Mini-open Carpal Tunnel Release: Clinical Outcome and Surgical Technique in 48 cases

Técnica “Mini-open” para liberação do Túnel do Carpo:

Resultado e Técnica cirúrgica em 48 casos.

Paulo Henrique Pires de Aguiar1,2,3
Carlos Alexandre Martins Zicarelli1,2,3
Fábio V.C. Sparapani1
Pedro Augusto de Santana Jr.1,2,3
Alexandros Theodoros Panagopoulos1,2,3
Marcos Vinicius C. Maldaun1,2,3
Carlos Emanuel Petito3
Adriana Tahara1,2,3

ABSTRACT

Introduction: Median nerve compression is the most common nerve entrapment syndrome. After carpal tunnel release, patients often complain about the scar cosmetic appearance.

Objective: The aim of our study was to evaluate the clinical outcome, surgical technique and complications of mini-open carpal release.

Methods: We reviewed data from 48 surgical procedures for Carpal Tunnel Syndrome in 32 patients at the Pinheiros Neurological and Neurosurgical Clinic in the period of 2000 and 2008. The mean age was 49 years-old. We used a 2 cm incision and microscopic technique to obtain meticulous access of the palmar hand anatomy with special attention to both the recurrent motor branch and palmar cutaneous nerve.

Results: Twenty-two patients had total resolution of symptoms. Two patients had no change of neurological symptoms. During the follow up no infection or neurological deficits were observed.

Conclusion: Mini-open is a safe and effective approach for carpal tunnel syndrome release. However detailed palmar hand anatomy is mandatory to prevent lesion of branching palmar nerve. The use of microscope is desirable to help identify important structures and avoid complications.

Key-words: Carpal Tunnel Syndrome, Mini-open Surgery, Phalen’s Sign, Carpal Tunnel Syndrome Descompression.

SUMÁRIO

Introdução: A compressão do nervo mediano é o acometimento mais comum das afecções que envolvem os nervos. Depois da liberação do túnel do carpo, os pacientes se queixam frequentemente da aparência cosmética da cicatriz.

Objetivo: O alvo de nosso estudo foi avaliar o resultado clínico, técnica cirúrgica e as complicações da realização do mini-open para a liberação do túnel do carpo.

Métodos: Foram revisados dados de 48 procedimentos cirúrgicos para a síndrome de túnel de carpo em 32 pacientes na clínica Neurologia e Neurocirúrgica de Pinheiros entre 2000 e 2008. A idade média foi de 49 anos. Foi utilizada uma incisão de 2 cm e o uso do microscópio foi necessário para obter o acesso meticuloso da anatomia palmar da mão, com atenção especial para o ramo motor recorrente e o nervo palmar cutâneo.

Resultados: Vinte e dois pacientes tiveram resolução total dos sintomas e dois deles não tiveram nenhuma mudança de sintomas neurológicos. Durante o estudo, nenhuma infecção ou déficits neurológicos foram observados.

Conclusão: Mini-open é um procedimento seguro e eficaz para a liberação do nervo na síndrome de túnel do carpo. Entretanto, a obtenção da anatomia palmar detalhada é mandatória para a prevenção de lesões dos ramos nervosos da região palmar; o uso do microscópio é fundamental para ajudar a identificar estruturas e evitar possíveis complicações.

Palavras-chaves: Síndrome de túnel de carpo, Mini-open, Sinal de Phalen, Descompressão da síndrome do túnel do carpo.
INTRODUCTION

Carpal tunnel syndrome (CTS) is the most common compressive neuropathy of the upper limbs. A recent population-based study established a prevalence of 2.7% for CTS in the general population. Most studies identify a threefold to fourfold preponderance of females to males. The syndrome has gained increase recognition in recent years because of prominent attention to its occurrence in certain industrial settings, and its currently one of the most commonly reported occupational diseases. CTS carries a considerable economic impact because it affects active people engaged.

Although most cases of CTS are idiopathic or related to occupations with repetitive wrist activity, this condition is associated with a wide variety of clinical conditions including obesity, rheumatoid arthritis, pregnancy, diabetes, thyroid dysfunction, renal dialysis (amyloid), radial malunion, wrist fracture or dislocation, tenosynovitis and mass lesions (ganglion cysts, neurofibromas, hemangiomas, lipomas). A minority of patients will present with a strong family history arising from hereditary neuropathy with liability to pressure palsy. Oral contraceptives or other medications which tend to cause fluid retention may also provoke carpal tunnel syndrome.

The clinical condition is caused by elevation of pressure in the carpal tunnel: this increased pressure produces ischemia of the median nerve, resulting in impaired nerve conduction and attendant paresthesia and pain. Early in the course, no morphologic changes are observable in the median nerve, neurological findings are reversible, and symptoms are intermittent. Prolonged and frequent episodes of elevated pressure in the CTS may result in segmental demyelization and more constant and severe symptoms, occasionally with weakness. When there is prolonged ischemia, axonal injury ensues and nerve dysfunction may be irreversible.

A combination of electrodiagnostic studies (nerve conduction studies and electromyography) and knowledge of the location and type of symptoms permits the most accurate diagnosis of CTS. The symptoms generally include pain, tingling, burning numbness, or some combination of them on the palmar aspect of the thumb, index finger, middle finger and radial half of the ring finger. They typically worsen at night. Often, patients report that they shake the symptomatic hand or hands when symptoms are at their worst “flick sing.”

On clinical examination, the Tinel’s test (percussion of the median nerve at the wrist creating tingling in the median innervated fingers) is considered to have a specificity of 99% and a sensitivity of 64%. Phalen’s test (flexion provoking tingling in median innervated fingers within 60 seconds) has a 95% specificity with a sensitivity of 75%. In severe cases, sensory loss in the median nerve distribution and weakness of the abductor pollicis brevis or opponens pollicis muscle may be noticed.

Electro diagnostic studies are most useful for confirming the diagnosis in suspected cases and ruling out neuropathy and other nerve entrapments. The palmar sensory latency test, the most sensitive test for CTS, is measured by stimulating sensory fibers in the palm and recording over the wrist. In addition, distal motor latency and electromyography tests of the thenar muscles are also measured and may reveal abnormal motor latency, loss of unit potentials and the presence of denervation potentials in advanced cases. MRI of the median nerve has been used for CTS since the mid-1980s. One study showed that the reliability of MRI is high, but the diagnostic accuracy is only moderate.

Treatment is based on reducing symptoms and correcting the associated conditions such as rheumatoid arthritis or other types of inflammatory arthritis which relieve the CTS. Wrist splint alleviates symptoms and reduces sensory latency. Prednisolone has a substantial reduction in symptoms. Patients who remain symptomatic after modification of their activities and splinting are candidates for injection of corticosteroids into the carpal tunnel. Injection of corticosteroids is superior to injection of placebo improving symptoms in more than 75% of patients. Local injection of corticosteroids is also associated with improvement in median nerve conduction. These kinds of conservative treatment are more successful in patients with mild nerve impairment, having recurrence of the symptoms within one year in patients with severe CTS. In these cases surgery should be considered. There are several surgical approaches to carpal tunnel syndrome: open procedure, endoscopic and mini-open procedure. In the open procedure the surgeon makes a 5 to 6 cm long incision extending distally from the distal wrist crease, and releases the transverse carpal ligament under direct visualization. In endoscopic procedure release, a device with either two portals or one portal is used to release the transverse carpal ligament. In the mini open procedure an incision of 2 to 2.5 cm and release of the carpal ligament under direct visualization is done. The endoscopic technique carries a higher risk than open and carpal-tunnel release of injury to the median nerve. Relief of symptoms is similar with the open and endoscopic procedures and many studies report that patients return to work earlier after the endoscopic surgery. The mini-open procedure was made to achieve the earlier recovery of the endoscopic release without their complications. The reviews indicated that the endoscopic carpal tunnel release technique is worse in terms of reversible nerve injury but superior in terms of grip strength and scar tenderness, at least in short-term follow-up compared with the mini-open.

Complications from carpal tunnel release have been reported...
for both open and endoscopic procedures\(^{11}\). Some of the common reported complications include injury to the recurrent motor branch, incomplete release of the flexor retinaculum, painful neuroma formation in the palmar cutaneous branch, wound infection and reflex sympathetic dystrophy\(^ {1,2,8,14,26,29} \).

The authors report on a series of 48 mini-open incisions as an approach to CTS in 32 patients. The surgical technique is described in detail. The indications, advantages and complications compared to traditional open surgery and endoscopic surgery are discussed.

**Surgical Procedure**

The patient was positioned supine, with the arm abducted and the forearm supinated on an arm board. After positioning we performed local anesthesia associated with laryngeal mask, propofol and midazolam. No troncular anesthesia was performed. The skin is prepared carefully and drapped and then the incision is marked along the ulnar border of the major thenar crease in line with the radial border of the ring finger (fig. 1).

**Clinical Material and Methods**

From 2000 to 2008 thirty two patients with CTS were submitted to 48 mini-open approaches for transverse ligament release. We reviewed the clinical presentation, electromyography (EMG) studies, surgical technique and follow up. All patients had clinical treatment before surgery. The proportion of women to men in the studied population was 75 to 25%. The age ranged from 32 to 71 years-old (average – 49.95 years, standard deviation 9.46). Most of the patients (75%) had bilateral carpal tunnel syndrome and 25% had unilateral syndrome. The time interval from beginning of symptoms until the diagnosis ranged from 2 to 3 months. Diagnosis was made clinically with complementary EMG reserved for uncharacteristic clinical presentations. Table 1 shows EMG results. All patients were submitted to an informed consent, including surgical risks, procedure and possibility of recurrence. Hospital stay was in average 36 hours, ranging from 24 to 48 hours and the mean follow up was 26.94 months ranging from 1.44 to 44.04 months (standard deviation 16.56). Transverse ligament biopsy was performed in all cases in order to establish the precise etiology.

**Table 1 - Distribution and degree of involvement based on EMG distal conduction latencies through carpal tunnel.**

<table>
<thead>
<tr>
<th></th>
<th>Right Arm</th>
<th>Left Arm</th>
<th>Sensitive Latency (*€)</th>
<th>Motor Latency (*Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>45%</td>
<td>40%</td>
<td>3.7-4.0</td>
<td>4.4-6.9</td>
</tr>
<tr>
<td>Moderate</td>
<td>45%</td>
<td>50%</td>
<td>4.1-5.0</td>
<td>7.0-9.9</td>
</tr>
<tr>
<td>Accentuate</td>
<td>10%</td>
<td>10%</td>
<td>➤5.0 (¥)</td>
<td>➤10.0</td>
</tr>
</tbody>
</table>

\*: Motor and sensitive latency values in milliseconds  
€: Latency time until the index finger  
Ω: Latency time until the short thumb abductor  
¥: Or no sensitive latency time
with a short S-shaped incision. The incision has in maximum 3 cm and minimum of 1.5 cm, with extra-fascicular neurolisis under microscopic magnification and microsurgical techniques. A small Jansen retractor is placed to spread the incision and meticulous hemostasis is maintained under bipolar coagulation (fig.3).

When making the proximal portion of the skin incision, it is important to avoid sectioning the branches of the palmar cutaneous nerve, which may be mistaken for fat, using a small flat Kelly and dissector. Then the palmar fascia with a portion of the palmaris brevis muscle must be divided and a small Jansen retractor is placed for the deeper dissection. The transverse carpal ligament will be visualized and progressively divided sharply under direct visualization (fig-4). The edge of the transverse carpal ligament and the underlying median is seen, a small sharp scissors is used for completion of division of the entire length of the ligament and a biopsy of the internal border of transverse carpal ligament is performed. At the end of the ligament, fat can be seen indicating the presence of vascular arcades and the motor branch of median nerve visualized and protected (fig-5). The nerve is palpated proximally and distally within the incision to make sure that no remaining areas of compression are identified. The wound is then irrigated thoroughly with sterile saline solution and hemostasis is obtained with bipolar coagulation. The ligament is left open and the fascia and subcutaneous tissues are re-approximated with 3.0 interrupted, inverted vicryl sutures. The skin is closed with simple running 4-0 nylon sutures. A bulky soft dressing and a light compressive bandage are applied. The patient is instructed to mobilize the hand and fingers in the immediate postoperative period. Dressing is removed after 2 days and the skin sutures are usually removed in postoperative day 10. Hospitalization was in average 1.5 days. Prophylactic intravenous cephalotin 500 mg was administrated each 8 hours till the discharge.
RESULTS

All patients reported an improvement in symptoms. The transverse ligament biopsy result in 47 patients revealed fibrosis of transverse ligament with one case of fibrosis plus fat. Biopsy was performed in all cases to exclude possible abnormal and/or infrequent etiologies that may accompany CTS. All the procedures were done in an outpatient basis with no complications related to anesthesia: all patients were discharged in the same day.

Ninety eight percent of patients had complete resolution of symptoms, returning to their daily activities in an average of 36 hours, ranging from 24 to 48 hours. One case presented with sympathetic dystrophy and two cases showed bad cicatrization, all in diabetic patients. In one case, palmar arcade lesion occurred, with extension of the incision for meticulous hemostasis. There was no recurrence of symptoms in all patients. None of the patients presented infectious complications.

DISCUSSION

Carpal tunnel syndrome is the most common peripheral nerve entrapment syndrome. The estimated prevalence is 270 cases per 100,000 population. The typical clinical presentation include dysesthesia, weakness of hand (especially grip), clumsiness of the hand and/or difficulty with fine motor skills, hyperesthesia in median nerve distribution, Phalen’s sign and Tinel’s sign. The diagnosis is made based on patient clinical evaluation. However, many of those clinical features are not unique it CTS and differentiation from other upper-extremity syndromes may require further evaluation with electromyography studies (EMG) and/or MRI.

All patients underwent surgery using local and intravenous anesthesia (with laryngeal mask). Under the effect of midazolam and propofol, patients reported minor discomfort when lidocaine was injected. No tourniquet was used for local anesthesia. There were no anesthetic complications, and all patients were discharged on the same day. The use of inhalatory agent may lower the stress for the patient, making the procedure more comfortable. As showed by many authors, the usage of local infiltration anesthesia is perfectly safe and preferable by most of the patients.

Previous studies reported that the type of incision on CTS surgery is not important provided that it does not cross the distal flexion crease of the wrist at a right angle, thus avoiding scar discomfort at wrist and lesion of the palmar cutaneous nerves. Our technique was performed with a 1.5 to 3.0 cm incision just distal to the wrist flexion crease. As demonstrated by Ahn et al., preservation of subcutaneous nerves is essential for the significantly lower scar discomfort after CTS surgery. With the microscope we performed a detailed identification of the transverse carpal ligament: after releasing the ligament, magnification allowed us to safely open the thin translucent ventral epineurium. Our results demonstrated complete resolution of symptoms in 98.0% of patients. Motor improvement occurred in 95% of the patients with no motor nerve injury. One year of follow-up showed no recurrence of symptoms among the patients that had complete resolution of the clinical picture.

Patients submitted to open CPS surgery frequently complain of the postoperative scar esthetic appearance and discomfort. The endoscopic (ECPS) surgery has been claimed to improve recovery time, postoperative scar discomfort, cosmetic appearance and grip strength recuperation. ECPS is a technically demanding procedure with a steep learning curve. The complication rate for both ECPS and open CPS is 1 to 2%. Despite the similar complication rates, the type of complication is incomplete ligament release. All the patients returned to daily activities in 48 hours after the surgery. Several authors reported earlier return to daily activities after endoscopic surgery when compared to OCPS. However Scholten et al, in a systematic review of CPS surgery, do not confirm this data. Vasen et al showed that ECPS and OCPS have similar total costs but ECPS is more costly if the difference between the techniques in mean time to return to work is less than 21 days. The mini-open ligament release showed lower scar discomfort compared to the modified incision.

CONCLUSION

The mini-open technique combines a less tender incision and discomfort provided by ECPS with lower incidence of serious neurovascular and tendon injuries. Moreover it improves the cosmetic appearance of the scar. The use of the microscope is important to help minimize sectioning of subcutaneous branches nerves and to identify the epineurium. The overall costs of surgical procedures are gaining increased importance: conflicting data regarding the earlier return to work provided by ECPS, the high costs of endoscopic equipment and its steep learning curve for presents many step-downs for this procedure. On the other hand the mini-open technique can be performed using the equipment already available in many hospitals avoiding the undesirable complications of the ECPS.
REFERENCES


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**CORRESPONDING AUTHOR**

Carlos Alexandre Martins Zicarelli  
Adress: Alameda Rio Claro, 95 apto 12  
01332-010, Jardim Paulista, São Paulo, SP, Brazil.  
Phone: (55) 11 32875599  
Fax: (55) 11 32515089  
E-mail: carloszicarelli@gmail.com