spring type, except that ankle section is modelled in neutral position and is left rigid
4. Floor-reaction AFO – orthosis with a ventral shell

The first floor reaction AFO (FRAFO) was designed by Al Masunis. A conventional FRO is a rigid type of AFO, and includes a ventral shell and a rigid footplate. The biomechanical mechanism of an FRO is to create a knee-extensor moment during midstance and terminal stance, by shifting of the ground reaction force forward. The FRO limits ankle dorsiflexion in single support and consequently improves knee extension. As the leg passes forward over the foot, a lack of ankle joint dorsiflexion will prevent forward migration of the

tibia which will then cause an external knee extension moment. This occurs because by controlling the more distal joint, one can alter the ground reaction force and effect more proximal joints by the principal of coupling.¹

A floor reaction AFO (FRAFO) is a custom fabricated, molded plastic device that supports the ankle and foot area of the body and extends from below the knee down to the foot. This device is used to control instabilities in the lower limb by maintaining proper alignment and controlling motion. The various designs of FRAFO's include: (1) one piece: encloses the back of the lower calf, the shin, and bottom of the foot in one piece; (2) two piece: it has a removable front panel; (3) Rear-opening: encloses the front of the leg and top of the foot that may be articulated.

It is generally used in the patients suffering from post-polio residual paralysis, spina bifida, cerebral palsy, brain injury, and spinal cord injury. Where AFO part functions to maintain the affected joints in proper alignment, it accentuates the knee extension at midstance, and compensates for the weak gastroc-soleus muscles. FRAFO places the extension force closer to the knee than other AFO's and uses a rigid anterior shell with padding. It is important to know that the FRAFO will not improve kinematics if knee or hip flexion is a fixed deformity. Knee and hip flexion contractures of $\geq 15^\circ$ limit the efficacy of the orthosis in controlling knee extension in midstance. Such contractures should be considered as contraindications to the prescription of this orthoses or should be addressed (surgically or otherwise) prior to its application.²

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4. A – Dibenzoyl peroxide

Methylmethacrylate (MMA) is an ester of methacrylic acid. Polymethylmethacrylate (PMMA) is a type of bone cement used for clinical applications in orthopaedic surgery.¹ Bone cements usually have two components that are made of liquid and powder. Bead-shaped particles of typically 40 μm diameter make up the powder component. These particles contain MMA copolymers and benzoyl peroxide (BPO; the so-called initiator). The liquid component mainly contains the monomers. When the two components are mixed, a monomer becomes unstable by reacting with an initiator and polymerization is started. Cement is made radio-opaque by adding barium sulphate or zirconium dioxide compounds to the powder. Bone cements with zirconium dioxide have a significantly higher opacity.

Cement polymerization is an exothermic reaction with heat formation of 57 kJ per mole MMA. Lowering the handling temperature can extend polymerization time. The average

polymerization time is around 2–5 min, depending on the temperature and the manufacturer. The handling of bone cement can be described by four different phases, based on the viscosities: 1) The mixing phase (up to 1 min) is the period required to thoroughly homogenize the powder and the liquid. 2) The liquid phase (up to several minutes) is the period required to reach a non-sticky state of the cement. 3) The working phase (2–4 min) is the period in which the cement is injected. 4) The hardening phase is a short period during the final setting process and the development of polymerization heat.

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5. B – Increased rate of distal osteolysis and late femoral loosening

With the recognition of problems arising due to cemented fixation of femoral components with acrylic cement mainly the high incidence of mechanical loosening and the extensive bone loss which sometimes is associated with fragmented cement, extensive efforts have been made to provide for biological fixation of femoral components and avoid cement.¹ The focus then shifted to the bone ingrowth in the porous metal surfaces. The two necessities for bone ingrowth are immediate mechanical stability and intimate contact between the porous metal surface and viable host bone. For this purpose, implants were designed for snug fit in the proximal femur. Thus, the selection of implant type and size and the surgical technique and instrumentation all must be more precise than with their cemented counterparts.

Uncemented prosthetic fixation depends upon bone ingrowth into a porous implant surface or bone ongrowth to a biologically active implant surface, such as grit-blasted titanium or a ceramic such as hydroxyapatite.² Smooth press-fit implants without coatings or texturing to provide for bone ongrowth or ingrowth are not reliable in long-term fixation in total hip arthroplasty. For porous ingrowth to occur reliably, the optimal pore size should be 100–400 μm . Most popular materials for biologic fixation are cobalt–chromium and titanium. Biologically active osteoconductive ceramics have become popular, although unproven whether they have any advantages over porous metal surfaces. key prerequisite for bony fixation of uncemented implants is stable initial fixation of the implant against bone and micromotion should be less than 50 μm to cause bone ingrowth, whereas larger amounts of micromotion causes only fibrous fixation, thus, for stable long-term biologic fixation, there should be immediate stability with well fitted implantation against bone of sufficient strength to resist micromotion before bone ingrowth occurs.

Porous stem designs which are available today differ in their materials, shape, location of porous surface, and stiffness. Two materials are largely been used: (1) titanium alloy with a porous surface; (2) cobalt–chromium alloy with a sintered beaded surface. The results have been satisfactory with both. Titanium has got superior biocompatibility, high fatigue strength, and lower modulus of elasticity but more notch-

sensitive than cobalt-chrome alloy, predisposing it to initiation of cracks through metallurgical defects and at sites of attachment of porous coatings. When the stem is of a titanium substrate, the porous surface must be restricted to the bulkier proximal portions of the stem and away from areas that sustain significant tensile stresses, such as on the lateral border of the stem.

Extensive porous coating of femoral stems and stiffness leads to adverse femoral bone remodelling. Fully porous-coated cobalt-chrome alloy stems with extensive bone ingrowth cause minimal proximal bone loss, but when a fully coated stem is implanted, the magnitude of proximal cortical remodelling sometimes causes concern about the difficulty of extracting a well-ingrown device without causing severe damage to the remaining stress-shielded femoral bone stock. Extensive coatings are mostly used for revision arthroplasties in which distal fixation must be relied on for implant stability.

The extent of porous coating necessary is controversial, but still most experts rely upon circumferential porous coating at proximal extent. Porous stem designs which uses intervening smooth areas in proximal porous coating, allows joint fluid to transport particulate debris to the distal aspect of the stem. This design feature has been found to be associated with early development of osteolysis around the tip of the stem despite bone ingrowth proximally. Circumferential porous coating of the proximal aspect of the stem provides a more effective barrier to the ingress of particles and limits the early development of osteolysis around the distal aspect of the stem.

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