

# Tendon Transfers for Low Median and Ulnar Nerve Paralysis

## Part II

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**Abstract :** Part I of this presentation presented the authors method of restoring opposition to the thumbs, and will not be repeated here. Part II of this presentation outlines the authors methods of restoring adduction of the thumb in low ulnar nerve paralysis. This will consist of a ulnar insertion of the transfer on the thumb, utilizing the superficialis of the little finger as the motor. The authors method of restoring the interosseous muscle function to the fingers in low ulnar nerve paralysis will be presented. This method uses a modified Bunnel superficialis transfer, using a single tendon split into four tails. Time limitations of the presentation will not allow for discussion of other methods that could be used for the reconstruction in low median and ulnar nerve paralysis.

### EVALUATION PREOPERATIVELY

The claw hand deformity produced by a low median and ulnar nerve paralysis is the same whether the cause is due to a traumatic injury to the nerves, and infection such as poliomyelitis or leprosy, or neurological inherited disease such as Charcot-Marie-Tooth disease. The analysis of the patients deformity should include a determination that all joints have adequate mobility to obtain a satisfactory result following surgery. If joints are not mobile due to lack of proper splinting and prevention of deformity, then physical therapy and static or dynamic type of splinting must be used to restore mobility, prior to surgery. An evaluation of the proximal muscles, namely the superficialis muscles, and the long extensors of the fingers and thumb, must be done to determine that they are not involved and have adequate power to be utilized for the transfers. The functioning of the extensor mechanism of each finger must be determined prior to surgery. This can be done by holding the thumb into full opposition and holding the proximal phalanx and asking the patient to flex and extend the distal phalanx of the thumb. If the extensor mechanism over the distal joint is functioning the patient should be able to

actively flex and extend the thumb distal joint. The proximal phalanges of the fingers are then stabilized in about ten degrees of flexion, and the patient asked to flex and extend the middle and distal phalanges of the fingers. If the fingers can fully flex, and fully extend, then it means that the extensor mechanism of each finger is intact and the tendon transfers should bring about improvement in the claw deformity, and the power to flex the proximal phalanges restored.

### INCISIONS

In order to prevent any unnecessary exposure of tendons during the procedures all incisions for the opponens transfer and of the tendons to be transferred are made prior to removing any of the tendons from exposure, and decrease the chance of infection from prolonged exposure. When each incision is made the structures to be utilized are exposed fully. The necessary tunnelling for passage of the transfers can be done to shorten the exposure time when tendons are withdrawn from their normal position.

**Thumb.** The incision is a reverse shallow "C" incision for a left thumb, and a shallow "C" incision for a right thumb. This incision is used for the opponens transfer and the adductor transfer. The incision starts just proximal to the interphalangeal joint of the thumb on the dorsal surface, and continues into the midlateral line on the radial side, and ends about one centimeter proximal to the metacarpophalangeal joint. Care is taken to expose and identify the branches of the radial nerve to the thumb and retract them dorsally. The extensor pollicis longus over the metacarpophalangeal joint, the tendon of insertion of the abductor pollicis brevis, and the extensor pollicis longus distally to the interphalangeal joint are exposed. In addition, the tendon of insertion of the adductor pollicis exposed on the ulnar side of the metacarpophalangeal joint.

**Wrist.** If a fixed pulley is to be made from one half of the flexor carpi ulnaris as a loop (Riordan)<sup>2</sup>, The incision is a

transverse one in the flexion crease of the wrist from the middle of the wrist to over the flexor carpi ulnaris tendon. If the fixed pulley is to be the volar capal ligament (Snow)<sup>3</sup> a curving incision in the thenar crease is made. In both incisions care is taken to indentify and protect the sensory branches of the median palmar branch, and the small ulnar sensory branches near the pisiform.

**Fingers.** The incisions on the donor fingers (long, ring and little) are made in the midlateral position on the radial side of the proximal phalanx of each finger. On the index finger the incision can be on the radial side as described by Bunnell, or on the ulnar side as described by Brand<sup>4</sup>.

On the long, ring and little finger the incision is extended a little longer over the interphalangeal joint to make it easier to expose the insertion of the superficialis just distal to the A2 pulley. On each of these fingers the superficialis is exposed and the two slips of tendon cut about one centimeter proximal to the bony insertion, and just distal to the A2 pulley. The two slips of the tendon are cut, the conjoined tendon is split to the Chiasm of Camper, and the vincula is cut. One slip of the tendon is held in a hemostat for easir identification for its withdrawn later.

**Palmar incision.** The palm must be opened in the proximal flexion crease, in order to split the superficialis of the long finger into four slips, and facilitate the tunnelling and passage of the four slips into the area of the incision, and the lumbrical muscles partially exposed for the four fingers, care being taken to expose and not damage the digital vessels and nerves in the plam.

### **Withdrawal of tendons to be transferred for intrinsic replacement.**

In the palmar incision, the superficialis tendon of the long finger is exposed, separated from the profundus, and by traction on the hemostat placed on one slip in the finger incision, can be freed to allow its withdrawal. A rounded instrument can be placed under the tendon in the palm and lifted to withdrawn the tendon after release of the hemostat on the distal end of the tendon. Care is taken to try and preserve the paratenon. After delivery into the palmar incision, the two distal slips of the tendon are each grasped with two hemostats and each slip of the tendon is split into half by sharp dissection, marking a total off our slips of tendon from the one superficialis tendon. The separation is ended proximally about one centimeter proximal to the skin incision.

The tendon tunneller (Andersen)<sup>5</sup> is then passed from the incision in the little finger through the interosseous canal and delivered into the palmar wound. The most ulnar slip of the split superficialis is grasped and the tunneller pulled distally pulling the tendon slip through the interosseous canal and delivering it into the wound on the radial side of the little finger. This procedure is then repeated for the ring finger wound of the ring and then the long finger. On the index finger the insertion can be on the ulnar side as described by Brand, or the radial siade as described by Bunnell. If the tendon is to be

inserted on the ulnar side, the slip of tendon is grasped and pulled through the interosseous canal with the slip to the long finger, and then from the base of the long finger delivered into the ulnar side of the index finger wound. If the insertion is to be on the radial side, the tendon tunneller is passed through the lumbrical canal of the index finger and the fourth slip of the split superficialis is delivered into the wound on the radial side of the index finger.

**Withdrawal of tendon for opponens transfer.** The superficialis tendon of the ring finger is used as the motor for the opponens. It is withdrawn in a similar manner as described above. However, if the pulley is to be aloop of one half of the flexor carpi ulnaris, the withdrawal is done proximal to the volar carpal ligament through the exposure in the flexion crease of the wrist. The same technique of withdrawal is used, care being taken to preserve the tenosynovium so it can be used to line the loop tunnel where the tendon changes if direction to pass over the thenar eminence. Prior to withdrawing the tendon from the ring finger, the tendon tunneller is passed from the incision in the thumb deep to the fascia of the thenar eminence, and the tip of the tunneller is delivered into the wrist incision area. The superficialis of the ring finger is then withdrawn as described above, and is grasped by the tunneller and delivered over the thenar eminence and into the incision area of the thumb.

**Withdrawal of tendon for the thumb adductor replacement.** The flexor superficialis of the little finger is then exposed in the palmar incision, and a round instrument placed under the tendon. The tendon tunneller is then passed from the ulnar side of the thumb metacarpal head deep to the flexors of the fingers are the common digital vessels and nerves, and directly superficial to the adductor of the thumb. A resistance will be met at the mid-palmar septum over the third then brought superficial to the common digital vessels and nerves on the ulnar side of the little finger is then withdraw from the finger, and the tip grasped with the tunneller and withdrawn into the ulnar side of the wound in the thumb. This passes the tendon deep to the vessles and nerves and delivers the tendon at the insertion of the adductor on the ulnar side of the thumb at the metacarpal head level. This completes the transfers of the three superficialis tendons for the restoration of opposition, and the intrinsic replacement of the fingers, and the adductor replacement. Since the suturing of the tendons into their respective insertions will require that the fingers and thumb be held in the intrinsic plus position, it is best to suture the palmar skin incision before the tendons are inserted in their new positions. Suturing can be done with a continuous suture, or interrupted sutures of a non-absorbable type, depending on the surgeons preference.

**Tension adjustment and suturing of transferred tendons.** It is advisable to start the suturing of the transferred tendons with the little finger, and moving to the more radial fingers in succession since the fingers will have to be held in the intrinsic plus position after the suturing of the tendons, making skin suture difficult. The four slips of the intrinsic transfer have a

hemostat on the free end of the tendons. The wrist is placed in neutral position, the fingers in full flexion of the proximal phalanges, and the little finger in about 60 degrees of flexion at the metacarpophalangeal joint. The skin edges are retracted so that the extensor mechanism is exposed on the little finger, including the oblique fibers of the extensor aponeurosis on the radial side of the little finger. A hole is made through the oblique fibers about two millimeters from the free edge of the intrinsic tendon and the slip of superficialis passed from the deep side to the superficial side, brought around the tendon and passed through a second hole in the oblique fibers about five or six centimeters distal to the first pass through. The slip of the superficialis is grasped with a hemostat. The wrist is then placed in neutral position, the proximal phalanx in about seventy degrees of flexion, and the interphalangeal joints held in extension. The hemostat on the free end of the transferred slip is pulled distally as far as the muscle will let it stretch, and a mark made on the tendon. The hemostat tension is then let go and the tendon slip should retract proximally from the normal muscle rebound, and this point marked. This distance will be between one and three centimeters depending on the size of the hand and arm. The tendon slip of the superficialis then pulled distally to the halfway point of the tendon excursion and then sutured to the oblique fibers of the extensor at both levels of the pass through. Suturing should be of non-absorbable suture. Because the intrinsic plus position has to be maintained, it is best to suture the skin wound while this position is maintained.

The position of the wrist is maintained at neutral, and little finger in the intrinsic plus position, and the ring finger is then exposed through its incision. The same manner of adjusting tension of the slip of tendon is used, only this time the distal point of the excursion of tendon slip is judged when the proximal retraction will be lessened by the tethering of the superficialis by the sutured slip of the little finger. Observation of the travel, and feeling of the changing tension is difficult to judge, but hopefully the same tension will be judged and the slip is sutured after two pass throughs of the slip through the oblique fibers of the aponeurosis as just described for the little finger. This wound is then closed. The slip of tendon to the long finger is sutured to the oblique fibers in a similar manner as just described for the ring finger. The slip to the index finger is sutured into the oblique fibers either on the radial side as just described, or on the ulnar side if the insertion of Brand is to be used. After closing the wound of the index finger the hand is

maintained with the wrist in neutral position. All wounds are then closed.

**Immobilization.** After the tendon transfers just described have been completed, the hand and forearm are immobilized with adequate padding and plaster, or plastic splints. The wrist is immobilized in about 25 or 30 degrees of flexion to take tension off of the transfers. The fingers are flexed about 70 degrees at the metacarpophalangeal joints, and the fingers straight (zero degrees) at the interphalangeal joints. The thumb is held in adduction, rotated into opposition, and the distal joint held in extension. The tip of the thumb is in front of, but not touching, the tip of the index finger.

**Duration of immobilization.** The above position is maintained for three weeks, and the patient is asked to not try and move the fingers for fear of pulling the small tendons apart. At the end of this three-week period the sutures are removed, and the fingers are gently moved through a small range of motion passively. The wrist is then brought to the neutral position, the thumb held into opposition but its tip left loose, and the proximal phalanges of the fingers are blocked from extending past 25 degrees by the dorsal wrist splint. The patient is then allowed to gently flex the interphalangeal joints, but not against any resistance. The thumb is allowed motion of the distal joint, but is not allowed to go into adduction. At the end of two more weeks, the dorsal splint is removed for daytime exercises and reapplied at night time for protection. At the end of six weeks splinting can be discontinued unless there is a tendency for clawing of the fingers. If this occurs, a dorsal block to hyperextension of the metacarpophalangeal joints must be used until full motion of the interphalangeal joints occurs. Motion against resistance is not allowed until eight weeks has passed to prevent stretching of the freshly healed multiple tendon sutures. In some cases where the claw deformities have existed for a long time preoperatively, splinting may have to be continued for months. This recovery period is hastened by adequate physical

## SUMMARY

Part 2 of this presentation has presented the author's methods of restoring adduction of the thumb with transfer of the superficialis of the little finger, and using a modified Bunnell superficialis transfer of the long finger split into four slips as an intrinsic replacement for the low ulnar nerve paralysis. These transfers represent the methods that the author feels give the best results for the low median and ulnar nerve paralysis after 46 years of performing such transfers.

## REFERENCE

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