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ORIGINAL ARTICLES

Endoscopic treatment in carpal tunnel syndrome

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Abstract: *Carpal tunnel syndrome is currently the most common peripheral nerve compression neuropathy that affects approximately 1% of the population [7,8,9]. The incidence of CTS seems to be increasing. The diagnosis is based on clinical symptoms and electrodiagnostic studies.*

Keywords: *endoscopic, carpal tunnel, median nerve, compression*

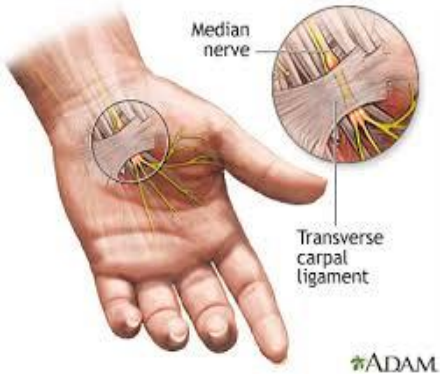
INTRODUCTION

Definition

Carpal tunnel syndrome is the compression of the median nerve in the wrist (radiocarpal joint and palm) and the most common neuropathy in the upper limb. Paresthesias, especially nocturnal pain, numbness and weakness of the hand, tingling, atrophy of the thenar muscles are the most common clinical signs of CTS in addition to the Tinel sign, the Phalen and Durkan test, ultimately leading to severe damage to the hand and forearm [1].

Anatomy

The Carpal tunnel consists of the carpal bones and the transverse carpal ligament that forms the roof of the tunnel and extends from the hamat bone (hook bone) and triquetrium (pyramidal bone) on the ulnar side to the scaphoid and trapezium on the radial side. The carpal bones are located in 2 rows (from radial to ulnar); proximal row: scaphoid, lunate, triquetrium, and pisiform bone, distal row: trapezium, trapezoid, capitate, and hamat. Through this canal pass the median nerve which is accompanied by the artery of the median nerve wrapped in a "perinerv" sheath and the flexor tendons which are wrapped by the synovial sheath which helps the proper functioning of the flexor apparatus under normal conditions. (long thumb flexor, four superficial flexors of the fingers, and four deep flexors of the fingers).



Also at the wrist, there is a canal where the ulnar vascular-nervous package passes called the Guyon canal, which may or may not be affected at the same time as the carpal tunnel syndrome.

Etiology

Among the causes of CTS are: idiopathic, hereditary,

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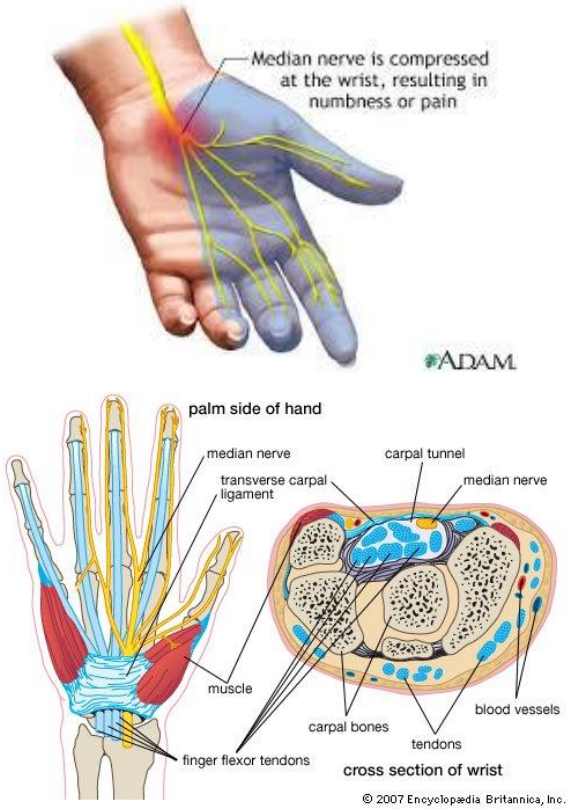
infectious, endocrinological, metabolic, hematological, renal, rheumatic, traumatic, tumor.



Diagnostic

It is put in principle on the clinical signs, the Tinel sign, the Phalen and Durkan test, then it is passed to the paraclinical analyzes: electromyography (EMG), nerve conduction speed, radiology, ultrasound, MRI, laboratory blood tests.

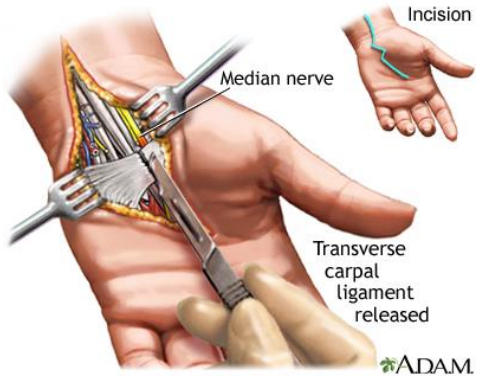
The costoclavicular Adson and Wright tests are used to exclude chest compression syndrome that can mimic CTS. Cervical examination, including the Spurling test, is essential to exclude cervical radiculopathy. The percussion of all the primary peripheral nerves can lead us to an unexpected area of compression [2].

A study of nerve conduction speed and electromyography is performed. They help us to confirm the diagnosis of CTS and to exclude other patho-logy[3].

Basic x-rays of the wrist are useful in detecting unexpected pathology.

TREATMENT

Over time, several treatment methods have been tried; conservative by rest and immobilization, treatment with topical or infiltrated anti-inflammatory drugs in the carpal tunnel (in rare cases), and surgical treatment by a classical or endoscopic technique that have proven effective compared to conservative treatment which is considered a way of delaying surgery; Surgical treatment by classical technique involves a curved longitudinal incision parallel to the tenerian crease for prolonged sometimes proximal zigzag to forearm through the flexion creases of the wrist to relax the forearm fascia, external or internal neurolysis, sinevoectomy or remove any formations that can compress the median nerve, sectioning TCL from proximal to distal on the ulnar side to avoid injury to the thenar motor branch, hemostasis control, skin suture, dressing, and immobilization. Risks including pillar pain, weakness in the hand, sensitivity to scarring, delayed return work and slower return to office, relatively long recovery period, and the risk of adhesions. This technique has proven good over time, but because medicine is evaluating and we are continuing our search for new techniques and procedures to minimize risk and recovery time, we will present endoscopic surgical treatment.



History of carpal tunnel endoscopy

Interest in less invasive open procedures for treating CTS developed in the early 1980s. Paine [4], a neurosurgeon, used a retinaculatom to divide TCL through a small transverse incision in one of the creases of the wrist. However, he found a 2.5% incidence of the incomplete division of the TCL. There were four cases of palmar hematoma, most likely developed due to superficial palmar arch injury. Pagnanelli [5] reported the use of retinaculatom in 577 patients and had only two incomplete divisions (0.3%) of TCL with no median or vascular nerve injuries.

In the history of carpal tunnel endoscopy, 2 main techniques for relaxing the carpal tunnel have been described; "One portal procedure" and "duel portal procedure". The first endoscopic technique was introduced in the relaxation of the carpal tunnel "one portal procedure" in 1986-1987 by Okutsu, a Japanese orthopedist, and in 1989 the technique

"Duel portal procedure" was introduced by Chow, an orthopedist. the two techniques had modifications and developments by other doctors (Agee, Menon, Worseg, Brown, Tsai Resnik, and Miller...) but remained in 2 categories: one portal procedure and duel portal procedure.

Indications

The indications are similar to those of classical technique and include the severity of symptoms, duration of symptoms, ineffective response to conservative treatment.

Relative contraindications

Include patients with severe CTS with evidence of muscle atrophy, rheumatoid arthritis, previous surgical treatment of repeated CTS !!, significant loss of wrist extension, proliferative synovitis, and lesions invading the carpal tunnel [2].

Endoscopic surgical technique

One portal procedure (Agee's technique modified):

Following the inflation of a tourniquet with the initial recommendation of general or regional anesthesia, then with the evolution of the surgeons' experience, they started to use local anesthesia with or without sedation, a 2-3 cm incision is made in one of the flexion creases of the wrist between ulnar carpal flexor and radial carpal flexor. Longitudinal subcutaneous dissection exposes the forearm fascia.

A U-shaped incision is made on the forearm fascia, creating a rectangular flap based distally on the TCL. While the flap is raised, a synovial lift is placed under the TCL [6]. An instrument (a kind of dilator) is inserted into the carpal tunnel to create a path for the blade assembly. The blade endoscope assembly is then inserted into the carpal tunnel and is passed distally to the distal edge of the TCL. A few steps are usually required to obtain an adequate definition of TCL. After defining the distal edge of the ligament, the tip of the instrument (along with the blade) is placed distal to the edge of the TCL. After checking the correct positioning, the trigger mechanism is activated and the blade is engaged and raised to 3.5 mm above the assembly at an angle of 80° [6]. The instrument is retracted, and under direct view, the TCL is split in a distal to proximal direction. With the blade retracted, several passes can be made to check the ligament transection. If necessary, the blade can be coupled and the remaining TCLs can be sectioned. Then, a proximal volar antebrachial fasciotomy is performed, followed by standard closure of the wound.

Dual portal procedure (Chow's technique and its modifications):

His original technique involved a transbursaral approach to the carpal tunnel. The surgeon and the nurse should sit in front of each other at the hand table. A TV monitor is placed behind each surgeon so that both can have a complete view of the procedure. A transverse incision of 1 cm is made at 0.25 cm proximal and 0.25 cm radially from the pisiform bone. Chow later modified his technique by changing the landmarks of the proximal incision [3, 7, 8]. He recommended that the proximal portal be made by drawing a transverse line of 1 to 1.5 cm radially from the proximal pole of the pisiform bone. A second line is longitudinally marked 0.5 cm from the end of the first line. A third line is transverse 1 cm to the radial from the end of the second line to indicate the entrance portal. A longitudinal incision is made on the forearm fascia, taking care to protect the artery and the ulnar nerve. The flexor tendons are exposed (trans-bursal) and retracted towards the radial part, finding the space between the ulnar neurovascular bundle and the flexor tendons. A trocar is inserted, and the wrist is placed and held in hyperextension by a special hand frame. Using the tip of the trocar, feel the base of the harness hook, then lift it and feel it, if you feel the cannula means it is above the TCL or in the Guyon channel and must be removed and reinserted into the channel under the TCL. A second incision (the palmar one) is made is distal to the distal edge of the carpal transverse ligament along the long axis of the ring finger. The endoscope is inserted proximally into the trocar, which has an end that is immediately below the TCL. Steps are taken to ensure that only the transverse fibers that makeup TCL are visible and not tendons or nerves. The endoscope is inserted into the proximal incision and advanced to the distal edge of the TCL. A knife inserted through the second incision (palmar incision) is used to cut the distal edge in a proximal direction up to half the ligament. To complete the release of the TCL, the endoscope

is inserted into the distal opening. The knife is used to cut the proximal edge of the TCL, and the retrograde knife is inserted into the middle section and advanced proximally to complete the release. The wounds are sutured, a simple dressing is applied, and the sutures are removed after one week postoperatively. Because the transbursive technique frequently produced ulnar neuropaxia, either due to withdrawal pressure or the cannula, the technique was modified by Resnick and Miller [9] in a subligamental or extracurricular approach. In this technique, the forearm fascia is incised proximal to the TCL, and the dissection is made under the fascia and in the carpal tunnel under the ligament, avoiding the flexor tendon bursa. The rest of the operation is performed in a similar way to the Chow method.

In our clinic, we use the endoscopic technique "one portal procedure" (Figures 1 to 6).

Figure 1: Surgical instruments for carpal tunnel endoscopy @ byDr.HazimElayan

Figure 2: Preoperative marking lines @ byDr.HazimElayan

Figure 3: Endoscope inserted into the carpal tunnel through an incision of about 1.5 cm @ byDr.HazimElayan

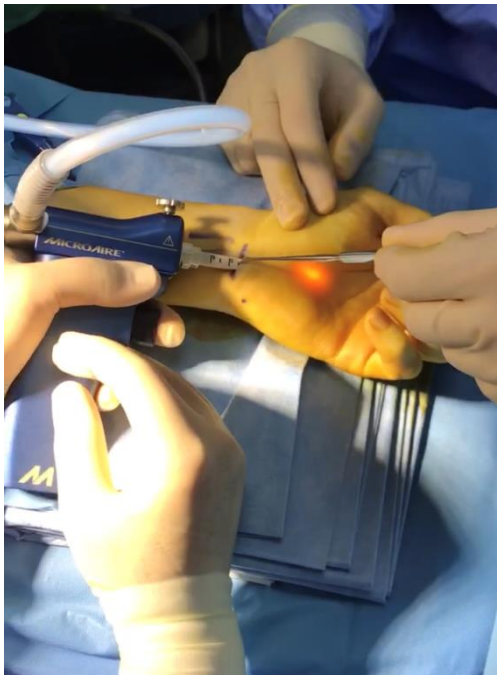


Figure 4: Transverse carpal ligament visualized on the monitor through the endoscope @ byDr.HazimElayan

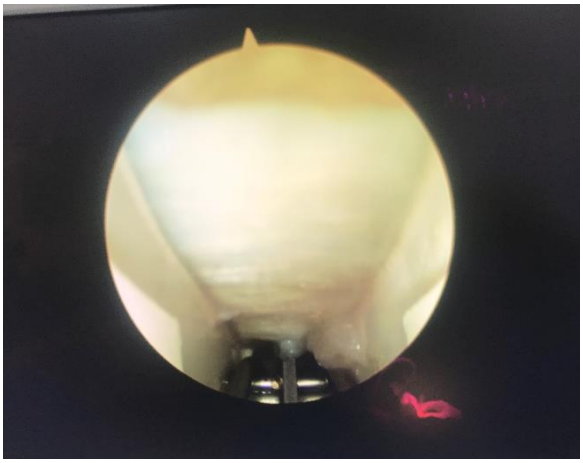


Figure 5: Sectioning the transverse carpal ligament, the remains of fibers that are sectioned by repeating the endoscope blade 2-3 times until complete sectioning @ byDr.HazimElayan

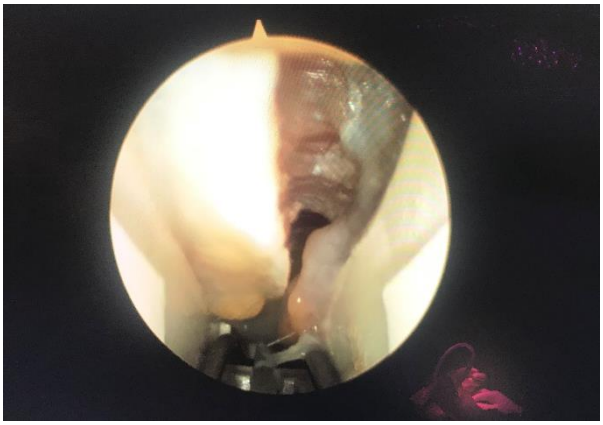


Figure 6: The end of the intervention, skin suture. @ byDr.HazimElayan

COMPLICATIONS

Endoscopic carpal tunnel release-specific adverse events have been described and are listed here to avoid these possible complications.

1. Nerve injury:

This usually involves the digital nerve of the middle and/or ring finger, which are in a straight line coinciding with the insertion of the endoscope [10, 11, 12].

2. Lesion of the superficial palmar arch:

Because the distance between the superficial palmar arch and the distal edge of the transverse carpal ligament is approximately 9.4±3.5 mm [11, 13], insertion of the endoscope too distally should be avoided.

3. Flexor tendon injury:

This is due to an absence of experience using the endoscope and most commonly affects the superficial flexor tendon of the ring finger, typically a risk in the one-portal procedure [11, 12].

4. Penetration of the Guyon Canal:

This can injury the nerve or the ulnar artery [11].

5. Incomplete sectioning of the TCL

The only recognition of this may be the persistence of carpal tunnel syndrome symptoms in the postoperative period [11].

Benefits (advantages)

Minor postoperative pain, faster recovery, no immobilization of the hand, minimal scarring, faster return to work.

Disadvantages

Higher cost. inability to excise the formation or other structures that may compress the median nerve.

CONCLUSIONS

1.It is a modern technique that requires a special professional experience of the surgeon.

2.It is a minimally invasive technique with the protection of noble elements (vessels, nerves, and tendons) at this level (from the radiocarpal joint and palmar).

3.Recovery of the hand-operated much faster with endoscopic technique (does not require immobilization, rapid socio-professional reintegration).

4.The duration of surgery in an experienced surgeon is much shorter than with the classical technique.

References:

1. Durkan JA. A new diagnostic test for carpal tunnel syndrome. J Bone Joint Surg Am. 1991;73:535–538.

2. Endoscopic Release of the Carpal Tunnel: A 2-portal-modified Technique. Enrique E. Pereira, MD,* Diego A. Miranda, MD,w Ignacio Sere´, MD,z and Guillermo Arce, MD*. Tech Hand Surg 2010;14: 263–265

3. Chow JC: The Chow technique of endoscopic release of the carpal ligament for carpal tunnel syndrome: four years of clinical results. Arthroscopy 9:301-314, 1993

4. Paine KWE, Polyzoidis KS: Carpal tunnel syndrome. Decompression using the Paine retinaculotome. J Neurosurg 59:1031-1036, 1983

5. Pagnanelli DM, Barrer SJ: Carpal tunnel syndrome: surgical treatment using the Paine retinaculatome. J Neurosurg 75:77-81, 1991

6. Agee JM, McCarroll HR, North ER: Endoscopic carpal tunnel release using the single proximal incision technique. Hand Clin 10:647-659, 1994

7. Chow JC: Endoscopic carpal tunnel release. Two-portal technique Hand Clin 10:637-646, 1994

8. Chow JC: Endoscopic release of the carpal ligament for carpal tunnel syndrome: 22-month clinical result. Arthroscopy 6:288-296, 1990

9. Resnick CT, Miller BW: Endoscopic carpal tunnel release using the subligamentous two-portal technique. Contemp Surg 22:269-277, 1991

10. Okutsu I, Hamanaka I, Yoshida A. How to perform endoscopic carpal tunnel release with fewer complications using the USE system. J Jpn Soc Surg Hand. 2005;22:1–5.

11. Frontiers in Endoscopic Plastic Surgery Guest Editor Geoffrey G. Hallock M.D.The Japanese Experience with Endoscopic Carpal Tunnel Release Kazufumi Sano, M.D.1. 10.1055/s-2007-1019141

12. Ikeda K, Okada K, Tomita K, Yoshimura M, Tamauchi S. Complications of the one portal endoscopic carpal tunnel release. J Jpn Soc Surg Hand. 1997;14:650–653.

13. Kunou M. An anatomical study of the carpal tunnel for endoscopic carpal tunnel release. J Jpn Orthop Assoc. 1994;68:878–884..