Different Modalities for Management of Congenital Absent Thumb

Essay Submitted for partial fulfillment of the
Master degree in ***General Surgery***

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List of Abbreviations

CMC ..... Carpo-metacarpal joint

MCP..... Metacarpophalangeal Joint

IP ..... Inter-phalangeal Joint

UCL..... Ulnar collateral ligament

EPL ..... Extensor pollicis longus

FOOSH..... Fall onto an outstretched hand

EPB ..... Extensor pollicis brevis

D.F. ..... Degrees of Freedom

MTP ..... Metatarsophalangeal

EIP..... Extensor indicis proprius

ADM…… Abductor digiti minimi

FDS…….. Flexor digitorum superficialis

FDMA..... Long First dorsal metatarsal artery

FPDA ..... Short First plantar digital artery

D B-G…….. Dieter Buck- Gramcko

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Introduction:

The hand deprived of the thumb loses approximately 40% of its function. It corresponds to a total body loss of 22% which is comparable with the loss of an eye.

Thumb deformity or absence imposes a great disability in hand function than does that of any other digit.

Bell emphasized in 1832 "On length, strength, free lateral motion and perfect mobility of the thumb, depends the power of the human hand. The thumb is called pollex because of its strength and that strength is necessary to the power of the hand being equal to that of all fingers" (Sarwat.Aziz.Gobrial 1986)

Hypoplasia of the thumb refers to a spectrum of clinical abnormalities ranging from a slightly small digit to complete absence (or aplasia) of the thumb unit(Riley.S.A 2009)

Absent thumb is type V thumb hypoplasia according to Blauth Classification(Tonkin 2011).

- Total absence of the thumb may be an isolated anomaly, but it is often associated with some other syndromes as in Holt-Oram syndrome, Fanconi's anemia, and ring D chromosome abnormalities

Absent thumb may be inherited as autosomal dominant or may be sporadic

Absent radius is almost always associated with an absent thumb, except in thrombocytopenia & radial aplasia (Fanconi's syndrome), where Thumb is present even when the radius is absent(Buck-Gramcko.D 1971, DI.Clark 1998)

Many approaches for reconstruction of the thumb have been described, including pollicization of a finger, toe- to- thumb transfer & manufacture of an artificial finger from living tissues (osteoplastic reconstruction and transfer of a neurovascular island graft)

Pollicization is the procedure of choice in congenital absent thumb. Good outcomes have been reported for range of movement, power, appearance and sensation.

A reconstructed thumb must meet five requirements: sensibility, stability, sufficient mobility, sufficient length and cosmetic appearance (Sarwat.Aziz.Gobrial 1986).

Finally, according to BUCK-GRAMCKO (1971), the optimum age for performance of the operation of index pollicization is the first year of life .He thought that the first year of life is the best age for pollicization.

While, EGLOFF and VERDAN (1983) prefer to perform this operation before the age of four years to allow normal integration of the new thumb in the body schema(Sarwat.Aziz.Gobrial 1986).

Aim of the work:

To study the different modalities of management of congenital absent thumb.

The Anatomical consideration of The Thumb

The bones of The Thumb

The thumb consists of 4 bones: (FIG.1)

Trapezium , first metacarpal bone, proximal phalanx and distal phalanx.

1-Trapezium:

This carpal bone articulates with the adjacent trapezoid, and these together by concave facets, fit the distal convexity of the scaphoid.

A distal articular surface, saddle shaped, is for the thumb metacarpal and this is a separate synovial joint.

2- The first metacarpal bone:

It has a head, a shaft and a base. It is shorter and stouter than the other metacarpal bones. Its dorsal surface can be felt to face laterally; its long axis passes distally and laterally diverging from its neighbor.

The shaft is flattened and its dorsal surface is uniformly broad and convex from side to side.

The palmar surface is concave in its long axis and is subdivided by rounded ridge into a larger lateral and a smaller medial part.

The oppenens pollicis muscle is attached to the radial border and adjoining palmar surface; the radial head of the first dorsal interosseus muscle arises from the ulnar border and adjoining palmar surface. The base represents a concavo-convex surface for articulation with trapezium.On its lateral side the abductor pollicis longus is attached to it.

The head is less convex than the heads of the metacarpal bones, and also in contrast to them is broader from side to side than from palmar to dorsal surface. On its palmar surface the ulnar and radial angles are enlarged to form 2 articular eminences, on each of which a sesamoid bone glides.

3- The phalanges of the thumb:

There are two phalanges in the thumb, each has, shaft and a base or proximal end and a distal end.

In each, the shaft tapers to its distal end and its dorsal surface is convex from side to side. The palmar surface is flattened from side to side, but is gently concave forwards in its long axis. The base of the proximal phalanx is marked by concave, oval facet for articulation with the head of the first metacarpal bone.

The head of distal phalanx is non-articular, but is marked on its palmar surface by a rough horse –shoe shaped tuberosity, to which connective tissue strands attach firmly the soft tissue (pulp) of the finger tip. The base of the proximal phalanx of the thumb receives on its dorsal surface, the tendon of the extensor pollicics brevis, on its lateral side the abductor pollicis brevis, the flexor pollicis brevis and the lateral part of the oblique head of the adductor pollicis .On its medial side, it receives the transverse and the remainder of the oblique head of the adductor pollicis.

To the sides of the proximal phalanx, the fibrous flexor sheath is conneted. The flexor pollicis longus is inserted into palmar surface of the base of the distal phalanx of the thumb. The tendon of extensor pollicis longus reaches its attachment to the base of distal phalanx of the thumb (Sarwat.Aziz.Gobrial 1986).

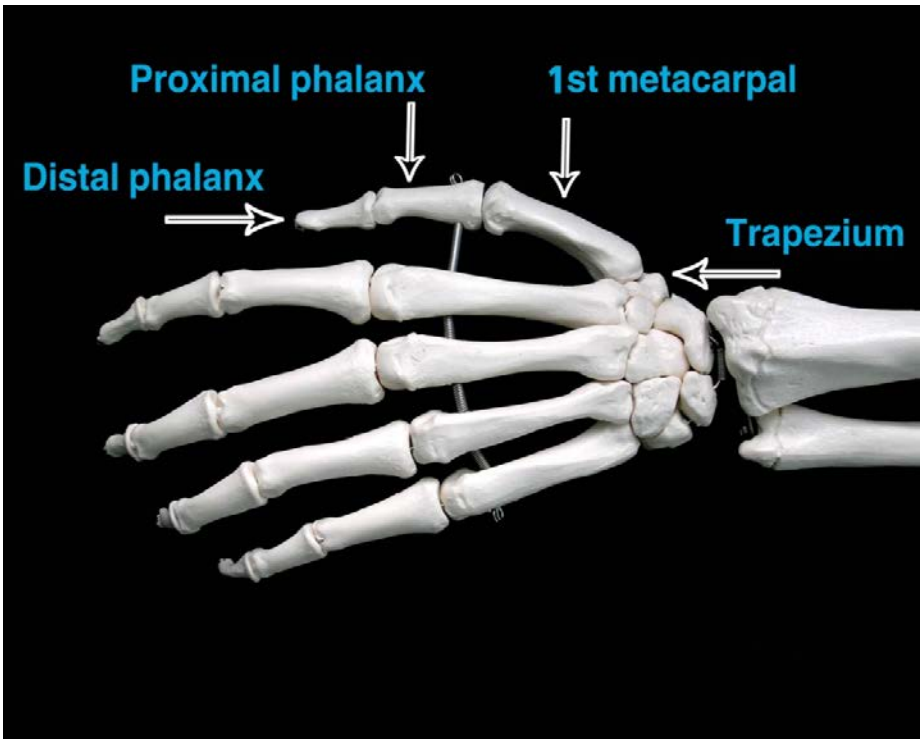

FIG.1 the bones of The Thumb

The joints of the thumb

1- Carpo-metacarpal joint (CMC): (FIG.2)

It enjoys a great freedom of movement on account of the configuration of the articular surface.It is a saddle joint between the trapezium carpal bone and base of the first metacarpal. This joint is dependent on several ligamentous constraints to provide stability (Bell C.1832)and although 16 different ligaments that stabilize the trapezium or the carpometacarpal joint can be identified through dissection(Verden C. 1968), only five have been directly implicated in joint stability (Kuczynski K. 1974): the anterior oblique ligament, posterior oblique ligament, ulnar collateral ligament (UCL), dorsoradial ligament, and intermetacarpal ligament.

2- Metacarpophalangeal Joint (MCP): (FIG.2)

This joint is classified as ellipsoid one. The articulation is between the head of the first metacarpal and the base of the proximal phalanx. This joint has a palmar ligament and two collateral ligaments (ulnar&radial).

3-Inter-phalangeal Joint (IP):

It is uni-axial hinge joint. The joint has the articulation between the head of proximal phalanx and the base of distal phalanx. The joint has a palmar ligament (volar plate) and two collateral ligaments (Sarwat.Aziz.Gobrial 1986).

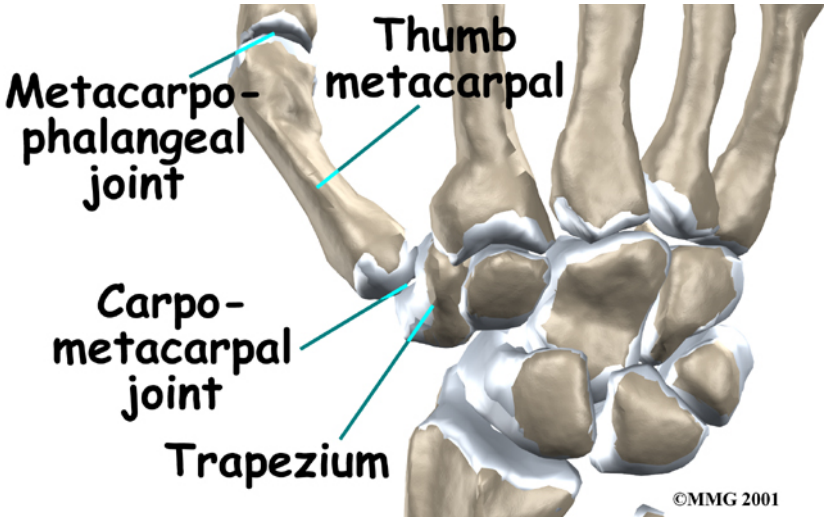

FIG.2 Carpo-metacarpal & Metacarpophalangeal joint

Ligaments& stability of the Thumb

The radial and ulnar collateral ligaments are important in the MCP and IP joints in retaining stability and restraining force in both flexion and extension.

The tendon that acts across these joints is the FPL, flexing both the MCP and IP joints. The extensors of these joints are more complicated. The extensor pollicis longus (EPL) extends the IP joint. The extensor pollicis brevis and EPL extend the MCP joint.

It is possible to have an EPL tendon laceration in which the IP joint can still extend through the action of extensor pollicis brevis by the oblique retinacular ligament, also called Landsmeer's ligament. (FIG.3). This small tendinous band originates from the abductor pollicis brevis or the adductor pollicis and passes parallel to the EPL and inserts with this tendon into the distal phalanx. (Kaplan.EB 1984, Elizabeth.A.Ouellette 2004)

The stabilizing ligaments of the trapezium and carpometacarpal joint with respect to osteoarthritis have been well described by Bettinger et al (Bettinger.PC 1999).

There are 16 ligaments in all. These are required to stabilize the trapezium, allowing pinch and grasping activities.

There are minimal osseous constraints, making the ligamentous structures extremely important stabilizers of the thumb base.

A total of 16 ligaments have been described around the thumb CMC joint, five are primary stabilizers of the thumb metacarpal:

The anterior oblique ligament, posterior oblique ligament, ulnar collateral ligament (UCL), dorsoradial ligament, and intermetacarpal ligament.

The remainder stabilize the trapezium, providing a stable foundation for the thumb.

Carpometacarpal (CMC) joint dislocations are rare and usually occur dorsally.

The IP and MCP joints have the usual configuration of collateral ligaments, volar plate, and capsule, which are important to the stability of the joints. (Eggers.GWN 1945, JW 1973

, Jensen.JS 1975, Elizabeth.A.Ouellette 2004).

Despite the inherent stability of the joints of the thumb, the vulnerable anatomic position of the first phalangis often subjects the joints to mechanical strain that leads to subluxation or dislocation of the metacarpophalangeal (MCP) and interphalangeal (IP) joints.

Most thumb MCP dislocations are dorsal.(Maheshwari R SH, Duncan RD.2007)They are caused by a longitudinal and dorsal stress along the axis of the digit that hyperextends the thumb and tears the volar plate of the joint. An example of this mechanism is a fall onto an outstretched hand (FOOSH) with an impact to the tip of an extended thumb.

Volar dislocation of the MCP joint of the thumb is comparatively rare and is associated with tears of both dorsal capsule ligaments and the extensor pollicis brevis (EPB). For this reason, anterior dislocations are often treated with surgical

repair of the torn structures, and closed reduction is rarely achieved with adequate postreduction stability.

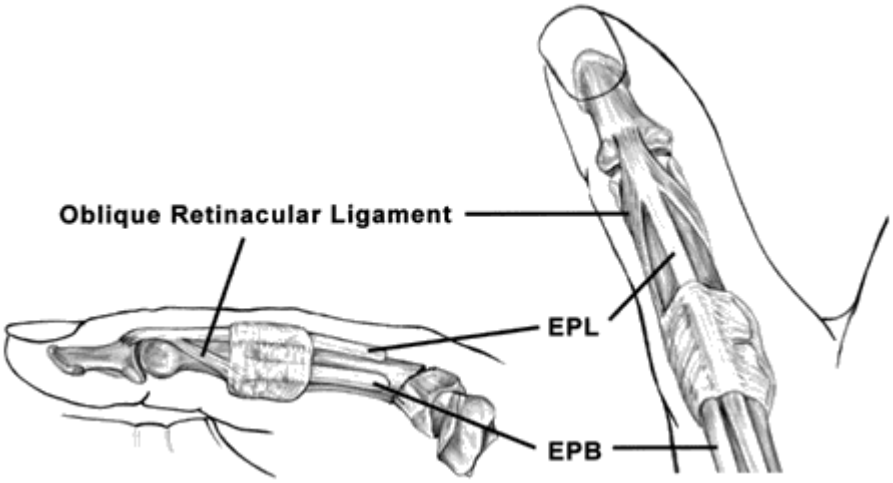

FIG.3 the oblique retinacular ligament

Movements of the Thumb

1- At Carpometacarpal Joint:

Movements at this joint are usually complex. Flexion and extension take place in a plane which is parallel to the palm, while abduction and adduction occur in a plane perpendicular to flexion-extension plane.

Flexion is done by flexor pollicis brevis and opponens pollicis, aided by flexor pollicis longus. Flexion is associated with medial rotation.

Extension is brought by extensor pollicis. brevis , extensor pollicis Longus and abductor pollicis longus.