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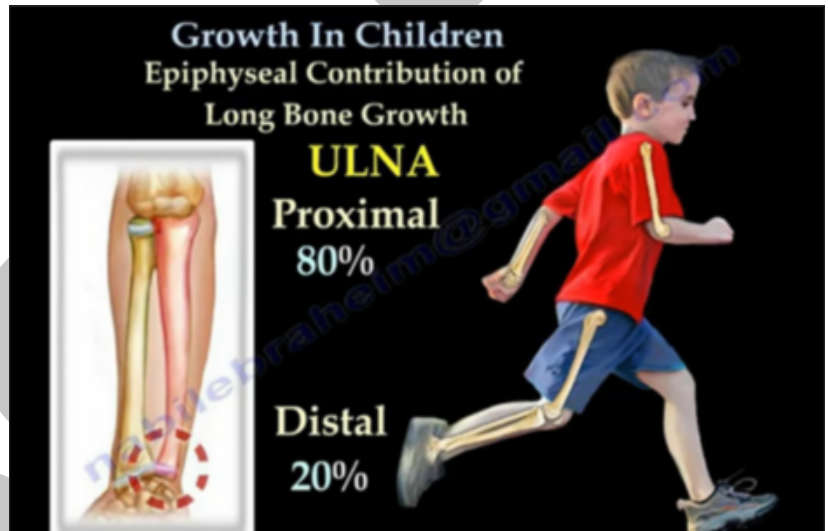
Growth in Children: Epiphyseal Contribution of Long Bone Growth

There are growth plates within the long bones with varying distributions across the bone.

The growth distribution in the humerus is about 80 percent in the proximal area and about 20 percent in the distal area. Displaced fractures of the proximal humerus in children are usually treated without surgery.

The growth distribution in the ulna is about 80 percent proximal and about 20 percent in the distal area. Growth arrest in fracture involving the distal ulna is approximately 50 percent. Within the radius, about 25 percent of growth occurs in the proximal area, while 75 percent occurs in the distal area. Fractures at the distal radius usually heal and correct their angulation after closed reduction. Surgery is rarely necessary. Fractures involving the growth plates of the distal radius rarely involve growth arrest.

Within the femur, the growth distribution is about 30 percent in the proximal area and about 70 percent in the distal area. Fractures involving the growth plates of the distal femur may cause major growth disturbances. It is expected that a child grows 1 cm per year from the distal femur growth plate. Males will grow-up until the age of 16 years old, while females will grow-up until 14 years of age.



Within the tibia, the growth distribution is about 55 percent proximal and 45 percent distal. In the fibula, growth distribution is about 60 percent proximal and 40 percent distal.

A growth spurt occurs at the time of puberty. Puberty typically occurs from ages 8 to 13 in females and from 10 to 15 years of age in males. Fractures near the growth plate remodel well.

My Deepest Appreciation

By Dr. Nabil Ebraheim, Chairman and Professor

This past month has been an extremely difficult month for me and my family. On Tuesday, November 1, my mother passed away at the University of Toledo Medical Center. It is difficult to lose your only living parent. You start having those feelings of getting older. It was a difficult time.

I want to sincerely thank everyone in the UTMC family for taking care of my mother. My family and I will forever appreciate the efforts of everyone at the hospital for giving us extra time with her. I feel an incredible sense of pride for having my mother treated here. I have never seen a team work harder or with more compassion. Born in

Egypt, our family's roots are in a country far away. She was the only root I had. Now, I have branches, but no roots. We received support and love beyond our expectations. The medical team and our friends were there for us.

I would also like to give a special thanks to my wife Tracy. She did all that I could not do at one of the most difficult times in my life. I am very fortunate to have her. I would also like to thank our friends and my patients who have given us the support to move on. It certainly will not be easy, but your support has been comforting.

Subscapularis Tendon Rupture

The subscapularis muscle is a large muscle that originates on the anterior surface of the scapula and lies in front of the shoulder. The subscapularis muscle is the largest of the four rotator cuff muscles and it proves about 50 percent of the total cuff strength. The subscapularis muscle inserts into the lesser tuberosity, while the other rotator cuff muscles have an insertion into the greater tuberosity. The biceps tendon lies in the groove and is held in place by the transverse humeral ligament.

For ultrasound examination, the probe is usually placed transversely over the bicipital groove to identify the groove and the biceps tendon while the arm is in a neutral position. The arm is then externally rotated to view the subscapularis tendon.

The subscapularis muscle functions as an internal rotator and acts as a dynamic stabilizer of the humeral head. It is supplied by the upper and lower subscapularis nerves. The upper and lower subscapularis nerves originate from the posterior cord of the brachial plexus.

Causes for subscapularis include the following:

- Anterior shoulder dislocation
- A fall onto an outstretched arm during abduction is usually the mechanism of injury
- May occur following anterior shoulder surgery
- In traumatic situations a subscapularis tendon avulsion can be associated with avulsion of the lesser tuberosity
- May be associated with a rotator cuff tear

Tears are rare and can either be chronic or acute. Patients will present with pain, anterior shoulder swelling, decreased range-of-motion, and weakness with internal rotation. Patients will also have an increase in passive external rotation. Diagnosis of a subscapularis tear could be difficult and may be missed. With complete rupture of the subscapularis tendon, the transverse humeral ligament will become torn, causing medial dislocation of the biceps tendon from its groove.

To diagnose a subscapularis tendon rupture, physicians will utilize different clinical diagnostic tests during physical examination. For the lift-off test, the patient places their hand behind their back at the



lumbar level and lifts the hand away from the back with an intact subscapularis tendon. If the patient is unable to lift the hand off the lower back, then a tear of the subscapularis tendon is suspected. For the lift-off lag test, the examiner will hold the patient's hand away from the back at the lumbar region and let go. The patient will be unable to keep their hand away from their back if their tendon is torn. For the belly-press test, the patient presses the palm of the hand against the abdomen with the wrist in a neutral position. A positive sign for the belly-press test occurs if the patient is unable to press his belly without wrist volar flexion or the elbow falls posteriorly. For the belly-off test, the shoulder is placed in flexion and maximum internal rotation. The examiner positions the patient's hand on their belly while holding the flexed elbow. If the tendon is ruptured, the patient will not be able to maintain this position and the hand will lift-off of the abdomen when the examiner lets go. For diagnostic evidence, tear can be diagnosed by MRI or ultrasound.

To treat subscapularis tendon ruptures, physicians need to identify if the rupture is complete. For complete ruptures, surgical repair is necessary. Surgical repair may be done either open or arthroscopic. Biceps tenodesis during repair is associated with improved outcomes. It is usually done if the biceps is involved in the process, otherwise subluxation of the biceps will stress and fail the repair. For chronic muscle tear, pectoral major muscle transfer is the procedure of choice.

Galeazzi Fractures

Galeazzi fractures are fractures of the radial shaft which is associated with dislocation of the distal radioulnar joint (DRUJ).

Galeazzi fractures are named after Ricardo Galeazzi, who was an Italian surgeon in Milan. This injury is uncommon as it accounts for roughly 7 percent of all forearm fractures in adults.

To understand Galeazzi fractures, it's helpful to know the associated anatomy. The radius is one of the two long bones of the forearm which extends from the lateral side of the elbow to the thumb side of the wrist. It runs parallel to the ulna from the medial side to the side of the little finger. The distal radioulnar joint forms between the head of the ulna and the ulnar notch of the distal radius. Finally, the

styloid process refers to the projection of the bone on the lateral surface of the distal radius.

Galeazzi fractures may be short, oblique or transverse. They involve fractures at the juncture of the middle third and distal third of the radius with associated injury to the distal-ulnar joint. The closer the fracture is to the distal radioulnar joint, the more likely that it will be unstable. Dislocation of the distal radioulnar joint is usually dorsal and may be associated with either a ligamentous injury or fracture of the styloid process of the ulna. The fracture is usually located above the proximal border of the pronator quadratus muscle. The distal fragment usually moves toward the ulna.

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Galeazzi fractures are best treated with open reduction and internal fixation of the radius and assessment of the distal radioulnar joint. Surgery is necessary. Non-surgical treatment in adults usually results in recurrent dislocations of the distal ulna and bad outcomes. Surgery is done by volar plate fixation. Next, the distal radioulnar

joint should be assessed. If stable, splint the forearm in supination for 6 weeks. If the joint is unstable, reduce the pin in the distal radioulnar joint in supination for about 4 weeks. If the joint is not reducible, open and explore the joint. Physicians should check for entrapment of the extensor carpi ulnaris.

Compartment Syndrome: Hand and Fingers

Compartment syndromes of the hand often result from iatrogenic injuries due to IV's or A-lines. Other etiologies include snake bites, crush injuries to the hand, burns, trauma, and prolonged pressure.

There are 10 compartments in the hand. There are the 5 metacarpals, 4 dorsal interossei, 3 volar interossei, 1 hypothenar compartment, 1 thenar compartment, and 1 adductor pollicis compartment.

Patients will present with the following:

- Hypoesthesia on the volar surface of the fingers
- Tenderness in the palm
- Weakness of thumb opposition and limited flexion
- Pain with passive abduction and extension of the thumb
- Passive extension of the little finger causes pain in hypothenar eminence
- Limited little finger flexion
- Intrinsic plus hand deformity with flexion of MCP joints and extension of IP joints
- Pain with flexion of IP joints

There are clinical signs to differentiate between forearm and hand compartment syndrome. With forearm compartment syndrome, there will be pain with passive extension of the fingers. With hand compartment syndrome, there will be pain with flexion of the IP joints.

A fasciotomy is needed if the compartmental pressure is greater than 30 mm of mercury or within 30 mm mercury of the diastolic pressure. A fasciotomy of the hand is performed by making two



dorsal incisions of the hand in-line with the 2nd and 4th metacarpals. Dorsal incisions alone may not be enough. Additional incisions and/or carpal tunnel release may be necessary. An incision may be necessary to release the thenar compartment. This is done by making an incision along the radial aspect of the 1st metacarpal. Release of the hypothenar compartment may also be necessary. This is done by making an incision along the ulnar aspect of the 5th metacarpal. Carpal tunnel release is sometimes needed in association with compartment syndrome. The median nerve passes through the carpal tunnel where it may be compressed by swelling to cause carpal tunnel syndrome.

For fasciotomies of the fingers, a mid-axial incision is made on the ulnar side of the index, middle and ring fingers and the radial side of the small finger. Physicians will dissect across the digit superficial to the flexor tendon sheath. The neurovascular bundles are retracted volarly and dissection is completed across the digit.

De Quervain's Syndrome

De Quervain's syndrome refers to stenosing tenosynovitis of the first dorsal compartment of the wrist. It will cause pain and swelling over the radial side (thumb side) of the wrist. De Quervain's syndrome is due to inflammation, thickening, and stenosis of the synovial sheath. This condition is more common in women and the patient will complain of pain with movement of the wrist as well as swelling with tenderness over the styloid process.

Activities that may cause De Quervain's syndrome include: twisting/wringing out wet towels, hammering, skiing, racquet sports, playing the piano, and lifting heavy objects. It may also be post-partum or post-traumatic.

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De Quervain's Syndrome continued

Pain from De Quervain's syndrome is usually located at the base of the thumb and to the side of the wrist. Differential diagnoses for De Quervain's syndrome include basal joint or thumb carpometacarpal joint arthritis, intersection syndrome, and Wartenberg's syndrome. Intersection syndrome is characterized by pain felt on the top of the forearm where two muscles cross over the underlying wrist tendons. Patients will complain of pain located about 4 cm from the wrist joint. Wartenberg's syndrome refers to a compression of the superficial branch of the radial nerve with pain located about 8 cm proximal to the radial styloid. Patients will experience pain and paresthesia on the dorsum of the hand with a positive Tinel's sign.

It is difficult to differentiate De Quervain's syndrome from basal thumb joint arthritis. The Finkelstein test is utilized to diagnose De Quervain's syndrome. Here, physicians will have patients make a fist with the fingers closed over the thumb and the wrist is bent towards the little finger. The hand is pulled so that the involved tendons are stretched, causing sharp, local pain if injury and inflammation are present. The Grind test is used to diagnose basal thumb arthritis. By axial loading, pushing and rotating the thumb metacarpal bone, grinding may be felt within the joint. Pain will be located on the volar aspect of the wrist.

Conservative treatment includes anti-inflammatory medications, thumb spica brace, and steroid injections. When using steroid injections, physicians should inject the tendon sheath of the first dorsal compartment with the wrist over a rolled-up towel. If conservative treatment fails, patients may require surgery. Physicians will surgically release the first dorsal compartment. It is important to protect the radial sensory nerve and identify all other compartments. The tendon may have separate compartments and each compartment should be identified and released. Also, the abductor pollicis longus tendon may have multiple slips. Pain may occur after surgery due to neuromas, inadequate decompression, or instability and scarring of the tendons.

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Neither Dr. Ebraheim nor Dave
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