Endoscopic Carpal Tunnel Release

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Steven M. Topper

Introduction

The debate in the literature between open and endoscopic carpal tunnel release (ECTR) through the 1990s and into the early part of the twenty-first century was voluminous. In the end we were left with no definitive scientific proof favoring one procedure over the other. Consequently both are still done today. While the controversy has died down, questions still remain. The Academy of Orthopedic Surgeons work group, which created clinical and diagnosis guidelines for carpal tunnel release, expressed in their 179 page report what is generally accepted as the conventional wisdom. They concluded that ECTR was favored for outcome measures of pain, pinch strength, and fewer wound complications at 12 weeks. Open carpal tunnel release was favored for the complication of reversible nerve issues (neuropraxia is less likely with OCTR). There were no differences for functional status and symptom severity at 1 year, including complications or infections [1]. In other words both procedures are equally safe and effective and there is a somewhat quicker recovery with the endoscopic approach in the first 3 months. Perhaps societal issues such as cost effectiveness and quality of life will drive us to seek more definitive answers such as happened with laparoscopic cholecystectomy [2]. Until that time we are left with randomized controlled trials and meta-analyses that generally have insufficient power and inconsistent outcome measures making it hard to draw conclusions [3]. Fortunately, division of the transverse carpal ligament is an effective way to treat carpal tunnel syndrome. The application of minimally invasive (endoscopic) techniques to the most commonly performed orthopedic procedure, back in the 1980s, made sense. The hope was that it would decrease the morbidity of the procedure and yield a quicker recovery. In so doing it may also create a societal cost savings, in light of the number of working young people that have carpal tunnel surgery. Though there is no definitive scientific proof that this has been accomplished there is also no proof that it hasn't. Early on there were major concerns about safety because the technical aspects of the procedure required a relatively new skill set. Triangulation used in all arthroscopic and endoscopic procedures is a universal skillset among orthopedic, plastic, and general surgeons today.

S.M. Topper, M.D. (✉)
Colorado Hand Center, 3470 Centennial Boulevard, Suite 200, Colorado Springs, CO 80907, USA
e-mail: stopper@coloradohandcenter.com

Anatomy

There are several anatomic points that are important to understand in order to perform endoscopic carpal tunnel release safely and effectively.

Transverse Carpal Ligament

Incomplete release of the transverse carpal ligament (TCL) has been touted as a cause for failure of both open and endoscopic carpal tunnel release. From the endoscopic perspective the distal aponeurotic portion of the ligament can be hidden by the fat pad. Additionally, just beyond the distal aspect of the ligament (about 4.8 mm) lies the superficial palmar arch. While striving for a complete release is important this must be done judiciously so as not to cause neurovascular injury. The goal is to maximize volume increase in the carpal canal in order to decompress the median nerve. In a cadaver study Cobb et al. [4] demonstrated that incomplete release of the distal 4 mm of the TCL allows carpal arch widening (volume increase) that is no different from that following complete division of the TCL (Fig. 28.1). So, while complete release is the goal it is not necessary to fight for every last distal fiber and increase the risk of neurovascular injury.

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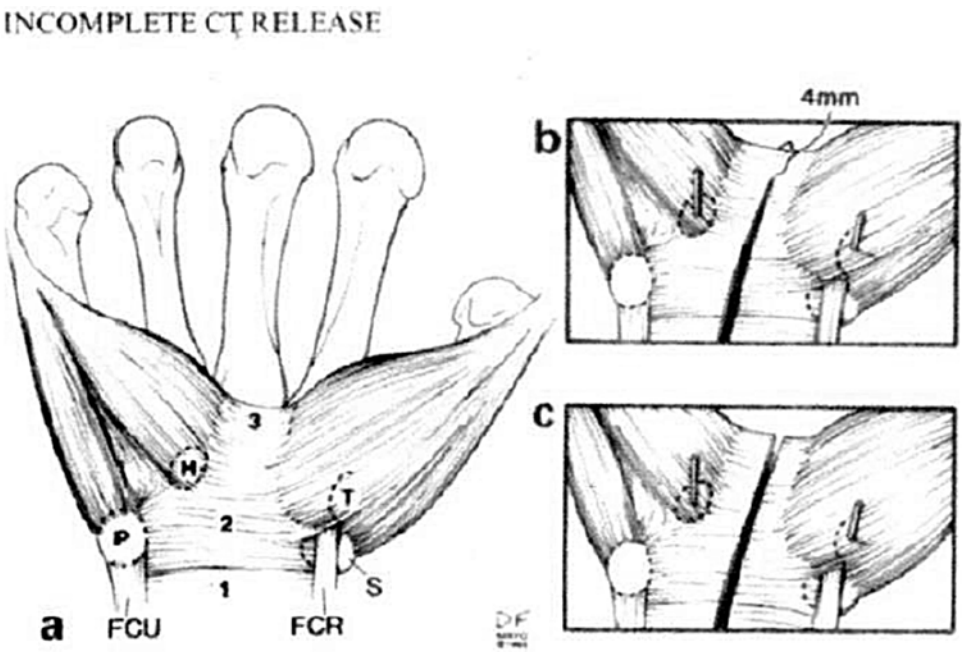

Fig. 28.1 (**a**) Three segments of flexor retinaculum. *H* hamate hook, *T* trapezium, *P* pisiform, *S* scaphoid, *FCU* flexor carpi ulnaris, *FCR* flexor carpi radialis. 1: proximal, 2: middle, true transverse carpal ligament, 3: distal aponeurotic portion of the flexor retinaculum. (**b**) partial release of the flexor retinaculum. (**c**) Complete release of the flexor retinaculum. K wires are shown in hamate hook and trapezium [Reprinted from Cobb TK, Cooney WP. Significance of Incomplete Release of the Distal Portion of the Flexor Retinaculum. J Hand Surg Br. 1994; 19: 283–285. With permission from Sage Publications]

Hook of the Hamate

There is an increased risk of neuropraxia with endoscopic carpal tunnel release. This can be minimized by hugging the ulnar aspect of the carpal canal with the endoscopic instrument. In order to do this effectively and provide for a straight line of pull it is important to place the skin incision in relation to the hook of the hamate. Unfortunately, the hook of the hamate can be difficult to palpate and the use of Kaplan's cardinal line is unreliable. Based on an anatomic study [5] the hook of the hamate can be reliably localized with the technique demonstrated in Fig. 28.2.

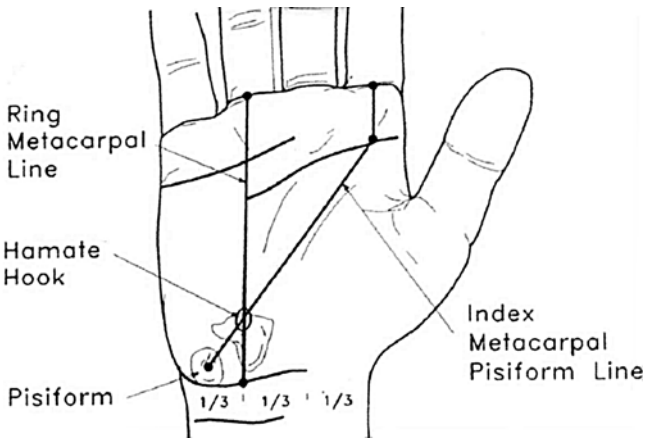

Fig. 28.2 The pisiform is palpated. A line is drawn from this point to the proximal palmar crease at the level of the central aspect of the index finger. A second line is drawn from the central portion at the base of the ring finger to the distal flexor crease of the wrist at the junction of the middle and ulnar thirds. The junction of these two lines marks the location of the hook of the hamate [Reprinted Cobb TK, Cooney WP, An K. Clinical location of Hook of Hamate: A technical Note for Endoscopic Carpal Tunnel Release. J Hand Surg Am. 1994; 19: 516-518. With permission from Elsevier]

Palmar Fascia

Palmar displacement of the flexor tendons after release of the transverse carpal ligament (Bowstringing) has been implicated as a cause for weakness after carpal tunnel surgery. In fact step cut lengthening of the transverse carpal ligament has been advocated to prevent this [6]. The majority of the palmar fascia is not divided with endoscopic carpal tunnel release which provides an uninjured natural tissue barrier to bowstringing.

Transligamentous Branch of the Median Nerve

The recurrent motor branch of the median nerve passes around the distal edge of the TCL in most cases. It also can pass through the ligament in up to 23 % of cases which causes challenges with both open and endoscopic carpal tunnel release [7]. Fortunately, the nerve rarely arises from the ulnar aspect of the median nerve and is therefore rarely encountered. This underscores another important reason to hug the ulnar aspect of the canal when performing endoscopic carpal tunnel release. Anatomic variations such as a persistent median artery or aberrant muscle tendon relationships and dimpling of the TCL should alert the surgeon to the presence of a transligamentous branch. Dealing with a transligamentous branch safely, for both open and endoscopic carpal tunnel release, is about visualization. Therefore the

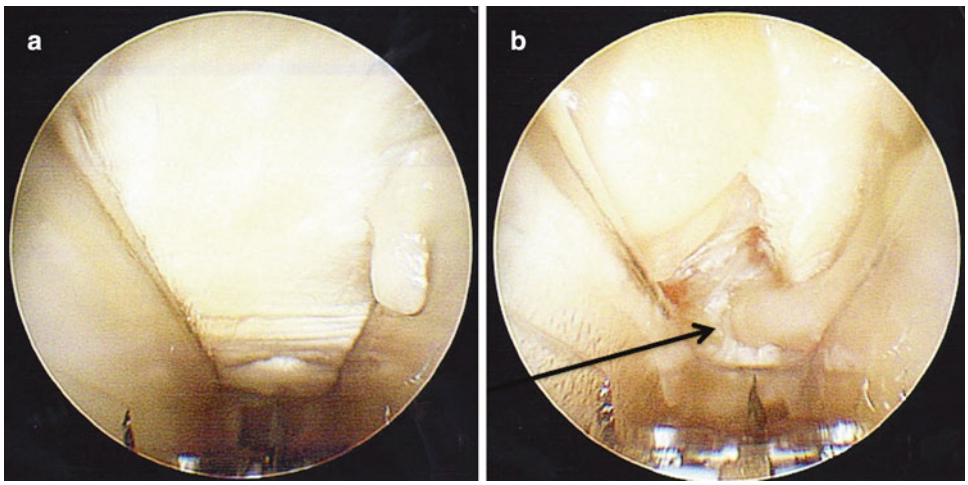

Fig. 28.3 (**a**) Endoscopic view showing a dimple in the distal 1/3 of the transverse carpal ligament. There is a small synovial frond on the *right*. (**b**) Post-division of the TCL. *Arrow* locates the transligamentous branch of the median nerve

presence of a transligamentous branch does not necessarily preclude accomplishing the procedure (Fig. 28.3).

Glabrous Skin

Glabrous skin (palm of hands and sole of feet) is unique in that it has no hair follicles and it is highly innervated. One of the distinct advantages of the single incision approach to endoscopic carpal tunnel release is the ability to place the incision outside of the glabrous skin, avoiding the associated morbidity and potential wound complications. This advantage is lost with the two incision endoscopic technique. Additionally the two incision technique is fraught with a higher complication rate [8].

Exposure

The patient is positioned supine on the operating room table with the arm abducted on a hand table. It is useful to place the hand palm up in a holder or over a surgical towel so that the wrist is extended 15–20° (Fig. 28.4). The hand, wrist, forearm, and the arm proximal to the elbow should be completely exsanguinated using an Esmark bandage. The tourniquet is then elevated to create a bloodless field. The surgeon's hand, when holding the instrument, should naturally align the blade assembly so that it points axially from the ulnar side of the carpal tunnel to the base of the ring finger. This course is anatomically optimal for avoiding injury to the median nerve. Right-handed surgeons will usually prefer a position in the axilla for a right carpal tunnel release and cephalic position for a left release. It is vice versa for left-handed surgeons. The surgeon should be able to easily view the monitor over the assistant's right or left shoulder. General or regional anesthesia is advised so that visualization is not obscured by a carpal canal full of anesthetic fluid.

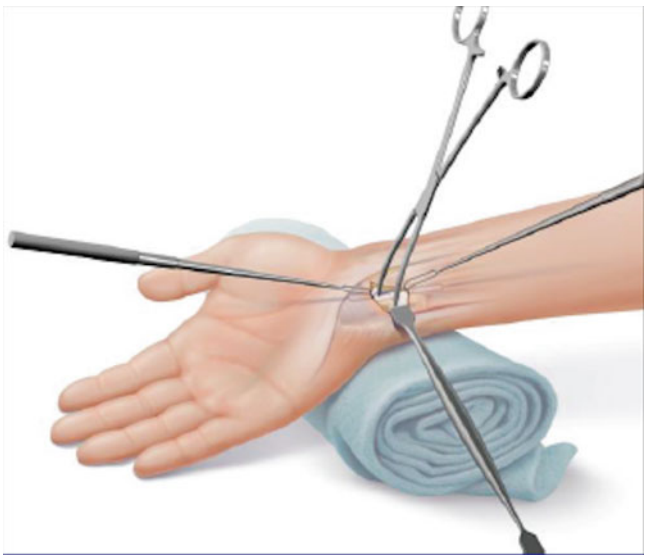

Fig. 28.4 Patient positioning [Reprinted from Centerline Endoscopic Carpal Tunnel Release: Surgical Technique. Arthrex, Inc.; 2010. With permission from Arthrex, Inc.]

The surgical incision is placed transversely in or near one of the wrist flexion creases (usually the proximal) between the flexor carpi ulnaris and the palmaris longus (PL) (Fig. 28.5). If the patient does not have a PL, the radial extent of the incision should be 2 cm ulnar to the flexor carpi ulnaris. The incision is usually 2 cm in length. Veins that cross the incision are coagulated with a bipolar and divided. Placement of the skin incision and the position of the hook of the hamate will set the trajectory of the endoscopic device. Therefore it is advisable to mark out the hook of the hamate, at least initially, as a surgeon is becoming comfortable with placement of the incision.

The soft tissue dissection is started on the radial aspect of the incision and taken directly down to the antebrachial fascia. In this location the flexor retinaculum is closely adherent to the antebrachial fascia. As you move medial and lateral

Fig. 28.5 Incision [Reprinted from Centerline Endoscopic Carpal Tunnel Release: Surgical Technique. Arthrex, Inc.; 2010. With permission from Arthrex, Inc.]

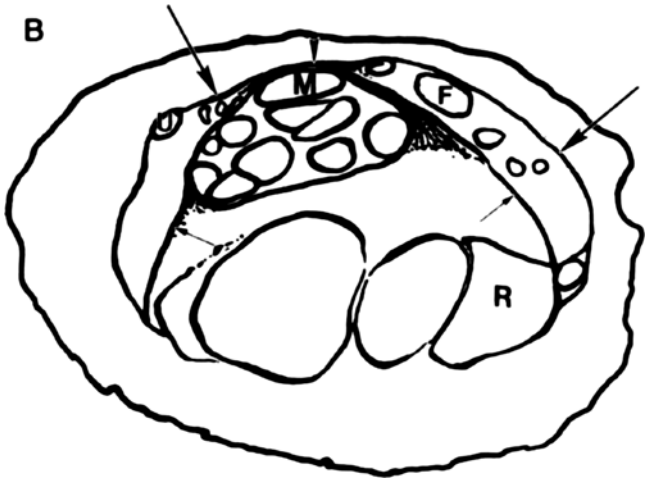

Fig. 28.6 Cross section of the wrist. The flexor retinaculum and the antebrachial fascia are closely apposed anteriorly in the middle (*arrowhead*) and split medially and laterally. *Large arrows* show antebrachial fascia. *Small arrows* show flexor retinaculum. *M* median nerve, *U* flexor carpi ulnaris, *F* flexor carpi radialis [Reprinted from Cobb TK, Dalley BK, Posteraro RH, Lewis RC. Anatomy of the Flexor Retinaculum. J Hand Surg Am. 1993; 18: 91-99. With permission from Elsevier]

from the center these tissues divide and it is much easier to get out of the proper plane of dissection [9] (Fig. 28.6). This dissection is then swept in an ulnar direction. This method reveals a consistent plane that mobilizes Guyon's canal contents, allowing for their retraction out of harm's way. During this portion of the procedure, fascial bands are often encountered that may inhibit the mobilization of these tissues.

This is overcome by simply dividing the restricting fascial bands. Once mobilized the subcutaneous fat and Guyon's canal contents are retracted in an ulnar direction with a blunt retractor. The antebrachial fascia is divided in line with the incision by simply spreading with a blunt tip scissor. It is not necessary to create a U shaped flap as has been advocated, which creates unnecessary surgical trauma. This maneuver creates access to the carpal tunnel. A small two-prong skin retractor is placed on the leading edge of the transverse carpal ligament and used to elevate this structure. This is actually the most important step of the operation. By securing the leading edge of the TCL the exposure is set and should be maintained until the operation is complete.

Preparation

A small Hagar Dilator is then used to dilate the carpal tunnel and create a track for the endoscopic device (Fig. 28.7). The dilator is aimed at the base of the ring finger while holding

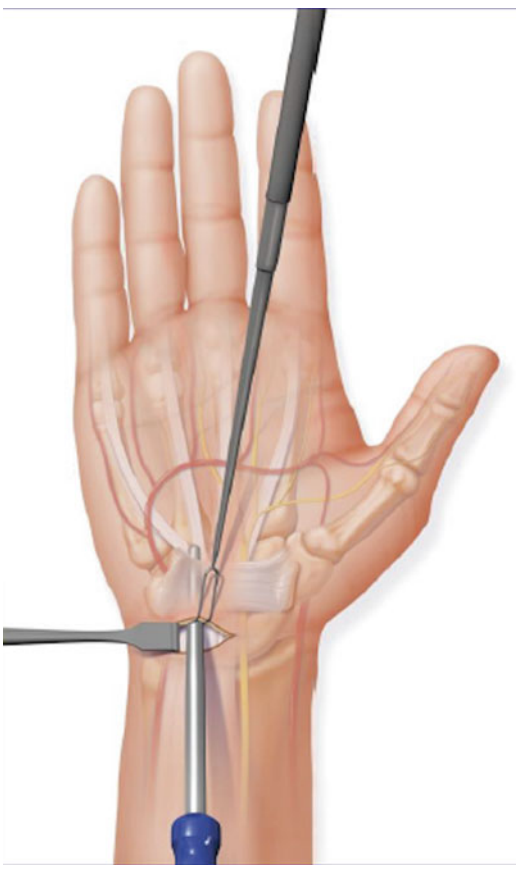

Fig. 28.7 Dilation of the carpal canal [Reprinted from Centerline Endoscopic Carpal Tunnel Release: Surgical Technique. Arthrex, Inc.; 2010. With permission from Arthrex, Inc.]

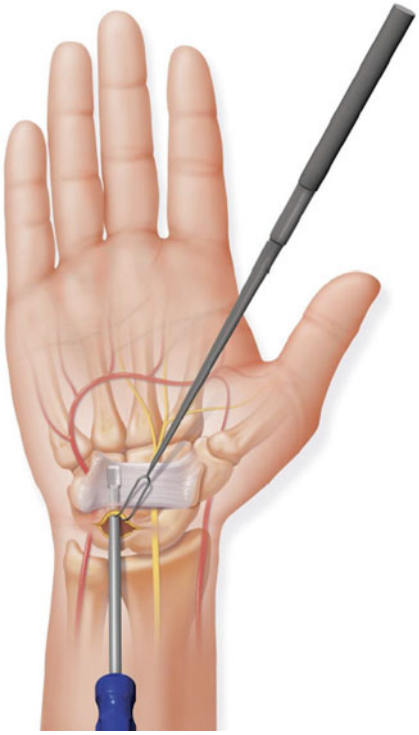

Fig. 28.8 Synovial elevator [Reprinted from Centerline Endoscopic Carpal Tunnel Release: Surgical Technique. Arthrex, Inc.; 2010. With permission from Arthrex, Inc.]

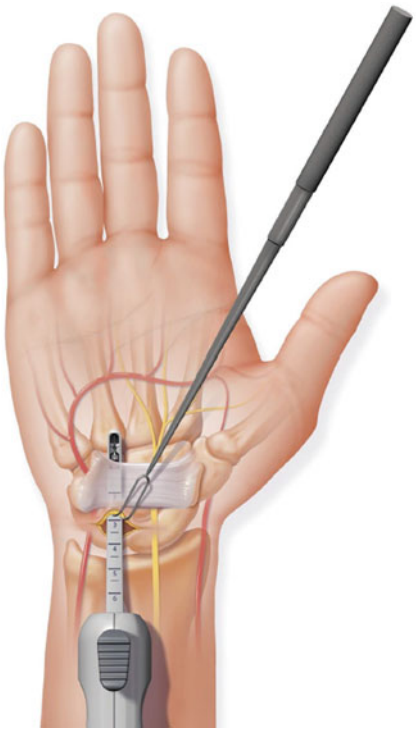

Fig. 28.9 Placement of the endoscopic device, hugging the ulnar aspect of the carpal canal and axially aligned with the ring finger [Reprinted from Centerline Endoscopic Carpal Tunnel Release: Surgical Technique. Arthrex, Inc.; 2010. With permission from Arthrex, Inc.]

the wrist in slight extension. Gently pass the dilator distally down the ulnar side of the tunnel hugging the hook of the hamate, and advancing distally until the tip is past the transverse carpal ligament. This is palpated by the index finger on the surgeon's non-instrument hand. When the dilator is in the carpal canal there is a definite sense of a substantial structure (TCL) between the dilator and the skin. When the dilator is subcutaneous or in Guyon's canal it is distinct and easily palpated. Next a small Synovial Elevator is used to dissect adherent synovium from the underside of the transverse carpal ligament (Fig. 28.8). This is a critical step because the safety of this procedure is directly related to clear visualization of the underside of the transverse carpal ligament. Follow the same path as the dilator and scrape the underside of the transverse carpal ligament from proximal to distal. A noticeable rough, washboard like effect will be felt. The carpal tunnel is now prepared for insertion of the endoscopic device; however, it is important to check for proper blade extension and retraction before insertion into the patient's hand.

Procedure

The endoscopic device is then inserted into the carpal canal (Fig. 28.9). It is important to hug the underside of the TCL and use the leading edge of the device to push synovium out of the way. This is achieved by the surgeon dropping his hand toward the patients arm as soon as the device is inserted and prior to advancing it into the carpal canal. While aiming at the base of the ring finger, advance the instrument distally, hugging the hook of the hamate to assure an ulnar course. Use a sufficient number of proximal-to-distal passes to accurately define an ulnar "strip" of the transverse carpal ligament. Transverse fibers of the ligament should be the only thing visualized in the viewing portal of the device. It is important not to deploy the blade until this level of visualization is achieved (Fig. 28.10). Defining the distal edge of the TCL is assisted by using a digit from the non-instrument hand to ballot in the area of the distal edge previously defined during the dilation of the canal. This demonstrates the transition between the terse TCL and the more pliable distal aponeurotic fibers. Sometimes this can be obscured by the distal fat pad but that doesn't matter because you never deploy the blade into the fat pad! Once a clear path from the distal end of the TCL to the proximal end is confirmed, the blade is deployed distally and the transverse carpal ligament is divided as the device is withdrawn along the previously established path. It is important to ensure that the device hugs the underside of the transverse carpal ligament during this portion of the procedure (Fig. 28.11). It is advisable not to put any downward pressure on the hand with the surgeon's non-instrument hand during this portion of the procedure.

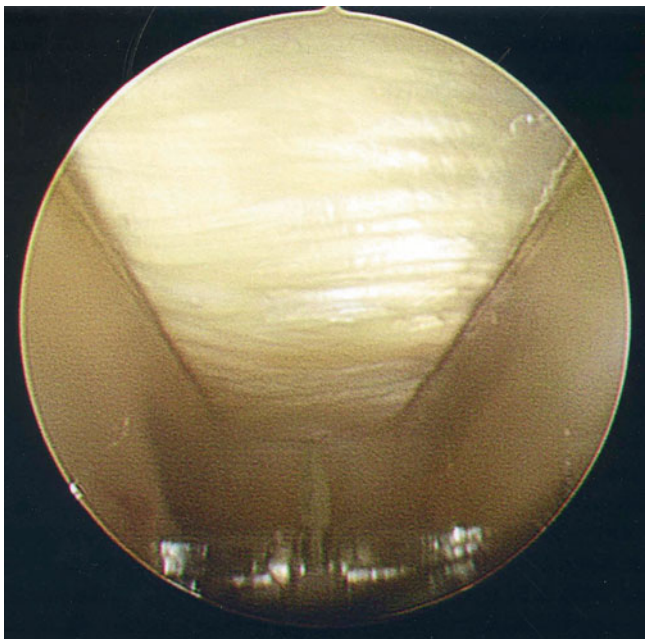

Fig. 28.10 Endoscopic view pre-cut

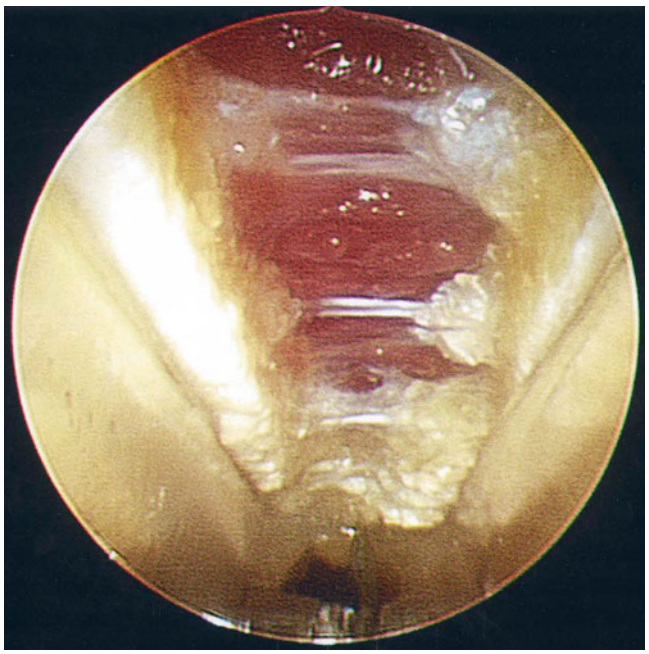

Fig. 28.12 Endoscopic view post-cut

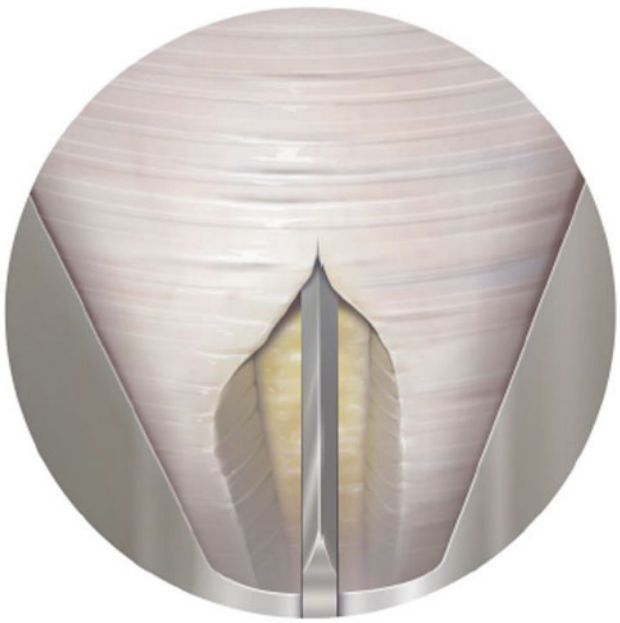

Fig. 28.11 The blade is deployed distally and withdrawn smoothly in one continuous motion dividing the TCL. It is important to hug the underside of the ligament during this motion to keep any surrounding soft tissues out of the viewing portal so that there is nothing for the blade to cut except the TCL [Reprinted from Centerline Endoscopic Carpal Tunnel Release: Surgical Technique. Arthrex, Inc.; 2010. With permission from Arthrex, Inc.]

This helps avoid injury to the ulnar artery as it often takes a more oblique course from the hook of the hamate to the superficial arch than is depicted in standard anatomic textbooks [10].

The device is then reinserted to confirm complete division of the transverse carpal ligament (Fig. 28.12). It should be easier to insert the device after TCL division. The spread of the TCL and consequent stretching of the fat pad will often reveal a few distal fibers initially hidden by the fat pad that are divided at this time. In the past some have advocated a partial ligament resection of the distal portion of the TCL with the first pass. The proximal portion is then cut with a second pass. The completeness of TCL division is then refined and accessed with a third pass. I have found this approach to be unnecessary as minimizing passes with the instrument also minimizes neuropraxia. The procedure is complete when the device can be freely advanced to the mid-palm without obstruction. The device may also be rotated (blade retracted) after a complete release to allow the surgeon to inspect the cut edges of the ligament. In addition to the video monitor image, assess completeness of ligament division by several means; sensing the reduced "pressure" upon the instrument when it is reinserted in a decompressed carpal tunnel; noting the more subcutaneous course of the blade assembly after division; the scope light shining through the skin without obstruction; and inserting a small right-angle retractor and looking directly inside of the released carpal tunnel at the cut edges of the ligament. In some cases there will be a persistent constriction of the proximal forearm fascia on carpal tunnel contents. In these cases, it may be necessary to release the proximal forearm fascia. Using tenotomy scissors, release the forearm fascia proximal to the skin incision, taking care to protect the median nerve.

This prevents the forearm fascia from acting as a constricting band that could continue to compromise median nerve function. I find this to be necessary in about 10 % of cases. The wound is closed with a subcuticular suture or steri-strip which yields the best cosmetic results. During the initial exposure I like to preserve the subcutaneous fat as a vascularized flap if possible. This can then be placed between the antebrachial fascia and the skin to provide for vascularized interposition that minimizes adhesions. It is a good idea to inject marcaine without epinephrine into the carpal tunnel for immediate postoperative pain control. The wound is dressed with xeroform, gauze sponge, and Coban and the tourniquet is released. The Coban bandage is changed to a BAND-AID® before the patient leaves the postoperative holding area.

Aftercare

The wound is kept clean and dry for 5 days. Activity is only restricted by the patient's comfort level as there are no mandatory restrictions. The wound is checked at 2 weeks postoperatively and a final check is performed at 6 weeks postoperatively.

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