Carpal tunnel syndrome

Treatment with small transverse incision

Paulo Roland Kaleff[1,3], Marcelo Senna Xavier de Lima[1],
Yvens Barbosa Fernandes[1,2], Danylo José Palma Honorato[4],
Antonio Augusto Roth Vargas[1], Donizeti César Honorato[1,5]

ABSTRACT

Objective: To evaluate the application of a limited transverse incision technique to treat the carpal tunnel syndrome, with concern to its safety and efficacy in the opening of the flexor retinaculum (FR). **Method:** A prospective analysis of thirty FR release procedures performed on twenty-eight patients subjected to the proposed incision technique. Safety and total opening of the FR were evaluated through a questionnaire and an endoscopic inspection respectively. **Results:** No major complications were observed. Two cases presented small local hematoma. One patient presented with transient neuropraxia of digital branch. In two of the first five cases, incomplete FR opening was identified during endoscopic revision with need of complementary opening. All patients reported relief of paresthesias and nocturnal pain symptoms. **Conclusion:** The technique was safely performed on the prospection group, no major complications were detected and the opening of FR was observed in the majority of the patients.

Key words: carpal tunnel syndrome, surgical procedures, minimally invasive, safety.

Utilização de técnica de incisão transversal mínima no tratamento da síndrome do túnel do carpo

RESUMO

Objetivo: Avaliação de técnica de incisão limitada no tratamento da síndrome do túnel do carpo, quanto à segurança clínica e efetividade na abertura do Retináculo Flexor (RF). **Método:** Estudo prospectivo de trinta procedimentos realizados em vinte e oito pacientes submetidos a técnica com incisão transversa mínima. A segurança da técnica e a abertura total do RF foram avaliadas através de questionário baseado em observações clinicas e inspeção endoscópica, respectivamente. **Resultados:** Não foram observadas complicações maiores. Um único paciente apresentou neuropraxia de nervo interdigital. Dois pacientes apresentaram hematoma local pequeno. Em dois dos cinco primeiros casos observou-se uma abertura incompleta do RF, sendo necessária abertura complementar. Todos os pacientes apresentaram melhora do quadro clínico de dor noturna e parestesias. **Conclusão:** A técnica foi executada com segurança no grupo analisado, sem a ocorrência de complicações graves, e com abertura do RF na quase totalidade dos casos.

Palavras-chave: síndrome do túnel do carpo, cirurgia, minimamente invasiva, segurança.

Correspondence
Paulo Roland Kaleff
Centro Médico de Campinas
Departamento de Neurocirurgia
Rua Edilberto Luis Pereira da Silva 150
CEP 13083-190 Campinas SP - Brasil
E-mail- prkaleff@terra.com.br
neuro@cmcnet.com.br

The carpal tunnel syndrome (CTS) is the most common compressive neuropathy in clinical practice. It is caused by the compression of the median nerve at the wrist, more precisely at the carpal tunnel. It is more frequent in women. The general clinical presentation is of painful paresthesias and/or burning pain in the lateral half of the hand, predominantly in the three first fingers. Typically, the paresthesias are predominantly nocturnal. The patients may also complain of anesthesia, loss

[1]Neurosurgery Department, Hospital Centro Médico de Campinas, Campinas SP, Brazil; [2]Neurosurgery Departement, Universidade Estadual de Campinas (UNICAMP), Campinas SP, Brazil; [3]Post-Graduate Student, UNICAMP; [4]Graduate Student University of Marília, Marília SP, Brazil; [5]Professor and Chief, Neurosurgery Department UNICAMP.

Carpal tunnel syndrome: small transverse incision effectiveness
Kaleff et al.

Arq Neuropsiquiatr 2010;68(1)

of dexterity, weakness and in more advanced cases loss of motor function and thenar atrophy[1,2]. The diagnosis is based on clinical presentation and physical examination, which may be confirmed by electrophysiological testing, specifically electroneuromyography (ENMG) based on sensory and motor latency, and the observation of conduction abnormalities[1]. The idiopathic CTS is generated by increased intra-carpal canal pressure with reports demonstrating that the carpal ligament section causes a significant decrease in the intracanal pressure and an increase in the cross-sectional area of the carpal tunnel[3,4]. Clinical treatment, with medication, physiotherapy, splinting or local infiltration can be considered initially, but surgical intervention is indicated in more advanced cases, and when there is no response to adequate clinical treatment[1]. Surgical intervention is traditionally accepted as bearing good results in the treatment of CTS, with strong clinical evidence[2]. Carpal tunnel release has become one of the most commonly performed operations.

Many surgical techniques, have been used to treat CTS, such as the classical open carpal tunnel release (OCTR) technique, the "mini-open" or limited visualization techniques and the endoscopic carpal tunnel release (ECTR) methods, as well as variations thereof. The advantages and disadvantages of the above techniques are a matter of debate, but their common goal is to release the median nerve by completely transecting the flexor retinaculum (FR)[5-10]. Whatever the technique, important structures such as the palmar cutaneous, recurrent motor and digital branches of the median nerve and the ulnar nerve, the superficial palmar arch and tendons must be protected during the operation[9]. Preferably, the chosen technique should be cost effective and performable with simple instrumentation.

In this study, results obtained by a small transverse incision technique that can be performed without the need of expensive and specific surgical instruments, using the hardware available in virtually all health facilities, are reported. To apply that technique on a routine basis, or for its clinical evaluation on a larger population to compare with other techniques, the present prospective controlled study was designed in order to evaluate the technique's safety, and effectiveness in the opening of the FR.

METHOD

A prospective analysis was carried out covering 30 subsequent FR release procedures performed with the here described technique on 28 patients with carpal tunnel syndrome, operated in our institution, between December 2006 and January 2008. There was no randomization or control group. Table presents the characteristics of the subject group: Sex, age, clinical presentation, duration of symptoms, findings in the ENMG. The diagno-

Table. Preoperative characteristics in 28 patients, subjected to 30 procedures, diagnosed with carpal tunnel syndrome.

Sex	
Male	8 (26.7%)
Female	22 (73.3%)
Age	53±10
Evolution time	
<1year	5 (16.3%)
1-3 years	15 (53.3%)
>3years	8 (30%)
ENMG	
Mild	8 (26.7%)
Moderate	19 (63.3%)
Severe	3 (10%)
Bilateral symptoms	2 patients

sis was based on clinical manifestation and confirmed by ENMG studies. Only patients with an idiopathic disease were considered; cases with suspected abnormal anatomy (ie: wrist fractures, tumors) were excluded.

Definition of topographical landmarks

Before initiating the procedure the main anatomic references are identified: Hook of the Hamate (HH) using the technique described by Cobb[11] (estimation after the ring-metacarpal line and index-metacarpal-pisiform line) or direct palpation; distal wrist crease; a straight line, perpendicular to the distal wrist crease, in line with 3rd interdigital web space long axis (3WL); palmaris longus tendon.

The presumed positions of important structures are marked: The superficial arch 2.5 cm distal to the HH, the distal edge of the carpal transverse ligament - 1 cm distal to the HH, both at the level of 3 WL. This orientation line serves also for safe zone concerning recurrent branch and palmar cutaneous branches.

Surgical technique

The procedure is conducted in the surgical theater, under locorregional anesthesia with Bier technique, in an outpatient clinic basis. An ideal hand position is obtained with a wrist extension of 30 degrees, the hand held in place by a cushion placed under the wrist joint and with the thumb abducted.

A 1.5 cm transverse incision is made just proximal to the distal palmar crease, ulnar to the palmaris longus tendon (Figure). Dissection is performed so that the palmaris longus is isolated and stays laterally in the field. The deep antebrachial fascia is identified, and the point of transition between the fascia and the transverse carpal ligament is sought. A longitudinal opening is performed in this transition point until the carpal tunnel is entered in its middle aspect. Structures are identified, specially the median nerve.

Arq Neuropsiquiatr 2010;68(1)

Carpal tunnel syndrome: small transverse incision effectiveness
Kaleff et al.
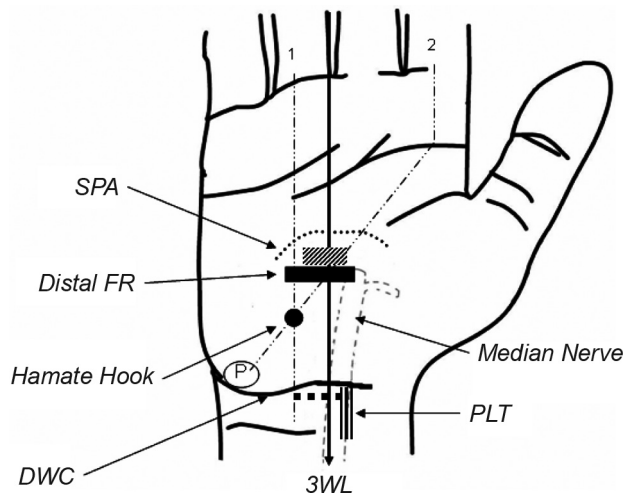
Figure. Landmarks for orientation during surgery. Transverse interrupted line: incision; Dashed area: safe zone after the FR, which should be reached with the cannula; DWC: distal wrist crease; P: pisiform; SPA: superficial palmar arch; PLT: palmar longus tendon; FR: flexor retinaculum; 3WL: 3rd webspace line; DWC: distal wrist crease; (1) ring-metacarpal line; (2) index-metacarpal-pisiform line.

This is followed by the distal dissection of the anatomic plane just above the FR in a distal fashion, following the 3WL, until 1 cm distal of the HH's estimated position .With this maneuver, a tunnel is created. A blunt tip dissector is advanced in the carpal canal, the hamatus is palpated medially. This step is important to avoid inadverted entry into Guyon's canal. A wide, 15-30° posterior bent, tentacannula is inserted under the transverse carpal ligament, following the 3WL and progressed beyond the distal end of the ligament line. The tip can be felt by palpation under the skin and agreement with the formerly identified topographical landmarks is sought. When advancing the tentacannula, one should follow the ligament by palpation, and feel no resistance. Forcefully introducing the cannula can lead to misdirection through the ligament or injury to the canal content. The goal with such maneuver is to set an endpoint to the opening of the distal ligament and to protect the superficial palmar arch and the median and common digital nerves. The tip of the tentacannula should not be advanced further than 3.5 cm to the distal wrist crease.

With a small Senn retractor, the subcutaneous-skin layer is elevated to allow for direct visualization of the opening through the tunnel. The opening of the FR is performed using slim straight scissors. The upper tip of the scissors runs in the dissected supraligamentar space. The lower tip runs between the FR and the tentacannula. The ligament is cut and the characteristic snap of the FR opening is heard and felt. Without withdrawing the tentacannula, the opening of the FR is palpated with a small hemostat, with is tip upwards; any residual liga-

ment should be opened then. After removal of the tentacanulla, hemostasis is checked. At this point, the retractor placed longitudinally should clearly expose the decompressed median nerve and total section of the FR. Opening of the thickened portion of distal antebrachial fascia, under direct vision is completed.

For the purposes of this study a 30° angled optic endoscope (regular knee arthroscope or wrist arthroscope) is introduced and advanced to visualize the adequate performance of the opening. After local irrigation, the skin is closed with absorbable intra-dermic stitches.

FR opening confirmation – In order to ensure the effectiveness of the FR opening, visual confirmation of total opening was checked by the surgeon during the procedure by means of endoscopic images. The opening was considered successful, when it included all portions of the FR, "U" shaped opening was achieved and the FR opened portions could be clearly visualized from the antebrachial fascia to the palmar fat. Data concerning the opening of the FR were recorded in a separate field in the safety evaluation chart.

Safety evaluation – An evaluation chart was used, which included the following parameters: intra-operative evaluation, evaluation at surgery discharge day, 30 day post-operative evaluation. Intra-operative evaluation: adverse events, arterial bleeding. Discharge evaluation: median nerve examination, ulnar nerve examination, tendon lesion, hematoma, pain. 30-day post-operative evaluation: median nerve examination, ulnar nerve examination, tendon lesion, hematoma, revision surgery, pain, symptom relief. Median and ulnar nerve examination consisted in pinprick sensibility examination, two point discrimination, motor function of abductor policis brevis muscle, and motor function of ulnar nerve innervated muscles. Abnormalities in examination were recorded.

The study was approved by the local ethics committee, CEP- FCM/UNICAMP, under number 045/2007, and registered in the CONEP- FR 122073. Informed consent was obtained from all patients.

RESULTS

No major complications were observed in any of the patients. No intra-operative adverse events were observed either.

In the first post operative evaluation two patients presented small palmar and antebrachial hematoma, which in neither case demanded a direct approach. The hematoma was attributed to the use of a pneumatic cuff for the venous local anesthetic blockade, and the nonidentification of the bleeder because of transitory ischemia.

Anesthesia and tingling of the 4th digit were observed in one patient. No direct intervention was needed and symptoms had disappeared at the patient's 30-day nor-

Carpal tunnel syndrome: small transverse incision effectiveness
Kaleff et al.

Arq Neuropsiquiatr 2010;68(1)

mal neurological evaluation examination. Probably, neuropraxia of the common digital nerve was produced by the cannula, or during dilation and dissection of the carpal canal synovia. Mild local pain was reported by six patients but with relief after a few days' use of non steroidal anti-inflammatory drugs.

In all but two patients, who needed complementary opening or another "pass" of the scissors, total opening of the FR was confirmed by endoscopic inspection. The incomplete release was observed in the 2nd and 4th case of the prospection series. All patients reported relief of paresthesias and nocturnal pain symptoms at the 30-day evaluation.

DISCUSSION

The surgical options for carpal CTS treatment can be divided into three major groups: the classic open carpal tunnel release techniques, which remains as the golden standard for the surgical treatment, the endoscopic carpal tunnel release methods and the "mini-open" or limited visualization techniques, including their variations[5].

From the open techniques the main example is the approach through a variable interthenar longitudinal incision. This approach has the advantage of wide exposure of crucial anatomical structures as well as direct visualization of the FR opening. Some complications such as pillar pain, tender scars and delayed return to work were associated to those techniques[12]. With the intent to reduce those complications the alternative techniques were developed.

Endoscopic techniques showed to be a valuable option to the classic techniques, including some advantages such as small scar, less postoperative pain, early return to work and preservation of grip strength[13,14]. Some aspects such as availability of hardware, need of disposable items for some techniques with impact on direct costs and need of training with endoscopic equipment preclude their application in some environments, specially where low budget is a reality[15].

Limited incision techniques try to combine the simplicity and safety of OCTR with the reduced tissue trauma and postoperative morbidity of ECTR by using a short incision. A variety of techniques has been described such as: approaches using two incisions, palmar incision with distal to proximal FR opening, palmar and wrist oblique and longitudinally oriented incisions or using auxiliary tools such as translumination[16-18].

Some authors report approaches through small proximal transverse incisions but those differ from the technique presented herein regarding both the instrumentation used and the differing landmarks and safety parameters adopted[19-21].

Complications from carpal tunnel release operations unrelated to the kind of approach occur in all techniques, such as: reflex sympathetic dystrophy, infection, mild local hematomas, causalgia, pisio-triquetal pain and trigger finger. Important, and avoidable, complications occur from direct injury to anatomic structures that can occur in the ECTR or limited visualization techniques[22,23]. During those operations, the palmar cutaneous branch; the recurrent branches of the median nerve, ulnar nerve, ulnar artery, superficial palmar arch and the communicating branches of the ulnar nerve are potentially at risk. The technique presented herein is tailored to avoid those injuries. A strict evaluation of such complications was conducted during the intra-operative and postoperative periods. No major complications were identified.

Since it is a limited incision technique, a good manner to keep it safe is to use reliable clinical topographic landmarks and knowledge of the anatomical disposition and relationship of the FR and vital structures. The use of such landmarks was described to increase safety for endoscopic surgery[24,25]. The specific localization of the HH is crucial since it defines the medial limit of the carpal tunnel and gives the best estimation of the FR distal edge and superficial palmar arch position, respectively 1 cm and 2.5 cm distal to the HA at the level of the 3WL[11]. The HH showed to be more constant parameter than Kaplan's cardinal line, which has many variations on its estimation furthermore[26].

The 3WL is a safe zone for the motor recurrent branch of the median nerve which despite of its variations is generally described radially to the 3rd web space (>5 mm)[27]. The cutaneous palmar branches from the median and ulnar nerves can be avoided by staying straight in this line, since it corresponds to the long-ring finger web space, which has the lowest innervation density of the base of the palm. Preserving the skin and subcutaneous fat in that axis also helps avoiding injury[28].

Differences in the terms for the roof of the carpal tunnel are also a matter of discussion[25]. The parameters adopted here are of a detailed anatomical study with description of three portions of the FR[29]: the proximal portion or thickened antebrachial fascia, the "central portion of the flexor retinaculum" described as the transverse carpal ligament, which contains thick ligamentous fibers with bony attachment, and a distal portion formed by the interthenar muscle fascia. All portions should be opened for a successful procedure; our opening was addressed to all portions.

For opening confirmation evaluation we considered the ligament "U" shaped appearance (not the "V" shape of incomplete opening)[30], or when the palmar fat was reached after following one side of the open ligament form the proximal aspect to the distal aspect of the carpal tunnel. During endoscopic longitudinal inspection, the proximal, middle and distal portions of the FR could be

Arq Neuropsiquiatr 2010;68(1)

Carpal tunnel syndrome: small transverse incision effectiveness
Kaleff et al.

clearly differentiated by the thickened aspect of the middle portion. In the two cases (2nd and 4th case of this series) that needed complimentary opening of the ligament after inspection, incomplete division was in the distal aspect of the ligament. It was clear that the cannula positioning through the ligament led to partial RF opening. After the initial learning curve revision, we concluded that this is avoidable, by carefully advancing a broad tip cannula with concomitant palpation, and never forcing the dissection. The "slopes" that occur because of the difference in ligament thickness in each portion can mislead the cannula trajectory, leading to incomplete or partial opening and consequent failure to improve symptoms. The present technique aims the complete opening without the aid of endoscope, in this study used only for complimentary confirmation. Although, we feel that, when available, the endoscope is valuable as an adjuvant tool (canal inspection or FR opening confirmation).

As the immediate results were technically satisfactory, and no major complications were observed. Although the number of patients studied is not large, and may not adequately reflect the actual rate of occurrence of possible complications this technique is eligible for use in a larger number of patients, to evaluate its clinical results at long term and routine use basis, with continuous outcome survey. The application of this technique would be of help in daily clinical practice, as another surgical option, especially in facilities where endoscopic release is unaffordable and not available. Long term results and with a larger number of patients should be evaluated in further studies.

In conclusion, the technique was safely performed in this group, no major complications were detected and the opening of FR was observed in the majority of the patients.

REFERENCES

1. Huang JH, Zager EL. Mini-open carpal tunnel decompression. Neurosurgery 2004;54:397-399.
2. Chung K. Current status of outcomes research in carpal tunnel surgery. Hand 2006;1:9-13.
3. Okutsu I, Ninomiya S, Hamanaka I, Kuroshima N, Inanami H. Measurement of pressure in the carpal canal before and after endoscopic management of carpal tunnel syndrome. J Bone Joint Surg Am 1989;71:679-683.
4. Richman JA, Gelberman RH, Rydevik BL et al. Carpal tunnel syndrome: morphologic changes after release of the transverse carpal ligament. J Hand Surg 1989;14:852-857.
5. Cellocco P, Rossi C, Bizzarri F, Patrizio L, Costanzo G. Mini-open blind procedure versus limited open technique for carpal tunnel release: a 30-month follow-up study. J Hand Surg 2005;30:493-499.
6. Jacobsen MB, Rahme H. A prospective, randomized study with an independent observer comparing open carpal tunnel release with endoscopic carpal tunnel release. J Hand Surg 1996;21:202-204.
7. Jimenez DF, Gibbs SR, Clapper AT. Endoscopic treatment of carpal tunnel syndrome: a critical review. Neurosurg Focus 1997;3:e6.
8. Jugovac I, Burgic N, Micovic V et al. Carpal tunnel release by limited palmar incision vs traditional open technique: randomized controlled trial. Croat Med J 2002;43:33-36.
9. Palmer DH, Paulson JC, Lane-Larsen CL, Peulen VK, Olson JD. Endoscopic carpal tunnel release: a comparison of two techniques with open release. Arthroscopy 1993;9:498-508.
10. Zyluk A, Strychar J. A comparison of two limited open techniques for carpal tunnel release. J Hand Surg 2006;31:466-472.
11. Cobb TK, Cooney WP, Kai-Nan An. Relationship of deep structures of the hand and wrist to topographical landmarks. Clin Anat 1993;6:300-307.
12. Kluge W, Simpson RG, Nicol AC. Late complications after open carpal tunnel decompression. J Hand Surg 1996;21:205-207.
13. Hankins CL, Brown MG, Lopez RA, Lee AK, Dang J, Harper RD. A 12-year experience using the Brown two-portal endoscopic procedure of transverse carpal ligament release in 14,722 patients: defining a new paradigm in the treatment of carpal tunnel syndrome. Plast Reconstr Surg 2007;120:1911-1921.
14. DaSilva MF. Single portal endoscopic carpal tunnel release. Tech Orthopaedics 2006;21:35-41.
15. Oertel J, Schroeder HW, Gaab MR. Dual-portal endoscopic release of the transverse ligament in carpal tunnel syndrome: results of 411 procedures with special reference to technique, efficacy, and complications. Neurosurgery 2006;59:333-340.
16. Klein RD, Kotsis SV, Chung KC. Open carpal tunnel release using a 1-centimeter incision: technique and outcomes for 104 patients. Plast Reconstr Surg 2003;111:1616-1622.
17. Dayican A, Unal VS, Portakal S, Utkan A, Tumoz MA. Carpal tunnel release: using a short vertical incision above the flexor crease of the wrist. Mt Sinai J Med 2004;71:401-404.
18. Serra JM, Benito JR, Monner J. Carpal tunnel release with short incision. Plast Reconstr Surg 1997;99:129-135.
19. Hwang PY, Ho CL. Minimally invasive carpal tunnel decompression using the KnifeLight. Neurosurgery 2007;60:162-169.
20. LoVerme PJ, Saccone PG. Limited portal with direct-vision carpal tunnel release. Ann Plast Surg 1995;34:304-308.
21. Abouzahr MK, Patsis MC, Chiu DT. Carpal tunnel release using limited direct vision. Plast Reconstr Surg 1995;95:534-538.
22. Palmer AK, Toivonen DA. Complications of endoscopic and open carpal tunnel release. J Hand Surg 1999;24:561-565.
23. Boeckstyns ME, Sorensen AI. Does endoscopic carpal tunnel release have a higher rate of complications than open carpal tunnel release? An analysis of published series. J Hand Surg 1999;24:9-15.
24. Cobb TK, Knudson GA, Cooney WP. The use of topographical landmarks to improve the outcome of Agee endoscopic carpal tunnel release. Arthroscopy 1995;11:165-172.
25. Kretschmer T, Antoniadis G, Richter HP, Konig RW. Avoiding iatrogenic nerve injury in endoscopic carpal tunnel release. Neurosurg Clin N Am 2009;20:65-68.
26. Vella JC, Hartigan BJ, Stern PJ. Kaplan's cardinal line. J Hand Surg 2006;31:912-918.
27. Sacks JM, Kuo YR, Mclean K, Wollstein R, Lee WP. Anatomical relationships among the median nerve thenar branch, superficial palmar arch, and transverse carpal ligament. Plast Reconstr Surg 2007;120:713-718.
28. Ruch DS, Marr A, Holden M, James P, Challa V, Smith BP. Innervation density of the base of the palm. J Hand Surg 1999;24:392-397.
29. Cobb TK, Dalley BK, Posteraro RH, Lewis RC. Anatomy of the flexor retinaculum. J Hand Surg 1993;18:91-99.
30. Peimer CA, Brown R.K. Endoscopic Carpal Tunnel Release. In: Luchetti R, Amadio P, (Eds). Carpal tunnel syndrome. New York: Springer Verlag, 2007;171-176.