

THE UNIVERSITY OF TOLEDO MEDICAL CENTER

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THE UNIVERSITY OF TOLEDO MEDICAL CENTER
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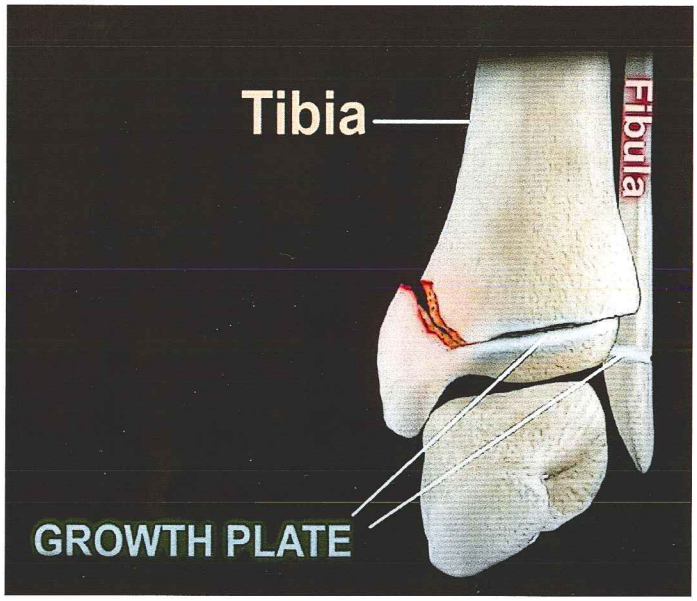
Salter Harris Fracture

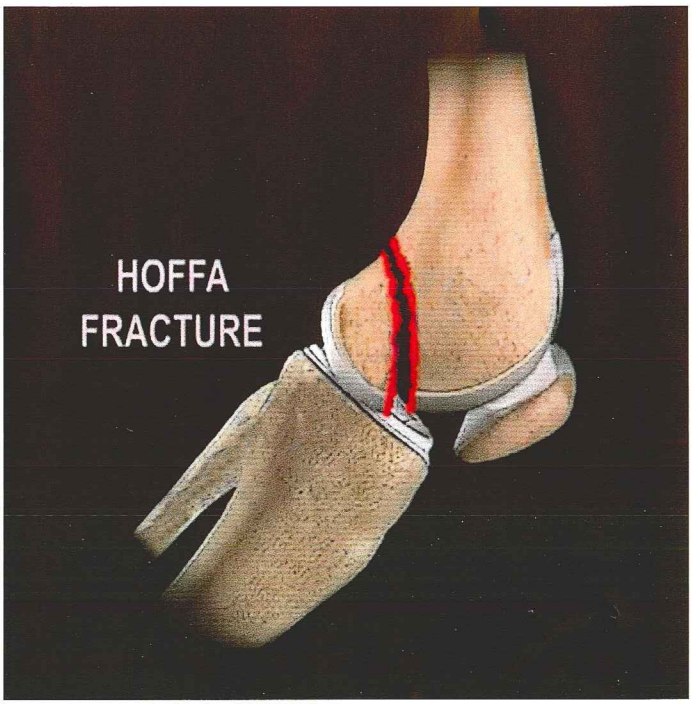
Salter-Harris fracture is a common injury in children that involves the growth plates. 15% of all fractures in children involves the growth plate, and it occurs more in boys than in girls. The growth plate injuries occur more distal than proximal, such as distal radius, distal tibia, and distal phalanges. Growth plate injuries in children are common in the bones of the lower leg (tibia and fibula). It is important to diagnose these fractures as they may affect the growth of the bone if not diagnosed and treated properly. There are generally five types of Salter-Harris fractures. The higher of the type number, the more complications associated with the fracture and worse prognosis. Growth plates produce the longitudinal growth bones. The reserve zone of the growth plate is the inactive zone. The proliferating zone of the growth plate has cellular proliferation and longitudinal growth, and this zone makes a person tall or short. The hypertrophic zone of the growth plate has maturation, degeneration, and provisional calcification. The majority of growth plate injuries occur in the hypertrophic zone. The hypertrophic zone is weak. In fact, the hypertrophic zone is weaker than the ligaments, and it provides a cleavage zone for the fracture to occur. Type I Salter-Harris fracture is difficult to diagnose; 5% of fractures are Type I. The fracture occurs through the growth plate, and there may not be an obvious displacement. Sometimes the diagnosis is a clinical one. Fracture occurs through the weak zone of provisional calcification. Type I is known by fast healing and rare complication rate. Type II is a fracture through the growth plate and the metaphysis, sparring the epiphysis. 75% of fractures are Type II. The corner of the metaphysis separates (Thurston-Holland Sign). With Type II, the fragment usually stays with the epiphysis while the rest of the metaphysis will displace. Healing is fast and growth is usually moderate. Injury to the distal femur will cause a high rate of growth abnormality. Type III is a fracture through the growth plate and epiphysis, sparring the metaphysis. The fracture splits the epiphysis. 10% of the fractures are Type III. Fracture extends into the articular surface of the bone (intraarticular fracture). It requires anatomic reduction of the joint and internal fixation. An example of Type III is the Tillaux fracture of the distal tibia. CT scan may be needed to diagnose this fracture. Type IV fracture passes through the epiphysis, the growth plate, and the metaphysis; 10% of fractures are Type IV. It can cause



complications such as growth disturbances and angular deformity. Type V is uncommon; about 5% are Type V. It is a compression or crush injury of the growth plate. There is no associated fractures of the epiphysis or metaphysis. Initial diagnosis may be difficult. Type V has the highest incidence of growth arrest and disturbance. Type I and Type II usually do not require surgery and will have a better prognosis than Type III, Type IV, and Type V. In Type I and Type II, the reduction of the fracture may not be anatomic. Despite this, the prognosis is usually good. In Type III and Type IV, the fracture is usually intraarticular and anatomic reduction is necessary. Type III and Type IV do not require surgery and the prognosis is usually fair. Type V is rare and has a poor prognosis. In general, the distal femur contributes to approximately 9-10mm of growth per year. The proximal tibia contributes to approximately 6mm of growth per year. Girls complete growth at the age of 14 years. Boys complete growth at the age of 16 years. In situations of child abuse, you may find growth plate injury or physeal separation as you can see in transepiphyseal separation of the distal humerus in children.

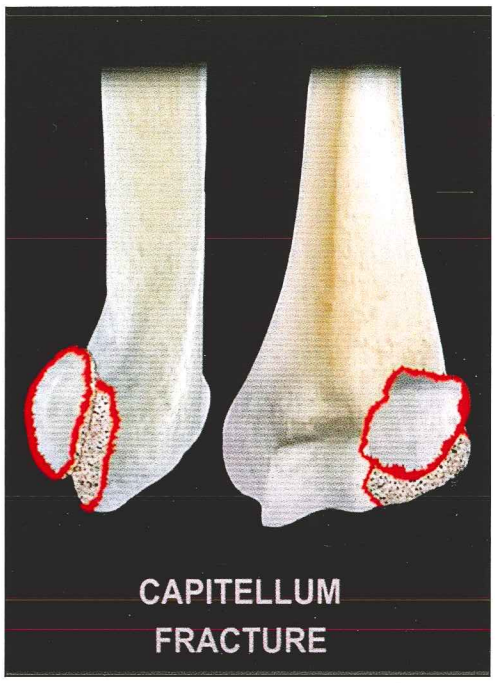
Fracture Femur Hoffa Fracture

Hoffa fracture is a coronal split of the posterior condyle of the femur. Hoffa fracture is a rare intra-articular fracture of the posterior femoral condyle occurring from violent trauma, and generally occurs in young adults. Three types of Hoffa fractures are described. This classification is based on the location of the fracture within the condyle. Hoffa fracture can be an isolated fracture; however, it is often associated with other distal femur fractures. 38% of intra-articular distal femur fractures may have a Hoffa fracture (coronal plane fracture). The Hoffa fracture is a lot more common in open fractures than in closed fractures. Fracture may occur in either condyle, but the lateral condyle is the most common one to be affected by Hoffa fracture. It affects a single condyle in about 75% of the time, and the lateral condyle in about 85% of the time. Hoffa fracture occurs due to axial compression in a flexed knee. The mechanism of injury is controversial. The fracture is coronal, and it can be missed on routine lateral x-rays. The undisplaced fracture of the condyle may become displaced if the fracture is missed. The Hoffa fracture is almost like the capitellar fracture of the elbow. This fracture has the same story as the capitellar fracture, it is hidden, and you can miss it on the x-ray (you must look for it). CT scan is very helpful in the diagnosis of Hoffa fracture and will give you great details about the articular surface of the distal femur, especially if the fracture is comminuted. X-rays are not very good in diagnosing the Hoffa fracture. 20% of Hoffa fractures are diagnosed with x-rays only, so the CT scan is the best study for diagnosing the Hoffa fracture. Use a high degree of suspicion in the diagnosis of this fracture because the fracture may be subtle, and you may not be able to see it on routine x-rays. Treatment is reduction and stabilization of the fracture. Stabilization of the fragment is usually done by headless compression screws and can be buried underneath the surface. Fixation can be done from either the anteroposterior (AP) direction or the posteroanterior (PA) direction. It can be temporarily fixed with k-wires. Permanent fixation is done with headless compression screws.



Fracture of the Capitellum

Fractures of the capitellum are rare and usually occur in the coronal plane and can be difficult to diagnose. Fracture of the capitellum is similar to Hoffa fracture of the distal femur. Both fractures are coronal, difficult to diagnose, and the x-ray may miss the fracture. Failure to diagnose this fracture and treat it appropriately can lead to a poor patient outcome. The Bryan and Morrey Classification has four types. Type I is a large fragment of bone and articular cartilage sometimes with trochlear involvement. Type II is a shear fracture of the articular cartilage. The articular cartilage is separated with a small shell of bone. Type III is a comminuted fracture of the capitellum. Type IV is the Mckee Modification; it is a coronal shear fracture that extends medially to include the capitellum and trochlea. You can see double bubble or a double arc on the lateral x-ray of the elbow. One arc represents the capitellum, and the other arc is the lateral ridge of the trochlea. The double arc sign is a pathognomic finding of the capitellar fracture and is usually seen in the lateral elbow x-rays. In more than 50% of the time, capitellum fracture may be associated with other injuries such as radial head fracture or lateral ulnar collateral ligament injury. Fracture of the capitellum can cause mechanical block to movement of the elbow. The fracture can be seen on the lateral x-ray of the elbow, however CT scan is helpful in showing the fracture adequately.



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Nonoperative treatment for nondisplaced fracture is to give the patient a splint for less than 3 weeks followed by range of motion. Open reduction internal fixation is done for displaced fractures. We rarely excise the capitellum, but you may get into this situation if the fragment is displaced and causing symptoms and if most of the fragment is cartilage attached to a thin piece of bone and the fragment could not be fixed. You will try to fix it first before you excise it. Excision is done for Type III fractures, for comminuted and displaced fractures, especially if there is a block to movement of the elbow. Small displaced, insignificant fractures can be excised if it is causing pain or mechanical block to elbow motion. Excision of a large fragment of the capitellum can create a problem of developing arthritis or instability, especially if the medial collateral ligament is injured. Perform total elbow arthroplasty when there is a comminuted fracture of the capitellum that extends to the medial column and the fracture is unreconstructable and the patient is old. For open reduction internal fixation, the ideal visualization of the fracture is usually provided by a lateral approach (Kaplan or Kocher approach). The patient is usually in the supine position. Elevate the common extensor tendons and the capsul anteriorly off the lateral column and use headless compression screws from anteriorly to posteriorly. The fracture is partial articular and vertical shear. Going anteriorly to posteriorly will allow excellent compression and stability of the fracture. Countersink the screws. Bury the screw heads beneath the articular cartilage anteriorly. Try to avoid destabilizing the lateral ulnar collateral ligament and try to make the dissection more anterior to the equator of the radial head. Try to avoid disruption of the capitellum blood supply that comes from the posterolateral area. Stay anteriorly to avoid these two problems. A complication of capitellar fractures is elbow stiffness. Surgery to fix the capitellar fracture will help in gaining the functional range of motion, but the patient will have residual stiffness. Surgery is probably better than no surgery, but the reoperation rate is high due to the residual stiffness of the elbow.

Neurological Evaluation of the Lumbar Nerve Roots

To study the involvement of any nerve root we look for sensory change, motor changes, and reflex changes. A herniated disc at T12-L1 affects the L1 nerve root. The sensory of the L1 nerve root is half the distance between the inguinal ligament and mid-thigh. Motor involvement is hip flexion. There are no reflexes of L1. A herniated disc at L1-L2 affects the L2 nerve root. The sensory of the L2 nerve root is mid-anterior thigh. Motor involvement is hip flexion, hip adduction, and knee extension. There are no reflexes of L2. A herniated disc at L2-L3 affects L3 nerve root. The sensory of the L3 nerve root is distal part of the thigh including the knee area. Motor involvement is hip flexion and knee extension. A herniated disc at L3-L4 affects the L4 nerve root. The sensory of the L4 nerve root is medial side of the leg down to the medial side of the foot. Motor involvement is L4 ankle dorsiflexion (tibialis anterior) and knee extension. L4 reflex changes will be a positive femoral stretch test. The test is positive if pain is felt in the ipsilateral anterior thigh. If the test is positive, it means that there is probably a disc herniation between L3-L4, affecting the L4 nerve root. The patellar reflex is mainly L4. A herniated disc at L4-L5 affects the L5 nerve root. The sensory of the L5 nerve root is dorsum of the foot and leg. Motor involvement is hip abduction (gluteus medius) and extension of the big toe. L5 nerve root is very popular in the exam. If you see a big toe extension, this involves the L5 nerve root (L4, L5 disc herniation). The patient may have Trendelenburg gait due to injury to the L5 nerve root (disc herniation between L4, L5 affecting the L5 nerve root). Both the gluteus medius and minimus muscles are innervated by the L5 nerve root. Straight leg raise can be positive with L5 nerve root irritation. This test is used to determine if the patient with low back pain has an underlying herniated disc irritating the nerves. A herniated disc at L5-S1 affects the S1 nerve root. The sensory of S1 nerve root is lateral and plantar aspects of the foot. Motor involvement is S1 hip extension (gluteus maximus), S1 ankle plantar flexion (gastro-soleus), and S1 foot eversion (peroneus longus and peroneus brevis). Use positive straight leg raise examination to determine whether a patient with low back pain has an underlying component of a herniated disc or not (stretch test). Reflexes are S1 ankle reflex.

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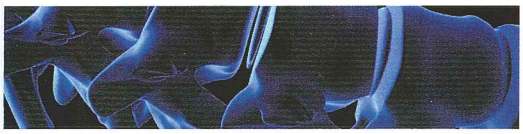

Anatomy of the Trapezius Muscle

The trapezius is a large superficial muscle that extends from the back of the skull, back of the neck, and back of the thorax. The upper fibers of the trapezius muscle arise from the external occipital protuberance and the medial third of the superior nuchal line. The middle fibers arise from the ligamentum nuchae and the spinous process of C7. The lower fibers arise from the spinous processes and supraspinous ligaments of all twelve thoracic vertebrae. The trapezius is inserted into the lateral third of the clavicle, and from the acromion process and the spine of the scapula. The trapezius muscle allows for rotation and lift of the scapula. Dysfunction of the trapezius muscle may cause lateral winging of the scapula. Winging can occur after radical neck surgery, but it usually occurs after biopsy or tumor dissection. The spinal accessory nerve will be injured, and the patient will have difficulty with overhead activity. If injury to the spinal accessory nerve occurs early, explore the nerve. If injury is late, do a muscle transfer. The spinal accessory nerve provides motor innervation to the sternocleidomastoid and the trapezius muscle. The spinal accessory nerve courses obliquely across the posterior triangle on the surface of the levator scapula muscle and reaches the trapezius. Within the posterior triangle of the neck, the nerve is vulnerable since it is superficial and only covered by skin and subcutaneous fascia. Extreme caution should be taken for any surgical procedure done in the posterior triangle of the neck.

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