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Pulley System in Hand

Aamir Siddiqui

Abstract: ***This paper intends to explain Pulley system in Hand. In this paper we will review the anatomy of the pulley system and its clinical importance.***

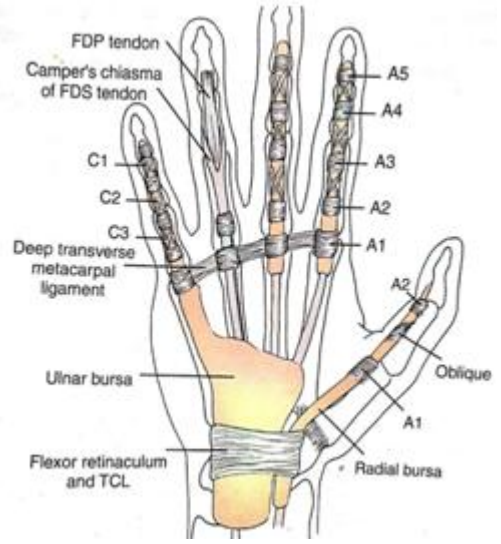
Keywords: Pulley, Aponeurosis, Bowstringing, Transverse, Oblique

1. Introduction

The pulley system is present on the flexor part of each finger, consists of five annular (transversely oriented), four cruciate (obliquely oriented) and one palmar aponeurosis pulley in the fibro-osseous tunnel. The function of the pulley system is to prevent bowstringing of the tendons on finger flexion. Many studies have shown that combinations of pulleys are required for mechanically efficient finger flexion and this helped surgeons in pulley preservation and reconstruction.

2. Annular Pulleys

- The annular pulleys are transversely oriented (as shown in fig.). The first two annular pulleys lie closely together, first pulley (A1) at the head of the metacarpal and the second one (A2) along the volar midshaft of proximal phalanx.
- The floor of the first pulley is formed by the flexor groove in the deep transverse metacarpal ligament, whereas all other annular pulleys attach directly to the bone.
- The third pulley (A3) lies at the distal most part of the proximal phalanx.
- The fourth pulley (A4) lies centrally on the middle phalanx.
- A fifth pulley (A5) lies at the base of distal phalanx.
- The base of each pulleys on the bone is longer than the roof, and the roof has slight concavity volarly.
- This shape prevents the pulleys from pinching each other at extremes of flexion, forming nearly one continuous grasp.



3. Functions of Annular Pulleys

- To keep flexor tendons close to the bone.
- To allow minimum amount of bowstringing and migration volarly from the joint axes.
- Enhances tendon excursion efficiency and work efficiency of long tendons.

4. Cruciate Pulleys

There are three cruciate pulleys, namely, C1, C2 & C3 (as shown in fug.) and are obliquely oriented.

- C1 pulley lies between the A2 & A3.
- C2 pulley lies between the A3 & A4.
- C3 pulley lies between the A4 & A5.
- The A4, A5, and C3 structures contain only Flexor Digitorum Profundus tendon because the Flexor Digitorum Superficialis muscle inserts on the middle phalanx which is proximal to A4, A5 & C3.

5. Pulley System of Thumb

The thumb has a distinct pulley system (as shown in fig.). It includes two annular pulleys (A1 & A2) and one oblique pulley.

6. Clinical Importance

Understanding the pulley system of hand will help the surgeons to resolve triggering finger or thumb conditions while avoiding complications such as bowstringing of the flexor pollicis longus tendon and iatrogenic nerve injury.

References

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