

THE UNIVERSITY OF TOLEDO MEDICAL CENTER

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THE UNIVERSITY OF TOLEDO MEDICAL CENTER
ORTHOPAEDIC MONTHLY

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The Orthopaedic Center is Going Green

The Orthopaedic Clinic recently acquired a Tower Garden—an aeroponic Garden with the ability to cultivate several different kinds of vegetables and herbs, all without the use of dirt! This beautiful tower stands in the main waiting area, gracing our patients with its gentle glow, evoking a fresh and calming sight.

Our patient's look forward to coming into our Clinic and discovering what new additions we have planted. Some have even taken their picture with our garden and posted the image on their FaceBook page tagging our clinic—in exchange for a free t-shirt. Other pediatric patients were given a teddy bear wearing a shirt supporting the Orthopaedic clinic.

The Orthopedic Clinic strives for excellence, providing the utmost experience for our patients. In addition to the Tower Garden, the Orthopaedic Center offers a complimentary coffee bar (with hot cocoa!), fresh fruit, delicious donuts for our early morning patients, as well as valet parking at no charge to our guests. While our patients are here, we want them to know that we will take care of them and that we appreciate them continuing to choose The University of Toledo for their Orthopaedic care.

We value our patient's time by offering appointments early in the morning, late afternoon, on Saturdays, and same day if deemed necessary. We want to provide our patients with access to one of the greatest Orthopaedic Clinics no matter what hours they have available to schedule appointments.

Make an appointment today with one of our physicians and don't forget to have your picture taken in front of our tower garden!

#plantsgrowingwithoutdirt #UTMCortho

Fracture Healing

The stability of the fracture decides what type of healing will occur. If there is a small amount of strain (below 2%), primary bone healing will occur. If the strain is between 2%-10%, then secondary bone healing will occur. For example, when using a cast, rod, or external fixator.

In primary bone healing you will need absolute stability, which is referred to as Haversian remodeling, cutting cone remodeling, or sometimes called intramembranous healing. Secondary bone healing will occur when the fixation is not rigid, such as with a cast, and there will be endochondral ossification.

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With an IM rod, there will be secondary bone healing. Early on, there will be a periosteal callus and as time goes on, a medullary callus will form. The external fixator predominantly causes a periosteal callus with endochondral ossification because most of the time the external fixator is not very rigid. When endochondral ossification fails due to the fixations being inadequate, a hypertrophic nonunion will develop and the bone will have predominantly Type II collagen. At this point, the endochondral ossification has failed and stability is needed in order to change the cartilage to bone.

The stages of fracture healing are:

1. Hematoma 2. Inflammation 3. Soft Callus 4. Hard Callus 5. Remodeling

When the fracture occurs, there will be bleeding at the fracture site. This will cause a fibrin blood clot to form.

From there, the stage of inflammation will begin.

•Cells •Macrophages •Mesenchymal cells

oStem cells migrate to the fracture and form the granulation tissue and will release the growth factors

oGranulation tissue tolerates the greatest strain before failure

The COX-2 inhibitor and nonsteroidal depressed the Runx2, which is important for the differentiation of osteoblasts.

Soft callus formation will occur within two weeks. The amount of callus correlates with the immobilization—the stiffer the immobilization, the less amount of callus. Flexible fixation will result in endochondral ossification (abundant callus). Secondary bone healing occurs through cartilage formation. The stability helps direct bone formation. A lack of stability helps the formation of cartilage, which later on can change to endochondral ossification.

During hard callus formation, the collagen changes from predominantly Type II to be followed by Type I (Type I- Bone; Type II-Cartilage). Blood flow at the fracture site is very important for fracture healing. The blood will supply the fracture with nutrients and cells. Initially there is decreased blood flow at the fracture site which will increase later on and the blood flow will peak at two week and return to normal after about three months.

The remodeling state will begin at 2 weeks and will continue for many years after the fracture has healed. The woven bone will be replaced by stronger, laminar bone, and the fracture healing will be complete with the continuation of the medullary cavity. The remodeling of bone is influenced by the Wolff's law (which means that the bone is affected by stress).

Endochondral bone formation occurs by chondrocyte proliferation followed by hypertrophy. Then, matrix mineralization will take place and the chondrocytes will die. Subsequent to the death of the chondrocytes, there will be vascular invasion, ossification, and remodeling to lamellar bone.

Chondroblastoma

Chondroblastoma is a benign, aggressive cartilage tumor. It has an epiphyseal location and it occurs more often in males. It usually occurs in younger patients between the ages of 10-25 years of age. It usually occurs in skeletally immature patients.

Other Epiphyseal lesions include:

•Clear Cell Chondrosarcoma: occurs in the older age group, has a more aggressive histological pattern, large cells with a central nuclei, and occurs in the proximal humerus and proximal femur

•Giant Cell Tumor: occurs in older age groups, has uniform cells and the nuclei of the stroma are similar to the nuclei of the giant cells

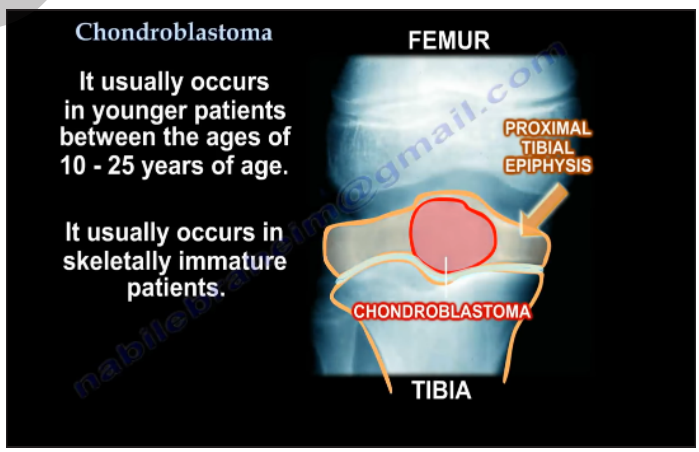
•Osteomyelitis: Brodie's abscess

The most common location of chondroblastoma is at the distal femur and the proximal tibia. About 30% of chondroblastoma occurs around the knee, followed by the proximal humerus, proximal femur, and the calcaneus.

During the clinical examination: the tumor may be painful, if the tumor abuts the joints, it may create joint symptoms, and my also cross the physis, and approximately 1% of these tumors metastasize to the lung

Radiological findings: lytic epiphyseal lesion with a sclerotic bony rim and sharp, well defined borders, it may have calcification in the matrix, and an MRI will show extensive surrounding edema.

You may find scattered giant cells with a cobblestone appearance and



cells with chicken-wire calcifications. One-third of the lesions may have an aneurysmal bone cyst (ABC). The lesion is chondroid with polygonal cells, a defined cytoplasmic border, and an oval shaped nuclei with a prominent longitudinal groove (coffee bean appearance of the nuclei). Chrondroblasts can be distinguished from giant cell tumors by staining for the S100 protein; chondroblastoma will be reactive.

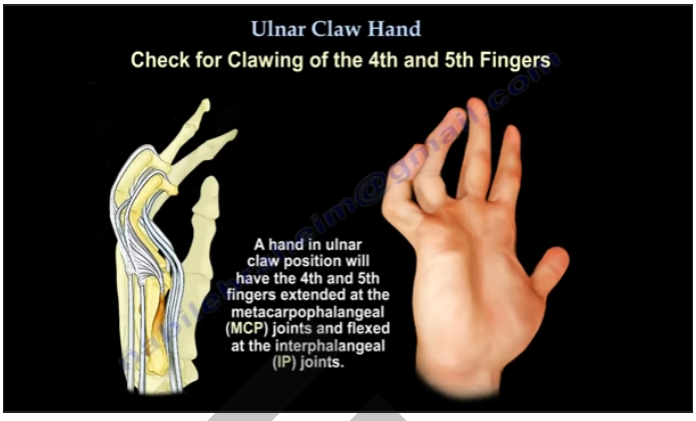
Chondroblastoma is typically treated with intralesional curettage and bone grafts. The recurrence rate is less than 10%. Some surgeons may use adjuvants such as phenol or liquid nitrogen.

Ulnar Claw Hand

Ulnar claw hand is an abnormal hand position that develops due to injury of the ulnar nerve. The ulnar claw hand deformity occurs more with a lower ulnar nerve lesion (below the elbow) and typically causes flexion and clawing of the fourth and fifth fingers due to the unopposed action of the medial part (ulnar part) of the flexor digitorum profundus muscle. Clawing is determined when the patient is asked to extend the fingers. A hand in the ulnar claw position will have the fourth and fifth fingers extended at the metacarpophalangeal (MCP) joints and flexed at the interphalangeal (IP) joints. When you ask the patient to extend the fingers, the patient will not be able to extend the interphalangeal (IP) joints at the fourth and fifth fingers.

This happens when the ulnar nerve innervates the ulnar half of the flexor digitorum profundus muscle. The ulnar nerve also innervates the third and fourth lumbrical muscles, all of the interosseous muscles, the adductor pollicis muscle. And the deep head of the flexor pollicis brevis. When there is an injury to the ulnar never at the wrist, there will be loss of function for all the interosseous muscles and the ulnar two lumbricals. The second and third digits are mainly unaffected by this injury except in adduction and abduction of the fingers, while the fourth and fifth digits are largely affected by injury to the ulnar nerve. With dysfuntion of these muscles, the extensor digitorum is unopposed, causing hyperextension of the fourth and fifth digits at the metacarpophalangeal (MCP) joints. The extensor digitorum is very affective in extending the MCP joint. The extensor digitorum gets help from the interossei and the lumbricals to extend the IP joints through the extensor hood or the extensor expansion. At the interphalangeal (IP) joints, the extensor digitorum has to overcome and counteract the flexion force that is exerted by the functional flexor digitorum profundus.

The extensor digitorum cannot do this because there is no assistance from the lumbricals or the interossei muscles (clawing of the fingers will show up). This is usually a distal ulnar nerve lesion that perseveres innervation to the medial half (ulnar half) of the FDP muscle. In this distal lesion, the sensation at the dorsum of the fourth and fifth fingers will be intact because the dorsal sensory nerve may be spared if the lesion is at the wrist. There will definitely



be numbness of the fourth and fifth fingers on the volar aspect. You may find wasting of the first interosseous muscle, and there may also be flattening of the hypothenar eminence. The fourth and fifth fingers will be stuck in a position of hyperextension at the MCP joints and flexion at the IP joints. If lesion of the ulnar nerve is high and the flexor digitorum profundus is not working, then there will be no clawing of the fingers. In a high ulnar nerve lesion, there will be loss of sensation in the dorsal aspect of the fourth and fifth fingers.

A differential diagnosis of Ulnar Claw Hand are Volkmann's ischemic Contracture, Dupuytren's Contracture, Spastic Hand, and Congenital Flexion Contracture (camptodactyly). While Claw Hand and The Sign of Benediction appear similar, they are not the same!

Claw hand occurs due to an ulnar nerve injury, usually a distal lesion. The fourth and fifth digits are flexed and the patient cannot straighten these two fingers. The Sign of Benediction usually occurs due to a median nerve injury, usually a high median nerve injury or anterior interosseous nerve lesion. The Sign of Benediction is the hand position that occurs when you ask the patient to make a fist and the second and third fingers will remain extended. When you ask the patient to extend the fingers, they will not be able to extend them. They cannot flex the second and third digits and also cannot do the "O.K. sign" (Figure 4). This is a median nerve or anterior interosseous nerve injury.

Martin-Gruber Anastomosis

Martin-Gruber Anastomosis is median to ulnar anastomosis in the forearm. It occurs though a communicating nerve branch between the median nerve and the ulnar nerve forearm. This connection carries motor nerves. It can be confusing clinically and also on an EMG.

It has clinical significance for understanding the median nerve lesions and carpal tunnel syndrome. The axons will leave the median nerve or the anterior interosseous nerve crossing through the forearm to join the main trunk of the ulnar nerve, innervating the intrinsic muscles of the hand. It occurs more on the right side and it may be autosomal dominant.

The lesion above the communicating branch will affect the median nerve muscles. A lesion below the anastomosis (connecting branch) will not affect the median nerve muscles, it will spare the thenar motor intrinsic muscles of the hand. An isolated ulnar nerve lesion at the elbow will produce an unusual pattern for intrinsic muscle paralysis. Martin-Gruber Anastomosis is the most common anastomosis anomaly between the two nerves. It appears in cases of nerve lesions of the median or ulnar nerve. This anastomosis serves as a conduit or an alternative innervation of parts of the hand and the forearm (it is really a detour).

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Martin-Gruber Anastomosis continued

This can be a good explanation for difficult challenges, especially in the differential diagnosis. The occurrence is fairly high (about 15%), and Martin-Gruber anastomosis should be factored into the differential diagnosis as well as the diagnosis.

Another scenario would be if the communicating nerve arises from the anterior interosseous nerve, then a patient with anterior interosseous nerve palsy may present with intrinsic hand weakness, normally supplied by the ulnar nerve. Additionally, damage of the ulnar nerve at the wrist will lead to severe deficit of the intrinsic hand function greater than expected. There are other anastomoses available and reported as well as many variations that are possible.

Three common anastomoses:

1. Ulnar to median anastomosis in the forearm—reverse of Martin-Gruber (Marinacci anastomosis)

2. Ulnar to median anastomosis in the hand (Riche-Cannieu anastomosis) The connection between the deep branch of the ulnar nerve and the recurrent branch of the median nerve. It carries motor fibers and this anastomosis usually occurs in the region of the thenar and adductor pollicis muscles.

3. Berrettini Anastomosis: Communication between the digital nerves (sensory nerves) arising from the ulnar and median nerves in the hand. The most common nerve anastomosis pattern

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Dr. Ebraheim, Amanda Critton, Julie Anderson and Ellen Finch do not have any relationships with industry to disclose.

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