

Wide-Awake Flexor Tendon Repair

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VIDEO+

The wide-awake approach to hand surgery is performed with no sedation and no tourniquet. Only locally injected tumescent lidocaine and epinephrine are used for anesthesia and hemostasis. The confirmation that epinephrine hemostasis in the finger is safe¹⁻⁵ has permitted the use of this technique, which has now become widespread in Canada.

With exceptions that include hand surgery in small children, major trauma patients, and on those who are mentally challenged, more than 95 percent of all of the hand surgery in our center is now being performed with the wide-awake approach. With the possible exception of tendon transfers,⁶ none of our hand operations have benefitted more from the advent of the wide-awake approach than flexor tendon repair. This video-plus presentation focuses on important technical aspects of wide-awake flexor tendon repair. It includes details of a zone 1 flexor tendon repair in a 16-year-old, from the injection of the local anesthetic to the 1-year postoperative result (see **Video, Supplemental Digital Content 1**, <http://links.lww.com/A657>).

TUMESCENT LOCAL ANESTHESIA IN FLEXOR TENDON REPAIR

Tumescent means the injection of large enough volumes of dilute local anesthetic solution containing epinephrine so that all tissues to be dissected are slightly firm to the touch. In flexor tendon repair, there are three important principles to tumescing the finger, hand, and forearm.

First, start proximally. The first injection should be in the subcutaneous fat 5 to 10 mm proximal to the most proximal area of dissection. In this way, the large volume of the first injection will bathe all of the nerves leading to the area of

the secondary injections. If one waits 10 to 15 minutes before performing the secondary injections, they will be totally pain free (Fig. 1). In the forearm and wrist, subcutaneous tumescence can be augmented by subfascial injection of 10 to 20 cc of tumescent solution to bathe major nerves, such as the median and ulnar nerves.

Second, the concentration of lidocaine and epinephrine does not matter nearly as much as large volumes. The key is to get the lidocaine and epinephrine molecules everywhere that may need to be dissected. In the finger, we use 2 cc per phalanx injected in the center of the volar subcutaneous fat between the digital nerves. In the wrist and hand, up to 30 cc is injected into the subcutaneous fat until tissues are white and firm. In the forearm, up to 200 cc can be injected in lacerations involving multiple tendons, as seen in the film.

If less than 50 cc will be required (as in most hand and finger repairs), we use premixed 1% lidocaine with 1:100,000 epinephrine. If 100 to 200 cc will be required (forearm), we dilute with saline to a concentration of 0.25% lidocaine with 1:400,000 epinephrine.

Third, if the patient is injected before being prepared and draped to allow at least 15 minutes for the epinephrine to maximize its effect, electrocautery will not be needed. By the time the

Disclosure: *The author has no financial interest in any of the drugs, products, or devices mentioned in this article.*

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From the Division of Plastic Surgery, Dalhousie University. Received for publication June 8, 2008; accepted July 29, 2008.

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DOI: 10.1097/PRS.0b013e318195664c

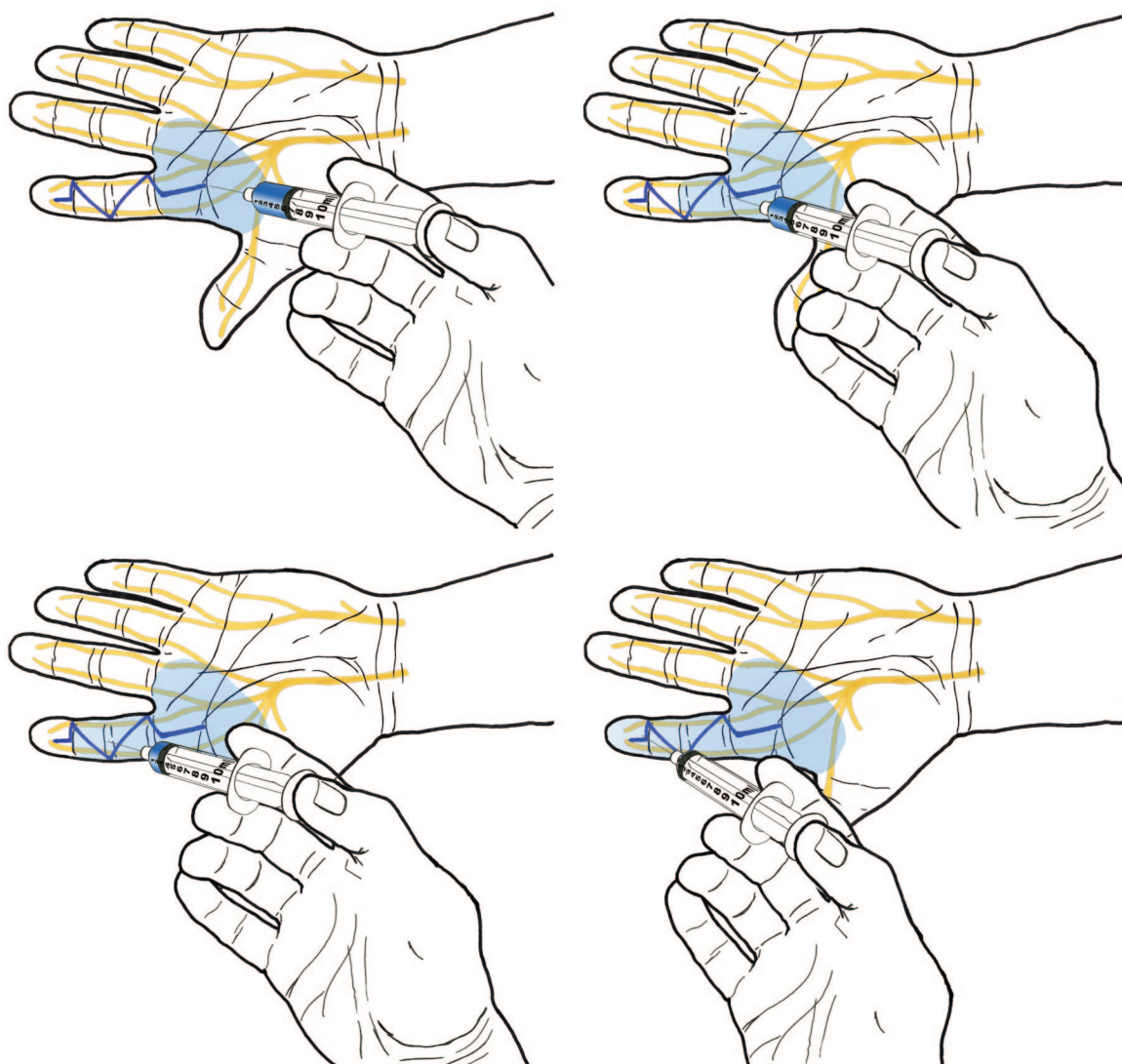


Fig. 1. (Above, left) The blue line is the incision to be made for a zone 1 or 2 flexor tendon repair. The light blue area represents the area bathed by the first injection of 10 cc of premixed 1% lidocaine with 1:100,000 epinephrine used to tumesce the tissue proximal to the area of dissection. (Above, right) Fifteen minutes after the initial tendon injection in above, left, the whole distal area of dissection is totally numb. The second injection of 2 cc in the subcutaneous fat between the digital nerves shown here is totally pain free. (Below, left) This third injection of 2 cc in the subcutaneous fat of the middle phalanx is also pain free. The same solution of 1% lidocaine with 1:100,000 epinephrine is used for all injections. (Below, right) The fourth injection of 2 cc in the distal phalanx is used mainly for the epinephrine vasoconstriction effect, as are the other two finger injections.

initial bleeding of the cut settles while the skin flaps are sewn back to expose the tendon and sheath, all bleeding points will dry up.

SURGICAL AND POSTOPERATIVE THERAPY ADJUSTMENTS WITH WIDE-AWAKE FLEXOR TENDON REPAIR

When the proximal ends of the tendon are pulled out to length, patients will sometimes ac-

tively pull the flexor tendon away from the surgeon. This is usually easily dealt with by asking the patient to relax the finger. If that does not work, the patient is asked to actively extend the finger, which reflexly relaxes the involved flexor tendon. The flexor tendon is then brought out to length and skewered into position with 22-gauge hypodermic needles.

In the beginning of our experience with wide-awake flexor tendon repair, the proce-

dures were performed in the main operating room with full sterility but without sedation or tourniquet. We now perform most of our flexor tendon repairs with field sterility in minor procedure rooms, as are 70 percent of Canadian carpal tunnel operations.⁷ The hand therapist attends the operation. She and the surgeon make a postoperative plan that is tailored by what they observe and discuss during the operation.

IMPORTANCE OF ACTIVE FLEXION BY THE PATIENT AS PART OF THE REPAIR PROCEDURE

There are four main reasons why it is important to observe a flexor tendon repair as the patient takes his or her fingers through a full range of active motion *before* the skin is closed: 1. Bunching of the suture inside the tendon with active movement will sometimes create a visible gap between the two tendon ends (see **Video, Supplemental Digital Content 1**, <http://links.lww.com/A657>). It is well known that gapping of flexor tendon repairs will lead to flexor repair rupture. This gapping can be corrected with additional sutures before the skin is closed. It is better to see the suture bunching create a gap during the repair, when it can still be fixed, than after surgery, when it will cause a tendon rupture. 2. With active movement, the repair will sometimes be seen to trigger in the sheath, or not fit through the pulleys at all, both of which can lead to a poor result (see **Video, Supplemental Digital Content 1**, <http://links.lww.com/A657>). These problems can be addressed before the skin is closed by additional epitenon suturing to smooth out the triggering bump of the tendon, or by dividing pulleys to allow the repair to glide smoothly and optimize range of motion. 3. Watching active movement after tendon suturing allows more pulley/sheath preservation. Needles can be passed through tendons inside intact pulleys through small transverse sheathotomies so that the pulleys are not harmed. Verification that the suture has not caught the inside of the intact sheath is confirmed by a full

range of active movement by the patient before the skin is closed. 4. Uninterrupted patient education by the surgeon and hand therapist in totally unседated patients during the operation allows the patient to have a much greater understanding of the importance of postoperative therapy and to practice the postoperative movement regimen in a pain-free state. The surgeon and therapist can observe the tendon repair gliding with movement of the different joints. They can tailor the postoperative movement protocol to what they have seen together of the actively moving anatomy, and also to what is observed in patient behavior during the operation.

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REFERENCES

1. Thomson CJ, Lalonde DH, Denkler KA, Feicht AJ. A critical look at the evidence for and against elective epinephrine use in the finger. *Plast Reconstr Surg.* 2007;119:260–266.
2. Nodwell T, Lalonde DH. How long does it take phentolamine to reverse adrenaline-induced vasoconstriction in the finger and hand? A prospective randomized blinded study: The Dalhousie Project experimental phase. *Can J Plast Surg.* 2003;11:187–190.
3. Lalonde DH, Bell M, Benoit P, et al. A multicenter prospective study of 3110 consecutive cases of elective epinephrine use in the fingers and hand: The Dalhousie Project clinical phase. *J Hand Surg (Am.)* 2005;30:1061–1067.
4. Wilhelmi BJ, Blackwell SJ, Miller J, Mancoll JS, Phillips LG. Epinephrine in digital blocks: Revisited. *Ann Plast Surg.* 1998;41:410–414.
5. Denkler K. A comprehensive review of epinephrine in the finger: To do or not to do. *Plast Reconstr Surg.* 2001;108:114–124.
6. Bezuhly M, Sparkes GL, Higgins A, Neumeister M, Lalonde DH. Immediate thumb extension following extensor indicis proprius to extensor pollicis longus tendon transfer using the wide awake approach. *Plast Reconstr Surg.* 2007;119:1507–1512.
7. Leblanc MR, Lalonde J, Lalonde DH. A detailed cost and efficiency analysis of performing carpal tunnel surgery in the main operating room versus the ambulatory setting in Canada. *Hand* 2007;2:173–178.