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Results of 1236 Endoscopic Carpal Tunnel Release Procedures Using the Brown Technique

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ABSTRACT

In a series of 1236 patients who underwent endoscopic carpal tunnel releases using the two portal Brown technique, the results were favorable in 98%, the failure rate was 2%, the instance of iatrogenic injury was 0.08% (one tendon injury), and the overall complication rate was 0.97%. The patients had resolution of carpal tunnel syndrome in an average of 14 days and returned to work in an average of 15 days. Recurrence rate to date has been 2%, with the longest follow-up of 80 months. These results indicate that this is a safe and efficacious method of treatment for patients with carpal tunnel syndrome who require surgery.

INTRODUCTION

Surgical treatment of carpal tunnel syndrome was first described in 1947. An open approach to division of the transverse carpal ligament has been the mainstay of surgical treatment for this condition. With the exception of blindly performed division

of the transverse carpal ligament, open carpal tunnel release requires division of the overlying palmaris brevis muscle, palmar fascia, subcutaneous fat, possibly fibers of the thenar and hypothenar muscle, and skin. Division of these over-lying structures has been cited as a cause for "pillar pain" and delay in the patient's return to work and activities of daily living.

An endoscopic approach to the transverse carpal ligament was first described in 1989. In a double blind prospective randomized study comparing patients undergoing endoscopic carpal tunnel release with those undergoing open carpal tunnel release, the results were found to be superior in the endoscopic carpal tunnel release group with respect to postoperative strength, wound tenderness, and earlier return to work and participation in activities of daily living. The superiority of endoscopic carpal tunnel release was supported further by a study demonstrating that a two-portal procedure is superior to a one-portal procedure. Considerable controversy has arisen regarding the ability to divide the transverse carpal ligament safely and completely using an endoscopic technique.

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Endoscopic Carpal Tunnel Release

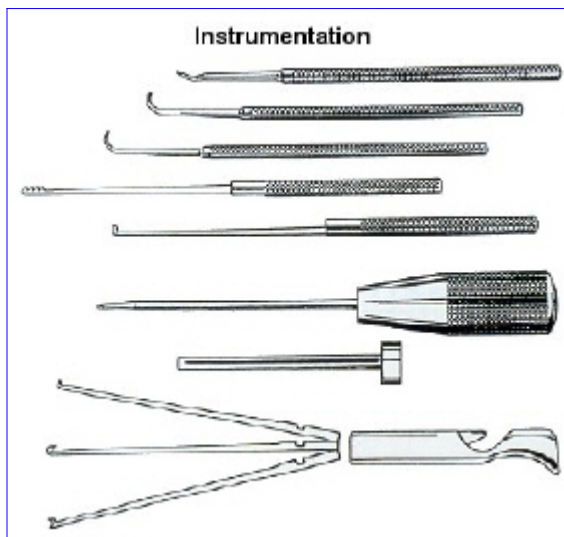


Fig. 1 Diagram of the instrumentation used for the Brown technique of two-portal endoscopic carpal tunnel release.

Two cadaver studies using the technique described by Chow showed an unacceptably high incidence of incomplete ligament division and other technical complications.

A technique for two-portal endoscopic carpal tunnel release is described that is technically easy to perform, and the results with the use of this procedure in of 1236 patients are reviewed.

MATERIALS AND METHODS

The two-portal endoscopic carpal tunnel release procedure was performed using specialized endoscopic carpal tunnel instrumentation (Fig. 1). All patients had electrodiagnostically confirmed carpal tunnel syndrome refractory to nonoperative treatment with anti-inflammatory agents and splinting.

The patient, surgeon, surgeon's assistant, scrub nurse, and video monitor are positioned

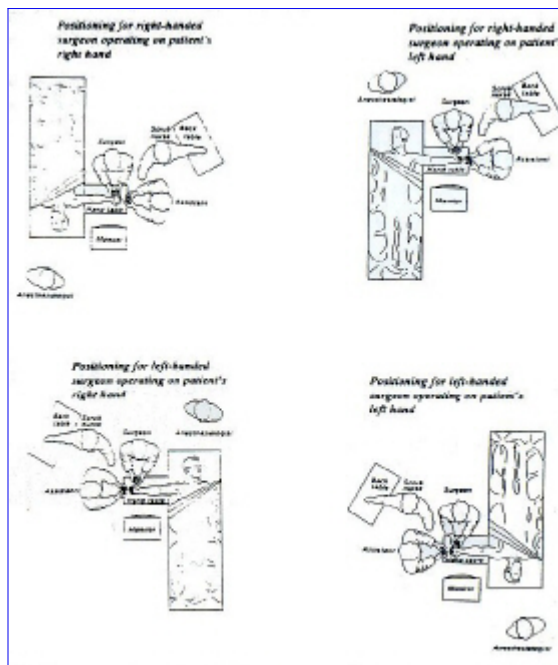


Fig. 2 Diagram illustrating proper positioning of the patient, surgeon, assistant, scrub nurse, and video monitor.

general mask anesthesia is preferable, thereby avoiding the presence of anesthetic agents that could obscure the surgeon's view of the operative field. The hand is placed on a rolled towel, allowing it to fall into gentle wrist extension. A 1cm long proximal incision is marked out in the volar midline (just ulnar to the palmaris longus tendon if present) approximately 1-2cm proximal to the distal wrist crease. If the proximal wrist crease falls within this range, it is used in order to conceal the incision. Two marks are made 3-4cm distal to the distal wrist crease in the mid palm along a line with the third web space. The distal edge of the transverse carpal ligament is located 3.25cm (\pm 5mm) distal to the distal wrist crease. The exit portal is typically within a 0.5cm radius of the distal mark; however, its precise location is determined by palpation of the distal border of the ligament with the

as shown in Figure 2. The surgeon must hold the obturator with the dominant hand, and the video monitor must be placed directly in front of the operating surgeon. All video equipment and instrumentation are checked prior to induction of anesthesia. While the procedure may be performed under IV regional or local anesthesia for patients with medical conditions precluding general anesthesia,

obturator (Fig. 3).

The extremity is exsanguinated and the tourniquet is inflated. There is no advantage to performing this procedure without tourniquet control. The proximal portal incision is made just through the dermis, and blunt tip scissors are used to spread

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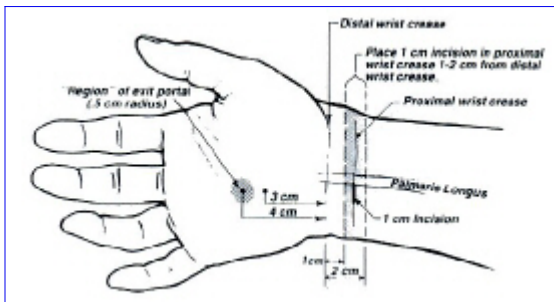


Fig. 3 Diagram depicting the proximal incision site and region of the exit portal.

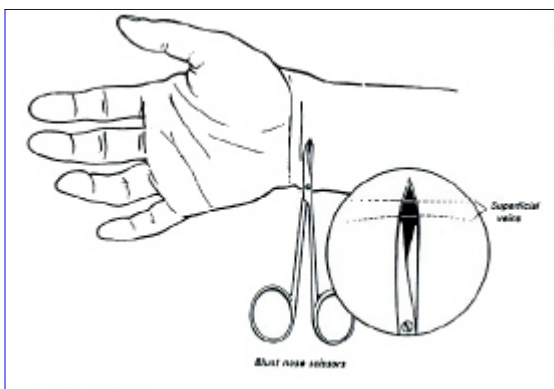


Fig. 4 The proximal portal incision is made just through the dermis, and blunt nosed scissors are used to spread the subcutaneous tissue to the level of the volar forearm fascia, avoiding injury to the superficial veins.

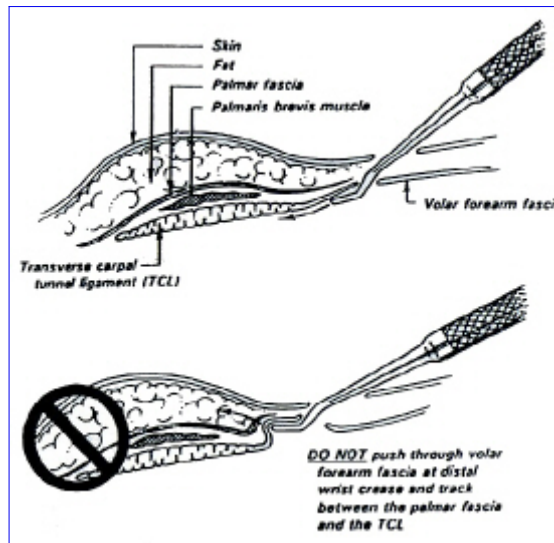
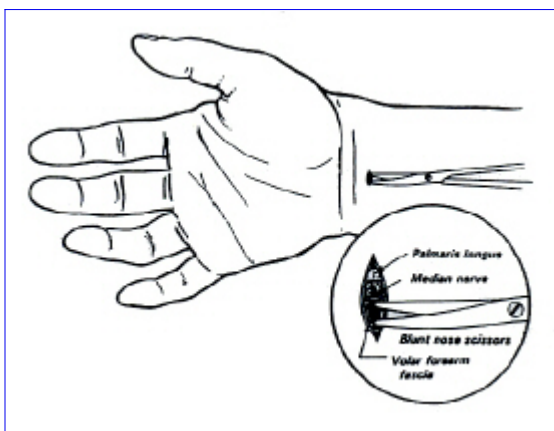


Fig. 6 The synovial elevator is placed under the volar forearm fascia and pushed distally, removing the ulnar synovial bursa from the underside (dorsal) of the transverse carpal ligament.

the subcutaneous tissues to the level of the volar forearm fascia (Fig.4). With the volar forearm fascia visualized, the blunt tips are used to spread the transverse fibers of the forearm fascia, thereby entering the fascia. At this point in the procedure, the median nerve can be visualized in the radial portion of the wound deep to the forearm fascia. If the incision is properly located in the midline, it is not necessary to search for or to retract the ulnar neurovascular bundle (Fig. 5). A synovial elevator is placed under the volar forearm fascia and pushed distally, gently removing the ulnar synovial bursa from the underside (dorsal) of the transverse carpal ligament (Fig. 6). A distinct washboard feel is noted as the blunt synovial elevator slides along the transversely oriented fibers of the ligament.

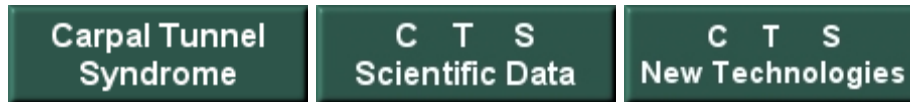
The obturator cannula assembly is then passed beneath the transverse carpal ligament from proximal to distal. The

Fig. 5 The blunt tips of the scissors are used to spread the transverse fibers of the forearm fascia entering the fascia just ulnar to the palmaris longus tendon.

surgeon's nondominant hand is used to hold the patient's hand and place the wrist in neutral position when passing the point just beneath the distal wrist crease. As the obturator and cannula pass under the transverse carpal ligament, ulnar pressure is applied to assure the obturator cannula assembly is radial to the hook of the hamate.

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TABLE I

Key Points of the Brown Technique of Endoscopic Carpal Tunnel Release

The procedure requires a surgeon and a properly trained surgical assistant.

Proper positioning of the surgeon, patient, and video monitor is essential.

The obturator cannula assembly must be held in the surgeon's dominant hand.

Palpation of the distal extent of the ligament is critical for proper positioning of the cannula to avoid incomplete ligament division.

If the ligament cannot be clearly visualized, the procedure should be abandoned in favor of open carpal tunnel release.

It is essential to divide the distal forearm fascia to avoid creating a postoperative area of constriction at the edge of the distal forearm fascia.

The disposable blades should not be reused.

Holding pressure on the wound reduces postoperative bruising; however, some postoperative bruising is common and not unexpected.

A bupivacaine block postoperatively is highly recommended.

Splinting for ten days postoperatively is highly recommended.

Prior carpal tunnel release procedures are a contraindication to performing this procedure.

obturator cannula assembly and confirmed with the endoscopic view, the surgeon inserts the hooked scalpel in the proximal portal, hooks it around the distal margin of the ligament, and divides the ligament with one smooth continuous stroke. The hooked scalpel used in this series of patients was

to perform a volar forearm fasciotomy through the proximal wound, dividing the volar forearm fascia to 4cm proximal to the distal wrist crease (Fig. 10). The subcutaneous tissues must be bluntly dissected from the volar forearm fascia to avoid injury to the superficial veins. This step of volar forearm fasciotomy is important to avoid creating a

designed to divide only the transverse carpal ligament, with minimal or no injury to the overlying palmaris brevis muscle and palmar fascia (Fig. 9).

The endoscope is then passed to ensure complete ligament division, which is confirmed by retraction of the edges of the transverse carpal ligament. The palmaris brevis muscle and the fibers of the palmar fascia can be visualized between the retracted edges of the ligament. The cannula is removed, and scissors are used under direct visualization

secondary site of compression of the median nerve following division of the transverse carpal ligament.

If necessary, bipolar cautery can be used to control superficial bleeders. The skin is closed with two interrupted vertical mattress sutures of 5-0 nylon proximally and a simple 5-0 nylon suture distally. A field block is performed using 10ml of 0.5% plain bupivacaine, taking care to inject

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TABLE II
Results of 1236 Endoscopic Carpal Tunnel Releases Using the Brown Technique

Favorable results	98%
Failures (later required open CTR)	2%
Overall complication rate	0.97%
Iatrogenic injury	0.08%
Median nerve	0
Median motor branch	0
Ulnar nerve	0
Arterial	0
Tendon	1
Reflex sympathetic dystrophy	0.49%
Transient paresthesias	0.40%
Average days until CTS symptoms resolved	14 days
Average days until patient returned to work	15 days
Recurrence (longest follow-up 30 months)	2%

subcutaneously away from the median nerve. After the tourniquet is deflated, direct pressure is applied on both the proximal distal wounds and the midpalm for 1-2 minutes to decrease postoperative bruising.

A bulky dressing and volar splint are applied, positioning the wrist in 30° of extension. The splint is left in place for 5en days postoperatively to prevent entrapment of the median nerve between the edges of the divided ligament, which could result in an increased incidence of recurrence. It is important to avoid flexing the wrist for at least ten days postoperatively. At ten days postoperatively, the sutures are removed, and the patient is allowed to resume unrestricted activities within the limits of discomfort (Table

RESULTS

A favorable result with resolution of the symptoms of carpal tunnel syndrome was achieved in 98% of the 1236 patients in whom this procedure was performed (Table II). The 2% of the patients in this series, no significant change in symptoms was noted following the endoscopic procedure. These patients underwent subsequent open carpal tunnel release and epineurotomy with satisfactory outcomes.

The patients with a favorable result were asymptomatic and able to resume normal activities in approximately 14 days after surgery. Many patients were able to resume clerical type work immediately following surgery, being careful to keep the wrist positioning splint in place. Most patients had little need for postoperative analgesics. The absence of pain or discomfort was so marked in six patients that they were prompted to call the surgeon's office to confirm that the procedure had, in fact, been performed.

Only one iatrogenic injury occurred (0.08%). This was an injury to a flexor tendon (superficialis to the ring finger) that was identified and repaired at the time of surgery. There were no median nerve, median nerve motor branch, ulnar nerve, ulnar artery, or superficial palmar arch injuries. Reflex sympathetic dystrophy developed in six patients (9.49%), and transient paresthesias were noted in five patients (0.4%), resulting in an overall complication rate of 0.97%.

The longest follow-up to date is 30 months. The recurrence rate in this series of patients is 2%, which is comparable to that of open carpal tunnel release.

DISCUSSION

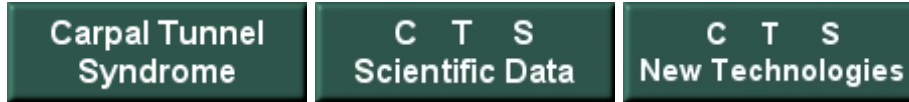
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Since this procedure leaves the overlying muscle and fascia intact (partly due to the smaller size of the hook blade), postoperative pain and recovery time are minimized.

superiority of endoscopic carpal tunnel release (ECTR) compared to open carpal tunnel release (CTR).^{3,4} In this series of 1236 procedures using the Brown technique of ECTR, 98% of the patients were successfully relieved of their carpal tunnel syndrome symptoms, with only a 0.97% complication rate, indicating that this procedure can be performed safely with excellent results.

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No significant improvement in symptoms was achieved in 2% of these patients, who subsequently underwent open CTR. None of these patients were found to have incomplete division of the transverse carpal ligament; instead they had a thickened epineurium and ultimately benefited from epineurotomy. These results uphold the findings of other investigators that in most cases decompression of the median nerve by division of the transverse carpal ligament alone is sufficient to relieve carpal tunnel syndrome symptoms without performing internal neurolysis of the nerve.⁷ The findings in this series suggest that a subset of patients (5%) have a thickened epineurium and will not benefit from division of the transverse carpal ligament alone. However, the results in this small subset of patients do not outweigh the benefit received by the remaining 98% of patients.

There were no injuries to nerves or arteries, which is a primary concern. The absence of injuries to the median nerve, median motor branch, ulnar nerve, ulnar artery, and palmar arch were a result of proper positioning of the obturator cannula assembly to isolate the structure to be divided (transverse carpal ligament) from neurovascular structures. The iatrogenic injury to the flexor tendon probably occurred because the obturator cannula was inserted into the proximal portal at an acute angle, causing the tendon to become looped about the cannula. Careful insertion of the obturator/cannula assembly parallel to the forearm should avoid this complication. The incidence of reflex sympathetic dystrophy was similar to that in reports of open carpal tunnel release procedures. The five transient paresthesias reported were encountered early in the study period when larger diameter instrumentation was being used. Transient paresthesias have not been noted with the

In this two-portal technique, the transverse carpal ligament is tented volarward by the cannula and effectively excluded from neurovascular structures. In our opinion, such isolation of the ligament cannot be accomplished in one-portal techniques because the distal end of the instrument (whether a sheath with a push blade or a scalpel containing a nose piece) must be positioned at what endoscopically appears to be the distal border. In addition, the air foil shape of the transverse carpal ligament (thick in the middle, tapered at the ends) precludes placing the end of the on-portal instrument flush against the distal edge of the ligament. Therefore, the common digital nerve to the third web space ulnar artery and ulnar nerve, which are located within 0.5 to 1.0cm from the distal border (forming a triangle), can easily be interposed between the scalpel of the on-portal device and the ligament.

These findings are based on the successful experience of the authors with 149 one-portal procedures. While on-portal procedures can be performed satisfactorily, they are inherently more dangerous, require greater operator expertise, are more difficult to learn, and offer no significant advantage over two-portal techniques.

Just as there are variations in the technique of performing open carpal tunnel release and therefore a variability in the outcome, there is a similar developing trend of variations in endoscopic carpal tunnel release procedures. Therefore, future reports are likely to differ with regard to the safety and effectiveness of endoscopic carpal tunnel release procedures. Because one-portal procedures do not effectively exclude neurovascular structures from the operative field, they are inherently more dangerous than two-portal techniques.⁴ In addition, one-portal procedures and other

use of smaller instrumentation.

In a prospective randomized study in which a one-portal technique was used, two patients experienced ulnar neurapraxia, and no injuries to the median nerve or superficial palmar arch were reported. However, median nerve injuries have been reported in patients outside the study group.³ In another one-portal technique, a large dilator (7mm) is used that may cause neural compression and resultant paresthesias. In addition, there is a greater risk of inadvertently cutting neurovascular structures with push blade division of the ligament because it does not afford the control provided with the use of a hook scalpel to cut retrograde.⁸

more complex two-portal techniques may be more difficult to perform safely and effectively.^{9,10}

CONCLUSION

An endoscopic carpal tunnel release procedure is described that has been performed safely in 1236 patients, resulting in rapid return to work and participation

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activities of daily living. These improved results provide an indirect savings to the patient, employers, and insurance carriers because of decreased cost of postoperative therapy, decreased time lost from work, and decreased cost of worker's compensation benefits. Most importantly, patient morbidity was reduced. The results in this large group of patients indicate that the two-portal endoscopic carpal tunnel release technique using the instrumentation described in this report can be performed safely and successfully with minimal risk of iatrogenic injury in patients who require surgical decompression of the median nerve in the carpal tunnel.

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