ENDOSCOPIC CARPAL TUNNEL RELEASE USING THE SINGLE PROXIMAL INCISION TECHNIQUE

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DESIGN RATIONALE OF THE SINGLE INCISION ENDOSCOPIC APPROACH

The device design and the surgical approach for the single incision endoscopic technique were developed in the Hand Biomechanics Laboratory, Inc., in Sacramento, California. The clinical goal was to decrease postoperative morbidity by using techniques that avoid an incision on the palmar surface of the hand. The surgical approach, accessed through a single incision proximal to the glabrous palmar skin, permits division of the transverse carpal ligament (TCL) while preserving the overlying palmar skin, subcutaneous fat, palmar fascia, and palmaris brevis muscle. The instrumentation evolved through a series of prototypes with surgery being performed on fresh cadaver specimens prior to use in a living patient. The device has a pistol grip and a blade assembly designed to be inserted down the ulnar side of the carpal tunnel (Fig. 1). A rectangular window on the flat upper surface near the tip of the blade assembly permits viewing of the TCL through an endoscope positioned just proximal to the window. The trigger-actuated blade can be elevated selectively to penetrate and cut the ligament during endoscopic viewing. The flat upper surface of the blade assembly is designed to avoid injury to the median nerve and digital flexor tendons when the window is snugly applied to the deep surface of the ligament. A video camera and fiberoptic light source coupled to an endoscope provide viewing similar to that provided by other endoscopic and arthroscopic systems.

The first commercial version of the Hand Biomechanics Lab, Inc, device (3M Company, St. Paul, Minnesota) had a blade design that did not allow viewing of the point of penetration of the blade into the ligament. This limitation, combined with a problem related to blade elevation, led to a voluntary recall of the device. The blade assembly was redesigned to permit viewing of the point of entry of the blade into the ligament, and the device was reintroduced to the market in 1992.

PATIENT SELECTION AND INDICATIONS FOR SURGERY

The overriding principle that dictates patient selection is that this single incision surgi-
Figure 1. The blade assembly is inserted into the carpal tunnel while the patient's wrist is held in slight extension. The viewing window is snugly pressed against the deep side of the ligament. Hugging the hook of the hamate, the instrument is advanced distally while aiming at the base of the ring finger. (From 3M HealthCare, 1992; with permission.)

cal approach is of value in viewing and dividing the TCL but nothing else. The device is not designed to explore the contents of the carpal tunnel.

Patient selection, therefore, requires careful preoperative evaluation designed to exclude those individuals with pathology requiring direct inspection or surgical treatment of their carpal tunnel contents. Excluded are patients with rheumatoid synovitis; fracture, non-union, and congenital malformation of the hook of the hamate; and other unusual carpal tunnel lesions, such as calcific tendonitis deposits of gout or amyloid.

Three studies support the ability of endoscopic release to decompress the carpal tunnel adequately. Okutsu et al. documented a reduction in carpal tunnel pressures to normal after a single incision endoscopic release. Brown et al. found no significant differences in postoperative interstitial pressure after carpal tunnel release by an open technique and by a two-portal endoscopic technique. Peimer et al. using the single incision technique for endoscopic carpal tunnel release and magnetic resonance imaging for volume measurements, demonstrated an increase in the volume of the carpal tunnel to values comparable to those after open carpal tunnel release. These findings are consistent with clinical studies that demonstrate relief of symptoms after endoscopic carpal tunnel release.1-3, 10

SURGICAL TECHNIQUE

The safe performance of this surgical procedure requires a complete and detailed knowledge of the anatomy combined with a commitment to master the technical details of the surgical approach. Doing this procedure necessitates adequate identification and exposure of the underside of the TCL before insertion of the instrument. Only then can the procedure be safely performed. Each surgeon should perform the procedure on a cadaver before surgically releasing a patient's carpal tunnel. During the procedure, if the surgeon has any questions regarding the patient's anatomy, the surgical procedure, or the endoscopic view of the TCL, then the endoscopic approach should be abandoned in favor of a traditional open carpal tunnel release.

Precautions

The snug appositional fit between the viewing window and the deep planar surface of
the transverse ligament defines the focal plane for accurate viewing of the ligament’s collagen bundles. In contrast, the carpal tunnel contents (median nerve, flexor tendons, and their associated synovium) present rounded, compliant surfaces to the viewing window into which they easily protrude during inappropriate exploration with the device. Any of these structures that drop into the window and that are out of the focal plane of its surface project a blurred video image. The image is further compromised when a film of tissue fluid is deposited onto the lens by these protruding soft tissues. Views of the median nerve are suboptimal, and attempts to explore its course will likely result in a neurapraxia. Endoscopic exploration of the skeletal walls of the carpal tunnel compromises viewing of the ligament by disrupting the surgical plane between the synovium and the deep side of the ligament. Surgeons who wish to experience these limitations should do so with a cadaver and not at the expense of their patient.

The Surgical Suite

The operating room setup is designed to offer the surgeon the optimal view of the video monitor (Fig. 2). The surgeon should be able to shift his or her gaze easily from the patient’s hand to the monitor positioned on either side of the surgical assistant.

Anesthesia

A general or regional anesthetic (axillary block or intravenous regional) is strongly recommended. Local anesthesia increases tissue fluid and can compromise endoscopic viewing and cause lens fogging. In our opinion, the procedure can be done safely under local anesthesia only after gaining considerable experience with the surgical approach and the endoscopic instrumentation.

Tourniquet Control

A pneumatic tourniquet secured above the elbow should be used to create a bloodless surgical field. Sterile draping should leave the arm distal to the tourniquet exposed to permit complete exsanguination of the hand, forearm, and elbow.

Skin Incision

In a typical patient with two or more wrist creases, an incision in a more distinct distal crease produces a better cosmetic result, whereas an incision in a more proximal crease is technically easier to use because of thinner subcutaneous fat. An incision made in the more distal crease increases the possibility of inadvertently inserting the device into Guyon’s canal. Some distal flexor creases extend into glabrous palmar skin on their ulnar extent. Wounds in this glabrous skin should be avoided because they and other incisions on the palmar surface of the hand produce tender postoperative scars. Placed between the adjacent borders of the flexor carpi radialis and ulnaris tendons, the incision stops short of the subcutaneous tissues and their cutaneous nerves. A longitudinal spreading dissection is used to protect the subcutaneous nerves and expose the forearm fascia.

The Critical Surgical Plane

Accurate definition of the anatomic plane between the deep (dorsal) side of the TCL and the finger flexor synovium (ulnar bursa) is essential for endoscopic viewing and division of the ligament. Attention spent on the details of this exposure will be rewarded with a clear endoscopic view of the collagen bundles of the TCL free from interposed synovial tissue.

A U-shaped, distally based flap of forearm fascia is incised and elevated (Fig. 3). Palmar retraction of this flap facilitates dissection of the synovium off the deep surface of the ligament and creates a mouth-like opening at the proximal end of the carpal tunnel. All tunneling tools and the endoscopic blade assembly remain aligned with the ring finger, hug the hook of the hamate, and remain snugly apposed to the deep surface of the TCL. This positioning defines a path between
Figure 2. The setup of the suite offers the surgeon the optimal view of the video monitor. The surgeon should be able to shift his or her gaze easily from the video image to the surgical field. (From 3M HealthCare, 1992; with permission.)

Figure 3. The U-shaped flap is elevated in a palmar direction. The synovium elevator, positioned in line with the base of the ring finger and radial to the hook of the hamate, prepares the wrist for the optimal endoscopic view by separating the synovium from the deep side of the ligament. (From 3M HealthCare, 1992; with permission.)
the median and ulnar nerves for the carpal tunnel instrumentation. The synovium elevator is used initially to scrape the synovium off the deep surface of the TCL. Care is taken to avoid sweeping the elevator in a radial direction because it may free the median nerve from the radial half of the ligament, thereby facilitating entry or postoperative subluxation into the cut edges of the TCL. Next, a rounded probe is gently passed down the ulnar side of the carpal tunnel to define a path for the blade assembly.

With the wrist in slight extension, the blade assembly is inserted into the carpal tunnel and its viewing window is pressed snugly against the deep side of the TCL (Figs. 4 and 5). Maintaining alignment with the ring finger, the blade assembly is advanced distally while hugging the hook of the hamate to ensure an ulnar position. Proximal-to-distal passes are used to define the distal edge of the TCL overlapped by several millimeters of fat. Multiple techniques are used to define the distal end of the TCL: the video picture, ballottement, and light through the skin. With the blade assembly correctly positioned, a partially elevated blade touches the distal end of the ligament to judge its point of entry for ligament division. When correctly positioned, the blade is elevated, and the device is withdrawn, incising the ligament.

With the blade retracted, the assembly is reinserted to inspect for completeness of ligament division. When making additional cuts, the window of the blade assembly is positioned in, between, or in and between the cut edges of the ligament to avoid injury to the median nerve. Completeness of ligament division is assessed by multiple techniques in addition to the video image. These techniques include palpation of the divided ligament with the blade assembly and the rounded

Figure 4. The safe zone of blade elevation is a triangle defined by:

a) the ulnar half of the distal edge of the Transverse carpal ligament,
b) the ulnar border of the Median nerve (i.e., its common digital branch to the long–ring web space),
c) Superficial palmar arch.

NOTE: Advancing the window of the blade assembly beyond the distal end of the Transverse carpal ligament may injure (stretch) the communicating branch between the ulnar and median nerves producing residual tingling in the long–ring web space. (See side view.)
Fig. 5. Longitudinal cross section through the carpal tunnel depicting blade elevation in the triangular “safe zone.” Note the relationship to the deep side of the ligament, hook of the hamate, superficial palmar arch, and communicating branch of the ulnar nerve. (From 3M HealthCare, 1992; with permission.)

distal end of the carpal tunnel probe, sensing the reduced pressure on the blade assembly when it is reinserted into the decompressed carpal tunnel, noting a more subcutaneous course of the blade assembly after ligament division, and direct inspection obtained by inserting one or two suitable right-angle retractors into the proximal end of the tunnel.

Alternate Technique to Facilitate Distal Ligament Division

With the original technique described previously, a common technical problem occurs when fat from the heel of the hand drops through the divided proximal half of the ligament and compromises subsequent endoscopic views. By initially releasing only the distal one half to two thirds of the ligament (Fig. 6), the fat superficial to the proximal ligament is prevented from dropping into the wound where it can wipe an oily layer on the lens to spoil the video image. With an unobstructed path for reinsertion of the instrument, distal ligament division can be viewed and completed accurately. A final proximal pass with the elevated blade completes proximal ligament division.

Endoscopic Assessment of the Completeness of the Ligament Division

The normal carpus loads the TCL in tension even in the anesthetized patient. This loading is evident during open carpal tunnel release when the lightest pressure from the scalpel produces division and retraction of collagen fibers in radial and ulnar directions. Several radiographic and magnetic resonance imaging studies quantitate the change in carpal tunnel dimensions secondary to release of this ligament tension. When viewed endoscopically, the partially divided ligament separates on its deep surface creating a V-shaped defect (Fig. 7). Subsequent cuts create
Figure 6. Initial release of the distal ligament, a new technique modification, facilitates an accurate view and division of the ligament. Release the distal one half to two thirds of the transverse carpal ligament completely before making a final pass to release the remainder of the ligament. This technique prevents fat, located superficial to the proximal portion of the ligament, from dropping into the wound and compromising the surgeon’s endoscopic view of the extent of the ligament division. (From 3M HealthCare, 1992; with permission.)

Figure 7. Inspection of the incised transverse carpal ligament in which the left view depicts an incomplete release as a V-shaped defect, with the superficial fibers of the transverse carpal ligament remaining intact. The center view depicts complete release of the ligament after reinsertion of the blade assembly. Fat and transverse fibers of the palmar fascia that remain palmar to the divided ligament can be noted. The view on the right demonstrates that rotation of the blade assembly approximately 20° in either direction causes the separated cut edges of the ligament to fall into the window. (From 3M HealthCare, 1992; with permission.)
a trapezoidal defect that is evident with complete ligament division when the two "halves" spring apart in radial and ulnar directions. The retracted ligament exposes transverse fibers of palmar fascia intermingled with globules of fat and muscle that can be forced to protrude by pressing on the overlying skin. By rotating the blade assembly in radial and ulnar directions, the edges of the ligament "flop" into the window, confirming their complete division and retraction. By palpating the palmar skin over the blade assembly window, motion is observed between the adequately divided TCL and the more superficial palmar fascia, fat, and muscle.

The tension-division-retraction quality of a TCL anchored to the bony pillars of a normal wrist is in sharp contrast to that found in patients with degenerative arthritis of their radiocarpal joints and in fresh frozen (not embalmed) cadaver specimens. The collagen bundles of these ligaments lack a resting tension and are troublesome to cut. When divided, they retract poorly and produce a narrow V-shaped defect; complete division of these ligaments is difficult to evaluate. Similar "relaxed" ligaments may be present in elderly patients that have no obvious clinical or radiographic abnormality of their wrists. These tissue characteristics deserve special consideration in the transfer of cadaver surgery experience to patient care and in the determination of the completeness of ligament division in these specific patients.

**Wound Closure and Splinting**

An intracuticular stitch reinforced with adhesive strips produces a scar that, when mature, is inconspicuous or invisible. The wound is dressed, and wrist splinting is optional. All patients with unsplinted wrists are advised to avoid gripping (pulling) with their fingers with their wrists in flexion until soft-tissue healing is reasonably mature (4 to 6 weeks). This measure minimizes the tendency for the flexor tendons to displace forcefully into the cut edges of the ligament.

**The Value of Endoscopic Carpal Tunnel Release**

In a multicenter randomized prospective study, Agee et al. compared patients treated by endoscopic carpal tunnel release with a control group treated with conventional open surgery. Of the 122 patients, 25 had bilateral carpal tunnel releases, and 97 had unilateral carpal tunnel releases. There were 65 control or open procedures and 82 endoscopic procedures. The best predictors of return to work and activities of daily living after surgery were strength and tenderness variables. For the patients with endoscopic carpal tunnel release in a single hand, the median time for return to work was 21.5 days less than that of the control group (46.5 versus 25 days). When the 21 patients receiving workers' compensation were removed from the data pool, the difference was 29 days (45.5 days for open versus 16.5 days for endoscopic release). As determined from postoperative measurements, endoscopically treated patients lost less pinch strength at 1, 2, and 3 weeks and less grip strength at 2 and 3 weeks (not measured at 1 week) than did control patients, and their strength returned to normal more quickly.

Brown et al. in a prospective randomized study using a two-portal endoscopic technique, studied variables similar to those studied by Agee et al. The study was performed on 169 hands in 145 patients. There were 85 hands in 75 patients treated with open release and 84 hands in 76 patients with two-portal endoscopic release. Among the reported post-
operative evaluations of hand strength were grip strength at 3 and 12 weeks and pinch strength at 3, 6, and 12 weeks. Key-pinck values in the endoscopically treated hands were reported to be significantly greater than values in the openly treated hands; grip strength was not significantly different between the two groups.

Palmer et al, in a single center prospective study, compared single-portal and two-portal endoscopic techniques to open release. In 163 patients, 211 releases were evaluated through 6 months after surgery. Of the 211 releases, 90 were single-incision, 49 were two-portal, and 72 were open procedures. Demographics of the three treatment groups were similar, with no significant differences among the groups with respect to age, gender, or percentage of workers' compensation involvement. Occupational demographics were also similar. Patients treated by endoscopic techniques returned to work significantly sooner than did patients treated with open release. Among the patients in the group that did not receive workers' compensation, those treated with a single incision (Agee) technique had less distal palmar tenderness and were able to return to work significantly earlier than were those treated with the two-portal (Chow) technique. Pinch strength was significantly improved in patients who underwent the single incision technique over patients who underwent open release at 2, 4, and 6 weeks and 3 and 6 months, whereas grip strength was greater at 4 weeks. Pinch strength after surgery with the two-portal technique as compared with open release was significantly greater than in the patients who had open release at 4 weeks only; grip strength was not different at any measured time. No neurovascular injuries occurred in their study.

AVOIDING COMPLICATIONS

Neurovascular Structures Distal to the Carpal Tunnel

Meals and Shaner defined the anatomy of a communicating branch that extends from the ulnar to the median nerve just distal to the carpal tunnel (Figs. 4 and 5). This nerve typically extends parallel and just deep to the superficial palmar arterial arch. In a cadaver study using 28 adult specimens, Rotman and Manske defined the anatomic relationships for endoscopic carpal tunnel release using a single incision endoscopic approach. With the endoscopic instrument aligned with the ring finger axis, the average distance from the distal ligament to the superficial palmar arch was 4.8 mm (range 3 to 6 mm). To avoid postoperative paresthesias in the long-ring web space and injury to the superficial arterial arch, this and other endoscopic carpal...
tunnel devices should never be inserted more than a few millimeters beyond the distal end of the TCL.

While Rotman and Manske\textsuperscript{13} showed a close relationship of nerves to the operating zone, just as in open exposure, these nerves can be retracted (with the endoscopic device) so that the cut can be made safely. As long as the surgeon can see what is being cut and adequately retracts critical tendons and nerves, division of these important structures should not occur.

**Inadvertent Entry of Guyon’s Canal with an Instrument**

Inadvertent entry of Guyon’s canal with an instrument, which may cause an ulnar neurapraxia, is a common complication when using a small “stab wound” for a proximal portal.\textsuperscript{8} This complication can be avoided by using a skin incision adequate to reflect the forearm fascia and to expose the finger flexor synovium immediately adjacent to the ulnar border of the median nerve. This exposure, just ulnar to the palmaris longus tendon, defines the ideal endoscopic plane lying between ligament and ulnar bursa, along an axis adjacent to the hook of the hamate, aimed at the base of the ring finger. From surface anatomy, this exposure extends from a few millimeters ulnar to the middle of the wrist flexor crease to the base of the ring finger.

**Rules for Avoidance of Complications**

One of the authors (ERN) has developed ten rules to help the surgeon avoid injury to critical structures within the carpal tunnel. If these guidelines are followed, injury to critical structures should be avoided.

1. Know the anatomy. This device is not the same as an arthroscope. Many critical structures lie within a few millimeters of the cutting blade. The safe area for ligament transection is in line with the ring finger.

2. Never, never overcommit to the procedure. Despite enthusiasm with this new technique, do not promise the patient an endoscopic release. Technical problems or anatomic abnormalities may prevent endoscopic carpal tunnel release. Patients should be informed at the preoperative visit that the incidence of conversion to an open procedure for patient safety is around 5%.

3. Make certain that the equipment is working properly before beginning the procedure. The light source should be on, a clear image obtained, focus and whiteness adjustments made, the lens defogged, and the blade assembly well secured and properly working. These measures will lessen the chance of technical problems that will obscure the surgeon’s vision and could increase the risk of injury to critical structures.

4. If the scope insertion is obstructed, abort the single incision procedure. An obstruction cannot be seen through the endoscope, and it could be an aberrant branch of the median nerve. To force the blade assembly into the canal could cause injury to such a nerve branch. Convert to an open procedure if this occurs.

5. Be certain that the blade assembly is in the carpal canal (the blade assembly had better not be in the loge of Guyon, which is when damage to the ulnar nerve occurs). Make the initial window through the forearm fascia beneath the palmaris longus tendon and look for the median nerve beneath the fascia. If the skin incision is begun in one of the more proximal volar wrist creases, it is easier to differentiate the volar carpal ligament covering Guyon’s canal from the TCL covering the carpal tunnel (although this approach leaves a less cosmetic scar).

6. If the view is not clear, abort the single incision procedure. Nothing will cause trouble faster than proceeding with division of the ligament without a clear view of the transverse fibers of the ligament. The transverse ligament fibers along a strip the entire length of the canal absolutely must be seen before cutting.
7. Do not explore the carpal canal with the scope. In the first place, nothing can be seen because the soft tissues collapse over the window, and the focal plane does not allow observations of conditions such as median nerve constriction. Second, manipulation of the scope around the canal may cause a neurapraxia or place the blade assembly into the wrong plane. The blade assembly is a retractor used only to view the ligament to be cut and to exclude other critical structures.

8. If the view is not normal, abort the single incision procedure. Unusual anatomy may prevent a clear view of the ligament, or more commonly, a clear distal demarcation of the ligament due to prolongation of fibers of the palmar fascia may be found. Rather than cutting more distally with the blade assembly, thereby risking injury to the superficial vascular arch and the common digital nerves, convert to an open procedure.

9. Stay in line with the ring finger. Draw a line on the skin and stay along this line in preparation of the pathway and cutting. This precaution will keep the blade assembly between the ulnar and median nerves. Because the scope pivots on the hook of the hamate, moving the handle slightly out of line with the ring finger can cause the tip of the blade assembly to swing even more out of line with the ring finger.

10. When in doubt, get out. If for any reason the surgeon is uncomfortable with proceeding, either a problem described previously or not yet reported, the procedure should be converted to an open release. The morbidity with an open procedure will be much less than with a severed nerve.

**DISCUSSION**

Endoscopic carpal tunnel release has an established ability to decrease postoperative morbidity, particularly during the first month after surgery.1-3, 10 Nerve injury2, 4, 8 can only be avoided with a complete knowledge of anatomy combined with an understanding of the principles of the operative procedure.

Endoscopic carpal tunnel release accomplished through a single incision proximal to the palmar skin should produce the least postoperative morbidity. Palmer et al10 reported a significant decrease in morbidity with endoscopic release over open release and with the single proximal incision technique over the two-portal technique. Although other studies have corroborated the

**INCIDENCE OF COMPlications**

To determine incidence of nerve and vessel injury during surgery with the single incision (Agee) technique, one of the authors (ERN) and DP Green surveyed 350 surgeons who attended a training course, and they received 172 responses about 2447 procedures. This survey revealed a 0.4% nerve injury rate and 0.12% vascular injury rate from carpal tunnel release using the original device that was introduced to the market. The nerves most commonly injured with endoscopic release included the common digital nerve to ring and middle fingers, the ulnar nerve, and the median nerve.

Concerns of the authors regarding nerve injuries that occurred with the original blade assembly have been largely relieved by the redesigned blade assembly that permits a view of the blade's point of entry into the tissue. In a prospective study (Agee JM, Peimer CA, Pyrek JD, et al: Endoscopic carpal tunnel release: A prospective study of complications and surgical experience. Submitted for publication, 1993), data were analyzed from 57 centers and 988 patients with 1049 single incision endoscopic carpal tunnel releases; 3-week follow-up data were available for 883 patients. Performed with the improved blade assembly, no device-related complications were confirmed. Minimal complications arose at the time of surgery: 2.5% of the cases were converted to an open release, and 0.2% were converted to the two-portal technique. One patient suffered an injury to the palmar cutaneous branch of the median nerve from the initial skin incision.
value of endoscopic release in decreasing postoperative morbidity, the study by Palmer et al. is the single study that addresses the relative morbidity of all three techniques.

Examination of published data on pinch and grip strength may provide the clinician important insights into the relative advantage to the patient of endoscopic carpal tunnel release techniques. In terms of how quickly function is regained, an interesting trend is shown in the cited prospective studies. This trend is related to the postoperative time at which strength is recovered, as measured by key pinch and grip strength during the first 6 weeks after surgery. Palmer et al. substantiated the findings of Agee et al. that grip strength was significantly greater in single incision patients than in open release patients at 2, 3, 4, and 6 weeks after surgery; pinch strength was also greater at 1, 2, 3, 4, and 6 weeks. The study by Palmer et al. also confirmed the findings by Brown et al. that the two-portal technique did not improve grip strength at any measured time, whereas pinch strength was better at 3, 4, and 6 weeks after surgery in patients who had open release. As reported earlier, the two best predictors of return to work and activities of daily living were strength and tenderness variables. Patients treated by the single incision (Agee) technique had significantly less distal palmar tenderness than did patients treated via open release or the two-portal technique. Thus, among the patients who did not receive workers’ compensation treated by the three carpal tunnel release techniques, it appears that factors related to less tenderness and earlier return of strength in those treated by the single incision technique contributed significantly to their earlier return to work.

**SUMMARY**

The goal of the single incision endoscopic technique is to avoid an incision on the palmar surface of the hand. As compared with open release and the two-portal endoscopic technique for release of the carpal tunnel, this single incision technique permits the patient to return earlier to work and activities of daily living as a result of less tenderness and earlier return of strength.

Safe performance of the technique requires that the surgeon have both a thorough knowledge of the anatomy of the hand and a commitment to master the technical details of the surgical approach. Because the technique is of value strictly to view and divide the TCL, patient selection requires careful preoperative evaluation to exclude those carpal tunnels with pathology that requires direct inspection or surgical treatment. In a prospective study with the redesigned point of entry blade assembly that allows a view of the blade’s entry into the ligament, no device-related complications occurred.

In considering a surgical approach for endoscopic carpal tunnel release, the authors feel that it is important to recognize the value of an “open” proximal surgical incision designed to directly view the plane between the finger flexor synovium and the deep surface of the TCL. Stab wound “portals" that are widely used in arthroscopic surgery are inadequate for endoscopic carpal tunnel releases. The device and the procedure are designed to obtain an unobstructed view of the underside of the TCL and divide it completely. Additional long-term prospective studies are needed to define the comparative recurrence rates of open versus single incision endoscopic carpal tunnel release surgeries.

**References**

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