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Quiz

Q1. The proper sequence of repairing structures during reimplantation of a digit is:

- A) Bone, extensor tendon, flexor tendon, arteries, nerves and veins.
- B) Bone, flexor tendon, extensor tendon, arteries, nerves and veins.
- C) Arteries, nerves, veins, bone, extensor tendon & flexor tendon.
- D) Arteries, nerves, bone, extensor tendon, flexor tendon and veins.

Q2. A patient has a focal contracture of the shoulder capsule in the region of the rotator interval, which of the following passive motion would most likely be limited.

- A) Internal rotation with arm abducted.
- B) Internal rotation with arm adducted.
- C) External rotation with arm abducted.
- D) External rotation with arm adducted.

Q3. Which of the following is least likely to be associated with limited knee extension after ACL Reconstruction:

- A) Anterior malposition of femoral tunnel.
- B) Inadequate notchplasty.
- C) Arthrofibrosis
- D) Cyclops lesion

Q4. Name the condition? How do you quantify its severity?

Q5. Which of the following intraoperative steps is most useful in preventing patellofemoral tracking problems in total knee replacement.

- A) Internal rotation of tibial component.
- B) Internal rotation of femoral component.
- C) Medialization of patellar component.
- D) Medialization of femoral component.

Q6. Reaction of degeneration or R/D test is:

- A) Is done for testing of how much articular cartilage is degenerated.
- B) The denervated muscle responds to faradic but not galvanic stimulus 2 days after injury.
- C) The denervated muscle responds to galvanic stimulus but not faradic stimulus 2 days after injury.
- D) The denervated muscle responds to galvanic stimulus but not faradic stimulus 2 weeks after injury.

Keys

1 – A

Replantation is replacement of tissue or a structure (digit) in the site from which it was previously lost or removed. For replantation of digit; at the trauma scene, collect and preserve all amputated parts, even those crushed and not thought to be useful. Parts not suitable for replantation can provide tendons or bone. Cool the amputated part to 4 °C to preserve it; 1 h of warm ischemia is equivalent to approximately 6 h of cold ischemia. Hence, cooling can markedly prolong the window of opportunity for replantation or revascularization. An amputated digit, for example, can withstand up to 30 h of cold ischemia. Wrap the part in saline-soaked gauze or towel. Next, place it in a dry, plastic bag. Place this bag on ice in an icebox/cooler, or in a second bag filled with ice and water, as soon as possible. This 2-layer approach avoids submersion of the part in ice water, which causes freezing of the tissues and cell destruction. Dry ice is too cold and causes tissue freezing and cell destruction. If possible, bleeding from proximal vessels should be controlled with pressure, and ligature control should be avoided. Bone, tendon, and skin can tolerate approximately 8–12 h of warm ischemia and as long as 24 h of cold ischemia. However, muscle necrosis after 6 h of warm ischemia or 12 h of cold ischemia. In general, amputated digits may tolerate 12 h of warm ischemia and 24 h of cold ischemia. Other major amputations tolerate 6 h of warm ischemia and 12 h of cold ischemia because of their larger muscle content. Excessive ischemia time reduces muscle function and can result in myoglobinuria on reperfusion, placing renal function at risk. More proximal amputations involving more muscles must, therefore, be treated quickly.

Any amputation is tetanus-prone; therefore, 0.5 mL of tetanus toxoid (adsorbed) must be administered intramuscularly if the last booster was received more than 5 years earlier. If the patient has not had primary immunization as a child or if the immunization status is unclear, administer tetanus toxoid as well as tetanus immune globulin (500 U intramuscularly) in opposite limbs.

The normal sequence of the digital replantation is as follows:

1. Debridement
2. Identification and/or tagging of vital structures
3. Skeletal stabilization
4. Extensor tenorrhaphy
5. Placing sutures within flexor tendon ends
6. Digital artery repair
7. Neurorrhaphy of digital nerve
8. Repair of flexor digitorum profundus
9. Venous repair
10. Skin closure
11. Dressing

The amount of bone shortening necessary is dictated by the extent of comminution and should be dictated to obtain adequate nerve, tendon, and skin approximation. Shortening to facilitate vascular repairs is not necessary because vein

grafting is adequate. However, poor skin coverage, nerve grafts, and the inability to primarily repair tendons to their adequate resting length have a negative impact on long-term outcome. Following appropriate shortening, the bone may be stabilized. Following bone and/or joint stabilization, the extensor tendon mechanism is repaired. This improves stability. Flexor tendons may be repaired prior to or following arterial and nerve anastomosis. If the flexor tendons are to be repaired following arterial repair and neurorrhaphy, the placement of sutures prior to microprocedures will simplify the process and minimize iatrogenic injury. In general, arteries are repaired first. For logistical reasons; the digital nerve adjacent to the artery is repaired next. If not repaired previously, the tendon is approximated. The hand is then turned, and the veins are mobilized, trimmed to normal, and repaired.

Reference: Morrison WA, McCombe D. Digital replantation. *Hand Clin.* Feb 2007;23(1):1–12.

2 – D

The rotator interval describes the anatomic space between anterior border of supraspinatus and subscapularis. The space contains the coracoid, coracohumeral and superior glenohumeral ligament, the biceps tendon, and anterior joint capsule. The coracohumeral ligament originates from outer border of the horizontal limb of the coracoid process and passes forward and downward in the rotator interval. Its fibres interlace with those of the fibrous capsule and insert with the capsule into both tuberosities, bridging the bicipital groove and forming roof of biceps tendon. The normal interval contains elastic membranous tissue and as a result enhances shoulder motion. The long head of biceps is under the interval. In patients who have severe chronic adhesive capsulitis the coracohumeral ligament is converted to a contracted cord and the rotator interval obliterated by contracted tissues. Release of these structures will relieve most patients.

Reference: Ozaki J, Nakagawa Y, Sakurai G, Tamai S. Recalcitrant chronic adhesive capsulitis of the shoulder. Role of contracture of the coracohumeral ligament and rotator interval in pathogenesis and treatment. *J Bone Joint Surg.* 1989 Dec;71(10):1511–1515.

3 – A

Malposition of the femoral tunnel is the most common reason for technical failure of ACL reconstruction, followed by tibial tunnel malposition. Too anterior femoral tunnel placement can result in excessive lengthening and tension on the ACL graft in knee flexion. Possible consequences are restriction of motion (flexion more), overloading of the graft and the graft fixation site, and excessive stress on the articular surface of the knee joint. The anatomic position for the femoral tunnel lies along the posterior articular cartilage border of the lateral femoral condyle and posterior to the lateral intercondylar ridge, also known as the “Resident’s ridge”. Cylops lesion is the most common pathology that causes loss of extension unique to ACL surgery; in this a scar nodule or a localized fibroproliferative process forms anterior to the tibial tunnel in 2–4%. As little as 5° loss of terminal extension has been associated with patellofemoral pain and limp, 10° loss diminishes running

speed and 20° loss of terminal extension functional limb length discrepancy. In contrast restricted flexion does not affect gait as long as the knee can be flexed at least 60°.

Various intraoperative and postoperative techniques are useful in markedly decreasing the rate of loss of extension:

- ❖ careful anatomic placement of graft tunnels;
- ❖ strict avoidance of anterior placement of the tibial tunnel;
- ❖ avoidance of over-the-top placement of the femoral graft;
- ❖ use of the intraoperative impingement test before graft tensioning;
- ❖ tensioning the graft with the knee in full extension;
- ❖ encouragement of immediate postoperative full-knee hyperextension;
- ❖ strict avoidance of immobilization in flexion or restriction of full hyperextension in any way;
- ❖ and early diagnosis and appropriate treatment of loss of extension.

Reference: Petsche TS, Hutchinson MR. Loss of extension after reconstruction of the anterior cruciate ligament. *J Am Acad Orthop Surg.* 1999 Mar–Apr;7(2):119–127.

4 – Congenital/developmental coxa vara; hilgenreiner epiphyseal angle

The term *congenital coxa vara* has been applied to two types of coxa vara seen in infancy and childhood. The first type is present at birth, is rare, and is associated with other congenital anomalies, such as proximal femoral focal deficiency or cleidocranial dysostosis. The second type, usually not discovered until the child is walking, is more common and is associated with no other abnormality except possibly a congenitally short femur. Coxa vara, often bilateral, is characterized by a progressive decrease in the angle between the femoral neck and shaft, a progressive shortening of the limb, and the presence of a defect in the medial part of the neck (Fairbanks triangle). Microscopically, the tissue in this defect consists of cartilage, which, because the columnar arrangement of its cells is irregular and ossification within it is atypical, resembles an abnormal physis. When walking is begun, the forces that the femoral neck must withstand are increased, and because the neck is weak, varus deformity gradually develops.

As the patient becomes older and heavier, the deformity increases until the greater trochanter eventually lies superior to the femoral head; pseudarthrosis of the femoral neck may develop. If pseudarthrosis is present, the head may be widely separated from the neck. After age 8 years, the likelihood of

obtaining a hip that would function normally rapidly diminishes. Surgery (Valgus osteotomy) is advised after 4–5 years of age or when the neck shaft angle is 110° or less.

Weinstein et al proposed a radiological means of quantifying CCV. This measure, the Hilgenreiner epiphyseal angle (HEA), is the angle subtended by the horizontal Hilgenreiner line through the triradiate cartilages and an oblique line through the proximal femoral capital physis, as seen in the image below. A study of normal values of the HEA found that the angle in children younger than 7 years averages 20°, with a wide variation of 4–35°. The mean value for those aged 8 years to maturity is 23°. 95% of patients in whom the Hilgenreiner epiphyseal angle was corrected to less than 38° had no recurrence of varus. The head-shaft angle was unreliable in determining adequacy of correction; two thirds of patients with correction to more than 135° had recurrences, and one third of patients with correction to less than 135° had satisfactory results.

So indication for surgery are:

- A child with a clinical limp and an HEA of more than 60°
- A child with a clinical limp and an HEA of 45–60° with documented progression of varus deformity

Reference: Weinstein JN, Kuo KN, Millar EA. Congenital coxa vara. A retrospective review. *J Pediatr Orthop.* Jan 1984;4(1):70–77.

5 – C

Patellofemoral tracking as assessed by ‘no thumb test’ is maintained by:

- ❖ lateralizing the femoral component,
- ❖ external rotation of the femoral component- as assessed by transepicondylar axis, perpendicular to Whiteside line (line from centre of trochlear to centre of intercondylar notch roof), 3° external rotation to posterior condylar axis and also parallel to tibial cut.
- ❖ Medialization of PATELLAR component contrast to lateralizing the femoral component.
- ❖ Even removing osteophytes from lateral aspect of patella help.
- ❖ Tibial component rotation should be such that its centre is on medial third of tibial tubercle as assessed by birds eye view. Tibial component should not be in varus; this is prevented by aligning the external zig with tibialis anterior tendon or 2nd toe.

6 – D

In 1850, the British physiologist Augustus V. Waller was showed that sectioning of a peripheral nerve results in a sequence of alterations resulting in degeneration of the distal portion of the severed axons; these changes occurred over some days before degeneration became complete. This change in the peripheral axons distal to the lesion is called “Wallerian degeneration”. Wilhem Erb, and others, showed that the contractile responses of muscles to different types of electrical stimulation depended upon whether the muscle was innervated or not. They showed that the differences to

the electrical stimuli between the innervated and denervated states also required a time lag after nerve section to occur. Since the time for Wallerian degeneration to become complete appeared to coincide with the time required for the electrical distinction between the innervated and denervated states to become apparent, the presence of the "abnormal" electrical responses became known as the Reaction of Degeneration, and the procedure to determine this reaction became known as Reaction of Degeneration (R/D) testing.

Short duration pulsed currents (PC) with pulse durations between 50 μ s and 1 ms will produce muscle contractions by depolarizing peripheral motor nerve. In contrast, if peripheral motor nerve is degenerated through trauma or disease, and time since nerve degeneration onset is greater than two weeks, denervated muscles require long duration PC (>10 ms) for depolarization. Muscle fibers are not as electrically excitable as motor nerves and require a current with long duration. The inability to obtain direct muscle depolarization with short duration currents is the R/D test.

The R/D test has been used to assist in ruling out central nervous system (CNS) lesions as a source of paralysis. Since the peripheral nerve remains intact with CNS lesions, the normal response to the short and long pulse duration currents will be preserved.

The R/D test is more of a qualitative and quick test that should not replace quantitative electro diagnostic procedures, (Electroneuromyographic and NCV studies) but instead be used as a simple initial screening test for individuals with motor paralysis. The R/D test is qualitative in nature and requires the examiner to view if a contraction is present and its quality (brisk versus sluggish).

The traditional R/D test is performed by stimulating the lesioned nerve and two muscles normally innervated by that nerve. Initially, short duration PC (<1 ms) or high frequency (>500 Hz) alternating current (AC) is delivered through the electrodes. A response obtained with short duration current is reported as either no R/D or partial R/D. A strong tetanic contraction is graded as no R/D, while a weak or sluggish contraction when compared to the non-involved side implies an incomplete nerve degeneration and is classified as a partial R/D. No response to short duration current is graded as either a full or absolute R/D and requires further testing with long duration current (>10 ms). The traditional R/D test uses a manually interrupted DC that provides a pulse duration greater than 100 ms. Innervated muscle contraction is usually brisk while denervated muscle is more vermicular in nature. Response to long duration current after no response to short duration current is classified as a full R/D while no response with either current is graded as an absolute R/D.

A full R/D indicates there is denervation but the muscle is intact and can be directly depolarized with long duration current stimulation. An absolute R/D is consistent with a severe denervation where there is muscle fiber atrophy and increased fibrotic tissue that cannot even respond to long duration current. Some limitations exist in Myopathic conditions and severe edema give negative or weak response. The R/D test is also not valid if performed immediately following denervation due to the time course of nerve degeneration. At least two weeks may be required for the nerve to completely degenerate distal to the primary lesion site. Proximal and distal muscles that share a common motor innervation can be stimulated to further localize denervation site.

R/D testing is a very simple, inexpensive, procedure that can be performed with any stimulator that has sufficient current intensity for motor stimulation. Small transcutaneous electrical stimulators (TENS) and NMES units or high voltage, and medium frequency stimulators can be used for short duration stimulation. Long duration current stimulators (low frequency AC, long duration PC, or DC) if available, could be used to differentiate between a full and absolute R/D in cases of complete nerve degeneration. The test is relatively painless and quick and can be performed on individuals of all ages in both the clinical and home care setting.

Reference: Holland TJ. Utilizing the reaction of degeneration test for individuals with focal paralysis. *J Brachial Plex Peripher Nerve Inj.* 2012 Jul 25;7(1):6.

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