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Letter to Editor

Practical applications of tenodesis in hand surgery

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Dear Sir,

The word "tenodesis" (ten-ŏ-dē′sĭs) is Greek in origin and derived from two words: "tenon," which means tendon, and "desis" which is binding or "to bind." Therefore, the literal meaning translates as suture or surgical fixation of the end of a tendon to the bone or some other structure.[1]

Many believe that tenodesis is only a physiological phenomenon with limited practical application. However, it has numerous applications in hand surgery, ranging from a simple diagnostic test to confirm flexor tendon injuries of the hand to tendon transfers for nerve palsies of the hand, wrist surgeries (flexor carpi radialis [FCR] tenodesis), elbow surgery (biceps tenodesis), and shoulder surgery (subclavius tenodesis). This article aims to deconstruct this often misunderstood concept and outline its physiological and practical implications in hand surgery.

When it comes to hand surgery, tenodesis comes broadly under two categories: A diagnostic sign/test or physiological effect and a surgical procedure to fix/bind tendon to the bone.

The "tenodesis effect" is a normal physiological process whereby joint motion (proximal joint) causes synchronous movement on the neighboring joints. Therefore, this tenodesis principle can be used as a clinical test in the examination of the hand. Typically, due to the tenodesis effect, passive wrist flexion causes all fingers to go into extension, and with wrist extension, all fingers undergo flexion. However, in flexor tendon injuries to the hand, the tenodesis effect is a valuable test for diagnosis, especially in uncooperative and irritable children. In this scenario, the affected finger rests in full/partial extension while other digits go into flexion and extension with wrist movement. Hand surgeons use this same principle to gauge the accuracy of tension intraoperatively during tendon transfers and repairs.[2]

Other examples of physiological tenodesis include the oblique retinacular ligament of Landsmeer (ORL) and the "quadriga" effect of the flexor digitorum profundus (FDP) tendons. The ORL arises from the lateral surface of the proximal phalanx, and the A4 pulley runs volar to the axis of rotation of the proximal interphalangeal joint (PIPJ); it then runs dorsal to the distal interphalangeal joint (DIPJ) and inserts into the terminal extensor tendon. When the PIPJ goes into extension, the ORL contracts, leading to an extension of the DIPJ, thereby synchronizing intrinsic and extrinsic hand function. The quadriga effect is based on the fact that the FDP of all four fingers shares a common muscle belly, hence following a flexor tendon repair, if the repair is too tight, it will affect the normal flexion of other fingers leading to a loss of the normal synchronous flexion of fingers.[3]

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The tenodesis procedures in hand surgery can be broadly classified into simple and dynamic tenodesis depending on whether the tendon traverses one or more joints.

A simple tenodesis procedure involves the tendon traversing through a single joint, and hence, it exerts a purely passive effect on the joint proximal to its insertion. The most straightforward tenodesis technique described in hand surgery is the FDP tenodesis used in chronic zone 1 flexor tendon injuries with an intact flexor digitorum superficialis (FDS) tendon. In this procedure, the distal stump of FDP is sutured to flexor synovial sheath at the level of the neck of the middle phalanx. Thus, it acts as ligamentous restraint to unopposed hyperextension and permits passive flexion of the DIPJ.[4]

Another example of a simple tenodesis procedure is Zancolli technique for correcting claw hand deformity. In this procedure, the FDS tendon to the middle finger is split into two slips and then each slip is passed beneath the A1 pulleys of the little and ring fingers sutured to itself. The aim here is to prevent hyperextension of the metacarpophalangeal joint (MCPJ).[5] Similarly, the FDS tenodesis procedure is used to correct swan neck deformity; here, a distally based half-slip of FDS tendon is brought through a window in the A2 pulley and sutured to itself to create a check rein against PIPJ hyperextension.[3]

Dynamic tenodesis involves the tendon traversing two or more joints leading to synchronous movement of adjacent joints. This translates as flexion of one joint activating flexion or extension in the adjacent joints.[4] Dynamic tenodesis can be categorized into two types: Direct dynamic tenodesis and crossed dynamic tenodesis.

Direct dynamic tenodesis involves a tendon traversing two or more joints in the same plane of the joint's axis of rotation, either palmar or dorsal. An example of this is the tenodesis of the extensor digitorum communis (EDC) to the posterior surface of the radius or extensor retinaculum, used in radial nerve palsy. Here, active or passive wrist flexion leads to an extension of the MCPJ's.[4]

In crossed dynamic tenodesis, the tendon traverses along both the dorsal and palmar plane of axes of rotation of adjacent joints. The net effect of this configuration, flexion of one joint, leads to flexion of the adjacent joint and vice versa. The most commonly used illustration of this principle is the various tenodesis techniques for correcting MCPJ hyperextension seen in the ulnar claw hand. The basic principle involves routing the tendon palmar to the deep transverse metacarpal ligament (MCPJ) and dorsal to the axis of the PIPJ for insertion on the lateral band of the extensor expansion. Several eponymous tenodesis techniques are presently based on this principle differing only in their proximal attachment. Riordan's tenodesis uses a distally based split half of the extensor carpi radialis longus and extensor carpi ulnaris (ECU), split further into two to yield a total of four slips which are then sutured to the lateral bands of fingers. Fowler's wrist tenodesis uses a tendon graft sutured proximally to the extensor retinaculum; hence, wrist extension "activates" MCPJ flexion. Parke's tenodesis uses tendon grafts (palmaris longus and/or plantaris) attached proximally to the flexor retinaculum. Srinivasan tenodesis uses a tendon graft sutured proximally to the EDC.[3-5]

Another example of crossed dynamic tenodesis is the lateral band (Littler) tenodesis used to correct PIPJ hyperextension seen in swan-neck deformity. The lateral bands are routed palmar to the PIPJ and sutured to each other at the middle phalanx level to act as a check rein against PIPJ hyperextension.[3]

Other examples of tenodesis in the upper limb include; at the level of the wrist for distal radioulnar joint instability, soft-tissue stabilization using flexor carpi ulnaris (FCU), and/or ECU tenodesis. In this technique, distally based slips of FCU or ECU are used and passed through a drill hole in the ulna, tensioned around the ulna, and sutured to itself. In scapholunate instability, a distally based slip of FCR is passed through a tunnel in the distal pole of the scaphoid and attached to the distal radius; this construct stabilizes the subluxating scaphoid (scaphotrapezoid tenodesis) and prevents it from assuming an abnormally flexed posture. Subsequent modifications of this technique include the three-ligament tenodesis and the scapholunotriquetral tenodesis. In lunotriquetral (LT) instability, a distally based strip of ECU tendon is passed through drill holes in the lunate and triquetrum and looped around the LT joint and sutured to itself (ECU tenodesis), this provides stability and improves function and pain in those with LT dissociation.[3,6]

Following trapeziectomy for thumb CMC arthritis, the ligament reconstruction and tendon interposition are a popular technique whereby a distally based slip of FCR tendon is passed through a window in the base of the first metacarpal and sutured to itself for thumb stability. This FCR-based tenodesis procedure aims to recreate the volar beak ligament support and mobility of the trapeziometacarpal joint without subluxation. Other examples include the distal biceps tenodesis to the brachialis tendon at the elbow following biceps tendon rupture and the tenodesis of the long head of biceps to the humerus or rotator cuff in shoulder impingement syndrome.[3,6]

The practical application of tenodesis in hand surgery is numerous and can be summarized to include diagnostic/physiological test in hand injuries, as a maneuver that can be used in rehabilitation following hand surgeries and in the various reconstructive options for tendon, nerve, and joint pathologies to restore motion.

AUTHOR'S CONTRIBUTION

The author has critically reviewed and approved the final draft and is responsible for the manuscript's content and similarity index.

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