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Quiz

1. Question

Which of the following imaging technique is used to detect specifically the loss of sulfated Glycosaminoglycans from the articular cartilage.

- STIR- MRI.
- T2 image MRI.
- T1 image MRI.
- dGEMRIC.

2. Question

Following are the procedures done for treatment of chronic mallet finger except:

- Little's procedure.
- Fowler tenotomy
- Tenodesis
- Oblique retinacular ligament reconstruction.

3. Question

Methods of decreasing polyethylene wear rate in a THR are all except:

- Using highly crosslinked polyethylene.
- Vit E oxidation of polyethylene.
- Increasing head size
- Decreasing head size.

4. Question

Which of the following is not true about surgical management principles of Gunshot-related fractures-

- Initial assessments should begin with ATLS principles.
- High risk wounds are those involving high-energy weapons, delayed presentation, large soft tissues defect, multiple projectiles, exposed bones and those occurring on a battlefield or farm environment.
- Most low risk gunshot fractures can be treated similarly to closed fracture.
- Bullet tracts easily decompress muscle compartments and fasciotomy is not required for compartment syndrome.

5. Question

Which of the following is false about Plumbism due to bullet injury.

- Synovial fluid act as a solvent an the lead core of the bullet and may cause synovitis or systemic plumbism.
- Toxicity is confirmed with blood level greater than 10 mcg/dl.
- Symptoms such as fatigue, headache, abdominal pain, anemia, nausea, renal failure, encephalopathy or peripheral neuropathy generally occurs at level >24 mcg/dl.
- Time between injury and toxicity may range from 2 days to 40 years depending on location of bullet and metabolic states of the patients.
- Bullet retained in the CSF, elute lead at faster rate compared to skeletal tissues.

Cartilage Zones	Properties	Collagen fibers	Proteoglycan	Water content
Superficial	Smooth gliding surface	Highest concentration. Orientation : parallel	Low	Highest.
Intermediate		Low concentration. Orientation: oblique	High	Low.
Deep	Dense	Orientation : perpendicular.	Highest	Lowest
Underlying	Calcified Smaller separates overlying deep zone from the subchondral bone	Orientation : radial in a calcified matrix.		

Morphological imaging of articular cartilage.

MRI types	Properties	Disadvantage
1. Fat-suppressed T1	<ol style="list-style-type: none"> 1. Low signal of suppressed fat in the subchondral bone contrasts with the high signal intensity of articular cartilage. 2. 90% sensitive and specific for cartilage defects. 	<ol style="list-style-type: none"> 1) Metallic artefacts. 2) Increased scan time. 3) Difficulty in distinguishing articular cartilage from surrounding soft tissues.
2. Intermediate-weighted fast-spin-echo (FSE) MRI	<ol style="list-style-type: none"> 1. Depends on the water content of articular cartilage. 2. Articular cartilage-intermediate, free water —high & the highly organized fibrocartilage meniscus-low signal Intensity. 3. 87% sensitivity, 94% specificity, and 95% negative predictive value. 	<p>Advantages</p> <ol style="list-style-type: none"> 1. Shorter imaging times. 2. Excellent contrast between articular cartilage and soft tissues. 3. Reduced susceptibility artefact. 4. Fat suppression—distinguish between cartilage, synovium, and joint fluid. 5. It can also visualize gray-scale anatomy, that is, it can differentiate signals based on the water content and collagenous organization of the various zones of articular cartilage.

Biochemical imaging.

MRI types:	Properties & what they detect	Appearances	Advantages/disadv.
1. T2 MAPPING (1.5 and 3.0 T-better. Cartigram)	<p>Measures</p> <ol style="list-style-type: none"> 1. The collagen component OF cartilage ECM. 2. The changing interactions between water and collagen molecules. 3. It can detect zonal variations in articular cartilage. 	<ol style="list-style-type: none"> 1. The deep layer of articular cartilage is densely packed with collagen fibers, and the high anisotropy of this layer — low T2-signal intensity. In transitional layer, there is less anisotropy, - increase in T2 signal. Thus, T2 mapping values increase from deep to transitional layers in healthy articular cartilage. 2. Disturbances in structure caused by cartilage injury/degeneration - increased free water — increased T2 signal intensity. 3. T2 — evaluation of articular cartilage after reparative procedures. 	<ol style="list-style-type: none"> 1. Scanning times are short (approximately 6 min), so they can be added to routine MRI without a notable increase in total scanning time 2. contrast administration is not needed 3. and three-dimensional imaging <p>Disadvantage:</p> <ol style="list-style-type: none"> 1. Bone-cartilage interface artifact as well as postoperative metallic particles. 2. The superficial zone of articular cartilage, which has a highly ordered collagen structure and therefore a shortened T2 value, is below the resolution of T2 relaxation mapping and cannot

Biochemical imaging – (continued)			
MRI types:	Properties & what they detect	Appearances	Advantages/disadv.
T1rho MRI Sodium MRI	Correlate with proteoglycan content. 1. Similar to dGEMRIC, this modality takes advantage of the highly negative fixed charge of GAG in articular cartilage. 2. Correlate with proteoglycan content.		be adequately assessed at this time. However, T2 mapping of cartilage has little or no relation to the proteoglycan depletion of cartilage. 1. Intravenous contrast administration is not needed. 2. Requires specialized hardware. 3. Suboptimal signal-to-noise ratio in comparison with proton imaging. 4. Higher field strength (eg, 7 T).
4. Delayed gadolinium enhanced MRI of cartilage: (dGEMRIC).	1. Proteoglycan-based imaging technique taking advantage of the highly negative charge of GAG molecules. 2. Early changes in OA include a reduction in GAG concentration.	Patient is injected with intravenous gadolinium contrast at 0.2–0.3 mmol/kg or 0.4 to 0.6 mL/kg, which is two to three times the standard dose used in gadolinium-enhanced MRI. 2. The patient must complete a short course of exercise (eg, stairs, walking) at his or her own pace to disperse gadolinium throughout the joint prior to imaging. 3. Gadopentetate dimeglumine disperses inversely with the amount of GAG in cartilage; thus, normal articular cartilage should have a low concentration, and damaged cartilage should have a high concentration.	1. Disadvantage – requires higher doses of intravenous gadolinium, so Patients with poor renal function should not undergo dGEMRIC because of the risk of nephrogenic systemic fibrosis, a rare and sometimes fatal syndrome. Uses: 1. See for increase of GAG with exercise that is adaptation of articular cartilage. 2. Reproducible and reliable way of prediction of osteoarthritis correlating with histology. 3. Early detection of articular cartilage pathology in femoroacetabular impingement, dysplasia etc. 4. Assess various articular cartilage treatments.

Answers

1. Answer: (d)

Articular cartilage contains water, chondrocytes, and a rich extracellular matrix (ECM) composed of collagen fibers and proteoglycan molecules. Water makes up between 65% and 80% of the total weight. The remainder of the wet weight is made up mainly of collagen (90%–95% type I), and proteoglycans, particularly glycosaminoglycan (GAG). The characteristic proteoglycan molecule, aggrecan, houses approximately 160 GAG chains. Each chain contains chondroitin sulfate and keratan sulfate, which are highly negatively charged. These proteoglycans help disperse load throughout a joint and endow cartilage with a high compressive strength. Their cumulative large negative charge increases the osmolality of the tissue and attracts water molecules into its substrate.

Swelling is prevented by the highly organized collagen fibers in the ECM. Cartilage is divided into zones based on its structure and function.

Glycosaminoglycans (GAG) are long unbranched polysaccharides consisting of repeating disaccharide unit. The repeating unit usually is an amino sugar like N-acetyl glucosamine/galactosamine along with uronic sugar (glucuronic acid or iduronic acid) or galactose. GAGs are highly polar and hydrophilic to water. This helps in their role as lubricant or shock absorber in articular cartilage of joints. Four groups are present: heparin/heparin sulphate, chondroitin sulphate are synthesized in golgi apparatus of cell. The other two are Keratan sulphate and the fourth important GAG is hyaluronic acid is produced by synovial membrane.

Proteoglycans are proteins that are heavily glycosylated. The basic proteoglycan unit consists of a core protein with one or more covalently attached glycosaminoglycan (GAG) chain(s). So chondroitin sulfate is GAG and aggrecan is the major proteoglycan in cartilage. The tightly packed and highly charged sulfate groups of chondroitin sulfate generate electrostatic repulsion that provides much of the resistance of cartilage to compression.

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2. Answer: (a)

Mallet finger is the result of disruption of the extensor tendon over the distal interphalangeal joint. This common hand injury resulting in a flexion deformity of the distal finger joint and may lead to an imbalance between flexion and extension forces proximally in the digit. The deficiency of extension at DIP joint leads to retraction of extension apparatus with overaction-hyperextension at PIP joint by the central slip; so flexion at DIP and hyperextension at PIP joint leads to a swan-neck deformity in chronic cases. Mallet injuries can be

Procedures for correction of chronic mallet finger.

Tenodesis	Spiral oblique retinacular ligament reconstruction	Fowler's central slip oblique tenotomy
Resection of an elliptical wedge of skin, tendon, and scar tissue with reapproximation of the skin and tendon as a single unit with sutures.	<ol style="list-style-type: none"> 1) Addresses the imbalance of flexion and extension forces contributing to a chronic mallet deformity & restores the dynamic tenodesis effect of the oblique retinacular ligaments in coordinating PIP and DIP joint extension. 2) Free tendon graft secured distally to the dorsal base of the distal phalanx. The graft is passed volarward in a spiral fashion around the radial aspect of the middle phalanx and is secured proximally to the ulnar side of the flexor tendon sheath at the level of the proximal phalanx or directly to bone. 	<ol style="list-style-type: none"> 1) Corrects increased extensor tone at the PIP joint resulting from retraction of the extensor apparatus. 2) Delay operation until at least 3 months after injury to allow restoration of terminal extensor tendon continuity by scar tissue. 3) To prevent boutonniere deformity, the triangular ligament must be preserved when cutting the extensor mechanism. 4) Active finger motion is permitted immediately after surgery unlike other surgeries.

classified based on skin integrity and the presence or absence of bony involvement. Patients who present for treatment more than 4 weeks after injury have chronic mallet finger. Splinting of the distal interphalangeal joint for 6–8 weeks for acute and at least 10 weeks in chronic mallet finger has yielded good results. Surgical management may be considered for acute and chronic mallet lesions in patients who have failed nonsurgical treatment, are unable to work with the splint in position, or have a fracture involving more than one third of the joint surface.

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3. Answer: (c)

The limiting factor in the longevity of total hip arthroplasty is osteolysis resulting from the biological reaction to polyethylene wear particles. It is addressed by creating cross-linked polyethylenes; crosslinks between chains in the polyethylene increases wear resistance and may increase the life of the implant. Crosslinks are formed when the polyethylene is exposed to high-energy irradiation (i.e. gamma or e-beam 50–105 kGy), which also causes an increase in the amount of unpaired free electrons (or free radicals) present in the material after irradiation. If these free electrons are not stabilised or eliminated, they can react with oxygen and start a chain reaction that causes oxidative degradation over time.

First generation crosslinked materials differ in the amount of crosslinking and the method used to counteract the decrease in oxidation resistance caused by residual free radicals. These methods that decrease free radical remaining after radiation induced cross linking are remelting (heating HXLPE again above melt temperature of PE.), annealing (re-heating below melting temperatures) AND E-Poly Highly Crosslinked Polyethylene (HXLPE).

Infusing vitamin E into irradiated polyethylene is a novel approach to reduce the oxidation potential of the material without reheating it. Unlike the remelted material, E-Poly HXLPE still has detectable levels of free radicals, but the key to this technology is the location of those free radicals. After the infusion process, the free radicals

detected in the polyethylene are likely associated with the ring structures on the vitamin E molecule, not the polyethylene molecule. Therefore, if oxygen was introduced into the system, the oxygen molecules would only react with the vitamin E molecules, leaving the polyethylene molecules untouched.

Large diameter femoral heads have a larger contact area in polyethylene liners than small diameter heads. As a result, they to produce more wear.

UHMWPE molecules typically having 100,000 to 250,000 monomer (PE) units per molecule (molecular mass –2 and 6 million u) each compared to HighDensityPE's 700 to 1800 monomers.

4. Answer: (d)

5. Answer: (e)

Surgical Management Principles of Gunshot-Related Fracture Rick Tosti, Saqib Rehman; *Orthopedic Clinics of North America* Volume 44, Issue 4, Pages 529–540, October 2013.

Fracture caused by firearms in the civilian population are typically caused by handgun injuries. Fractures and their associated wounds in gun injuries can be treated similarly to closed fracture with addition of minimal wound care and a short course of antibiotics. Patients must be treated on a case-by-case basis, as there are several indications for formal open treatment. It cannot be assumed that low-velocity missiles are involved. Injuries with larger wounds and more significant soft tissues injury require urgent debridement. Urgent operative treatment is also required in gunshot-related fracture with exposed bone, vascular disruption, and injuries with compartment syndrome.

The risk of lead toxicity from gunshot is low, as avascular fibrous tissue rapidly envelops the missile. Surprisingly, bullets retained in cerebrospinal fluid actually do not rapidly elute lead, and may remain in situ if not causing neurologic compromise or plumbism.

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