TRANSVERSE MINI-INCISION FOR CARPAL TUNNEL RELEASE

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ABSTRACT

Objective: To compare two incisions used for the surgical treatment of CTS: the classic longitudinal incision, over the transverse carpal ligament (TCL), and the mini-incision, at the wrist crease and near the proximal border of the TCL. Methods: 47 patients from the Hand Surgery Outpatient Clinic of the Clínica Traumato–ortopédica Madureira are evaluated. Group 1 consisted of 24 patients (28 hands) treated by the classic incision. Group 2 consisted of 23 patients (28 hands), treated by the transverse mini-incision technique. Both groups were compared in relation to discomfort of the scar, presence or absence of "pillar" pain, and time elapsed before returning to daily activities or unrestricted work. Results: There was prevalence of females (87.5% in Group 1; 91.3% in Group 2) and of electromyographic bilateral syndrome in both groups (75% patients of Group 1; 86% patients of Group 2). Scar discomfort and "pillar" pain were more frequent in Group 1, but there was no difference in the time elapsed before returning to work or daily activities between the groups. Conclusion: The mini-incision technique is a less invasive alternative, and enables complete release of the carpal tunnel, with less morbidity than classic longitudinal incision. Level of Evidence II, Prospective Comparative study. Therapeutic.

Keywords: Carpal tunnel syndrome. Decompression, surgical. Prospective studies.

Citation: *Alves MP. Transverse mini-incision for carpal tunnel release. Acta Ortop Bras. [online]. 2011;19(6): 362-7. Available from URL: http://www.scielo.br/aob*

INTRODUCTION

Carpal tunnel syndrome (CTS) is a condition in which the median nerve is compressed as it crosses the wrist, causing a set of signs and symptoms. Patients generally complain of constant or intermittent paresthesia or numbness in the area of the median nerve, which may be associated with pain. Nocturnal pain that wakes patients up is also common. In severe cases, there may be atrophy of the thenar musculature and weakness of thumb opposition.[1]

CTS is the most common compressive neuropathy, occurring in around 0.1% to 10% of the general population. The risk factors include obesity, hypothyroidism, diabetes mellitus, pregnancy, kidney disease, inflammatory arthritis, acromegaly, mucopolysaccharidosis, genetic predisposition, advanced age, smoking, and repeated and extreme flexion of the wrist at work.[1-3,4] According to Souza, CTS is the compressive neuropathy most frequently associated with repetitive strain injury.[5]

The diagnosis of CTS is eminently clinical, based on clinical history and physical examination, and confirmed by electroneurophysiological studies. Souza[5] states that clinical diagnosis, with the Tinel and Phalen tests, is sufficient, when related to patients' complaints. Other pathologies (such as cervical radiculopathy, brachial plexus lesions, thoracic outlet syndrome, apical pulmonary neoplasia, pronator syndrome, cubital and ulnar tunnel syndromes, and peripheral neuropathies) may cause paresthesia in the hand and should be excluded from the diagnosis.[6,7] A combination of findings from the clinical history and physical examination is more trustworthy than just one separate sign or symptom. CTS is accurately diagnosed in most cases when found in association with nocturnal pain, a positive Tinel's test, painful carpal tunnel compression test (Durkan test) and positive Phalen test.[1,3,6,8,9] According to Howard, Durkan's test has the highest sensitivity for detecting CTS upon physical examination.[2] Electrophysiological tests (nerve conduction velocity and electromyography) are used to confirm the clinical diagnosis. A pathological nerve conduction velocity study includes decrease in action potential amplitude, increase in distal latency and decrease in speed. Distal motor latency of more than 4.5ms and sensory latency of more than 3.5ms are abnormal.[1,3,9] On the other hand, Howard states that distal sensory latencies above 3.2ms and motor latencies above 4.2ms are already abnormal.[2] Abnormal electromyographic findings include diminished insertion activity, fibrillation at rest, positive sharp waves and complex repetitive discharges, as well as diminished motor unit recruitment. The clinical profile is often so classic that the signs and symptoms are sufficient to establish the diagnosis,[6] but electroneuromyography should be considered in the preoperative planning, even though it is uncomfortable for the patient. It is also

All the authors declare that there is no potential conflict of interest referring to this article.

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Article received on 10/3/09 and approved on 5/26/10.

a way of documenting the patient's case for legal purposes.[4,7] The treatment may be conservative or surgical, and there are various surgical techniques for decompression.[4] The conservative treatment for CTS includes modification of activities, nocturnal immobilization of the wrist, injection of corticosteroids into the carpal canal, and oral medications.[1,2] The corticosteroid injection into the carpal canal combined with nighttime immobilization has an early success rate of around 80% in symptom improvement. However, after 12 to 18 months, only 22% of the patients remain free from symptoms.[1] Howard states that 40% of the patients remain free from symptoms after the corticosteroid injection into the carpal tunnel, when the symptoms have been present for less than a year.[2]

Surgical treatment is indicated for patients that do not improve with conservative treatment and for patients with thenar atrophy or electrophysiological evidence of denervation. Even in more severe cases, with thenar atrophy, surgical release of the median nerve provides a certain degree of symptom relief and some functional recovery.[4] Various well-controlled studies evidence that there are no benefits from microneurolysis, epineurectomy or tenosynovectomy for idiopathic CTS,[1-3] and these procedures should be carried out only in selected cases.[4]

Regardless of the surgical technique used, the many anatomical variations in the region require a careful surgical technique during release of the carpal canal. The surgical complications are well documented in literature, and may occur in any one of the techniques used.[1,7,8,10,11] The incidence of complications is more closely linked to the surgeon's experience than to the technique used.[2] The open technique results in greater pain and sensitivity in the scar and a longer time for return to work. [4,10]

The incidence of persistent symptoms after surgery ranges from 1% to 25%,[1] reaching up to 40%.[2] The most common cause is incomplete release of the carpal canal.[1,12]

The aim of this study is to compare the surgical treatment for CTS performed by transverse mini incision, made proximally to the carpal canal, with the classic longitudinal incision over the carpal canal, in relation to the following postoperative parameters: 1) characteristic surgical scar (pain, discomfort, hypertrophy); 2) presence or absence of "pillar" pain; 3) time taken to return to work or to activities of daily living.

CASUISTRY AND METHODS

Between May 2007 and December 2008, we conducted a prospective study comparing two surgical techniques for carpal canal release: a conventional longitudinal incision and a proximal transverse incision, centered one centimeter proximally to the wrist flexion fold. In this study we evaluated 47 patients treated at the Hand Surgery Outpatient Clinic of Clínica Traumato – Ortopédica Madureira, suffering from carpal tunnel syndrome (diagnosed clinically and electroneuromyographically), divided into two groups and treated surgically. All the patients were always evaluated and operated by the same surgeon (the author), in a consecutive manner, with a random decision on the surgical technique to be used for each patient. All the patients agreed to take part in the study by signing an informed consent statement provided by the investigator.

Infiltration with corticoids was not performed on any of the patients before the operation, because it was considered that this would not produce any significant improvement in the symptoms in medium and long-term evaluations.[4] None of the patients was immobilized after the operation. Bathia et al.[13] state that this procedure is ineffective in decreasing postoperative pain.

Group 1 is formed by 24 patients (28 hands), operated using the classic longitudinal access route over the carpal canal. Group 2 is formed by 23 patients (28 hands), operated using the mini-incision technique, proximally to the carpal canal. All the patients were evaluated and operated by the investigator. The division into treatment groups was performed randomly, according to the investigator's decision. Factors related to labor legislation issues were not considered to be excluding factors, and these patients were included in both groups to avoid evaluation discrepancies.

Group 1 is composed of 21 women and three men, and Group 2 of 21 women and two men. The right hand was operated in 13 patients from Group 1 and in 13 patients from Group 2. The surgery was bilateral for four patients from Group 1 and five patients from Group 2. Bilateral impairment, shown by electroneuromyography, occurred in 18 patients from Group 1 and in 20 patients from Group 2.

SURGICAL TECHNIQUE

Surgery was carried out under Bier anesthetic block, using a pneumatic tourniquet, after draining the blood from the arm to be operated. The patients from Group 1 were operated using a conventional access route, with a longitudinal incision over the carpal canal, in line with the ulnar edge of the third finger, as established by Ortiz and Lobet.[14] (Figure 1) Careful dissection was performed, with identification of the transverse ligament of the wrist by direct viewing. This ligament was sectioned completely so as to identify the median nerve. The wound was cleaned using 0.9% saline solution, the hemostasis was reviewed and the skin was sutured using 4-0 mononylon. A compressive dressing was applied without wrist immobilization. The patients from Group 2 were operated using a minimally invasive technique with transverse access located one centimeter proximally to the wrist flexion fold and measuring two centimeters in length (Figure 2). The palmaris longus tendon was identified laterally to the median nerve on the anterior surface of the wrist (Figure 3) and the proximal edge of the transverse ligament of the wrist (Figure 4). The median nerve was protected by using a metal spacer (tentacannula), to avoid injuring it. The transverse ligament of the wrist was sectioned with visualization of the median nerve. The wound was cleaned using 0.9% saline solution, the hemostasis was reviewed and the skin was sutured with 4-0 mononylon. No wrist immobilization was applied.

Figure 1. *Conventional incision.*

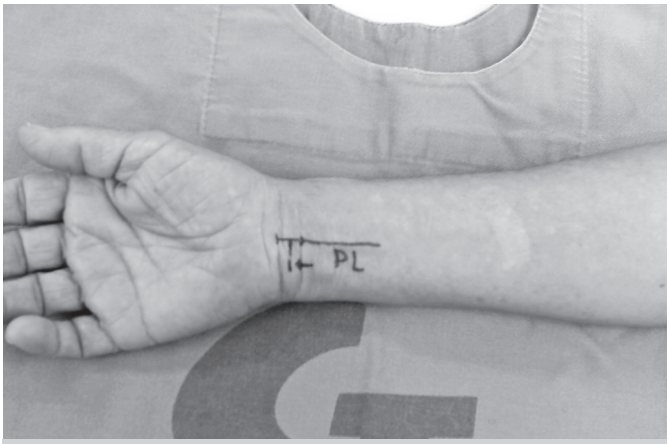

Figure 2. *Mini-incision.*

Figure 3. *Mini-incision and palmaris longus tendon.*

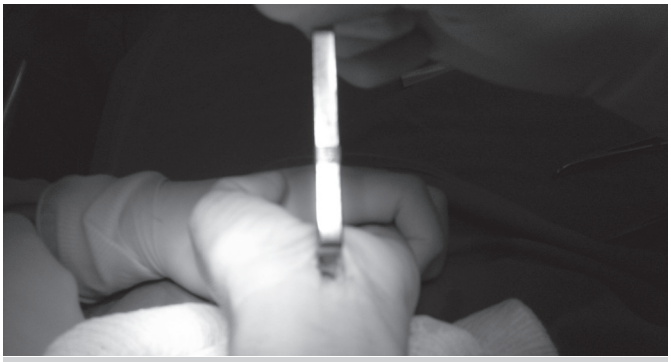

Figure 4. *Mini-incision and proximal edge of retinaculum.*

RESULTS

All the patients were always evaluated by the same examiner in the first and second postoperative weeks and in the first, second, third and sixth postoperative month. "Pillar" pain was evaluated in the third and sixth postoperative months. This pain was evaluated as present or absent on palpation, performed by the examiner, at the proximal limits (radial and ulnar) of the carpal canal.

Tables 1 and 2 show all the patients in the study, divided into two groups.

There was a predominance of female patients (87.5% in Group 1; 91.3% in Group 2) and of bilateral impairment proven by electroneuromyography (75% of the patients from Group 1; 86% of patients from Group 2). The surgery was bilateral in 16% of the patients from Group 1 and in 21% of the patients from Group 2. Bilateral surgery was carried out using the same technique on both hands.

Tables 3, 4 and 5 are related to the parameters evaluated in this study: numbers of patients that complain about discomfort in the scar, number of patients presenting "pillar" pain and time taken after the operation for patients to be discharged from the treatment and to return to household and/or work activities. The complications observed in the operative wound were basically seen in the first and second week evaluations, as superficial infection of the operative wound, inflammatory reaction at the suture stitches and, possibly, suture dehiscence (observed in one patient from Group 1). These complications were resolved immediately. At the subsequent evaluations, in the first, second, third and sixth postoperative months, the complications related to pain in the scar and its hypertrophy. As a means of generalizing the occurrence of complications with the scar, the patients from both groups were listed as complication cases. Table 3 and Figure 5 contain a list of the number of patients from each treated group that presented scar-related complications. "Pillar" pain (Table 4) was found to be more frequent in the patients from Group 1 in the third month evaluation; however, the presence of this complication found to be equal in both groups, in the sixth-month evaluation. (Figure 6)

Table 5 shows that the numbers of patients released from treatment, i.e., in a discharge condition where they were fit to return to work, were similar in the two groups. A greater number of Group 1 patients were released at three months, a fact compensated by a greater number of releases in Group 2 seen after six months. The general totals of patients released from follow-up six months after surgery were similar. Figure 7 shows the progression of the numbers of patients discharged.

In one case from Group 2, there was persistence of the painful symptoms and of the electroneurophysiological alterations, despite a long period of physiotherapy treatment and treatment with anti-inflammatory drugs. Magnetic resonance imaging evidenced the presence of a bifid median nerve. This patient was subsequently operated on for further decompression of the median nerve, using the conventional longitudinal approach. It was confirmed that early division of the median nerve was present, with signs of direct compression of the more radial branch of the nerve, which had not been released in the first operation. After surgery, there was considerable improvement in pain and paresthesia. There was no need for reoperations among the Group 1 patients.

DISCUSSION

Carpal tunnel syndrome (CTS) is a frequent pathology in orthopedics outpatient clinics, especially in hand surgery clinics. It is the most common and most studied compressive neuropathy of human beings, with prevalence from 51 to 125:100,000 individuals.[7] CTS surgery is a routine procedure performed worldwide, often in an outpatient setting[2,15,16] and is habitually indicated due to low rates of clinical improvement with conservative treatment.[12]

Table 1. *Patients from Group 1.*

Patients operated using classic approach	Operated side	Tinel	Phalen	Durkan	Enm	Age	Sex
1	Left	Yes	Yes	Yes	Bilateral	64	Female
2	Left	No	Yes	Yes	Bilateral	47	Female
3	Right	Yes	Yes	Yes	Bilateral	34	Female
4	Right	Yes	Yes	Yes	Right	56	Male
5	Right	Yes	Yes	Yes	Bilateral	52	Female
6	Right	Yes	Yes	Yes	Bilateral	41	Female
7	Right	Yes	Yes	Yes	Bilateral	40	Female
8	Right	Yes	Yes	No	Bilateral	42	Female
8	Left	Yes	Yes	No	Bilateral	24	Female
9	Left	Yes	Yes	Yes	Left	30	Female
10	Left	Yes	Yes	Yes	Bilateral	29	Female
11	Left	Yes	Yes	Yes	Bilateral	54	Female
12	Right	Yes	Yes	Yes	Bilateral	55	Female
13	Left	Yes	Yes	Yes	Bilateral	47	Male
14	Right	Yes	Yes	Yes	Bilateral	51	Female
15	Left	No	Yes	Yes	Normal	38	Female
16	Right	Yes	Yes	Yes	Bilateral	39	Female
17	Right	Yes	Yes	Yes	Bilateral	53	Female
18	Right	Yes	Yes	Yes	Right	46	Female
19	Left	Yes	Yes	Yes	Bilateral	46	Female
19	Right	Yes	Yes	Yes	Bilateral	39	Female
20	Right	No	Yes	Yes	Right	47	Female
21	Right	Yes	Yes	Yes	Bilateral	48	Female
22	Left	No	Yes	Yes	Bilateral	54	Female
22	Right	No	Yes	Yes	Bilateral	54	Female
23	Right	No	Yes	Yes	Right	55	Female
24	Right	Yes	Yes	Yes	Bilateral	38	Male

Repeated numbers refer to patients that were operated bilaterally. Source: CTO Madureira. Caption: ENM = electroneuromyography.

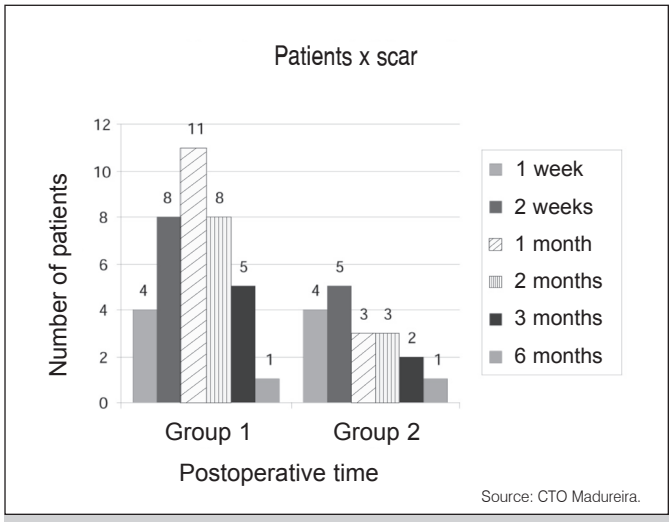

Figure 5. *Number of patients by group presenting complications relating to the scar.*

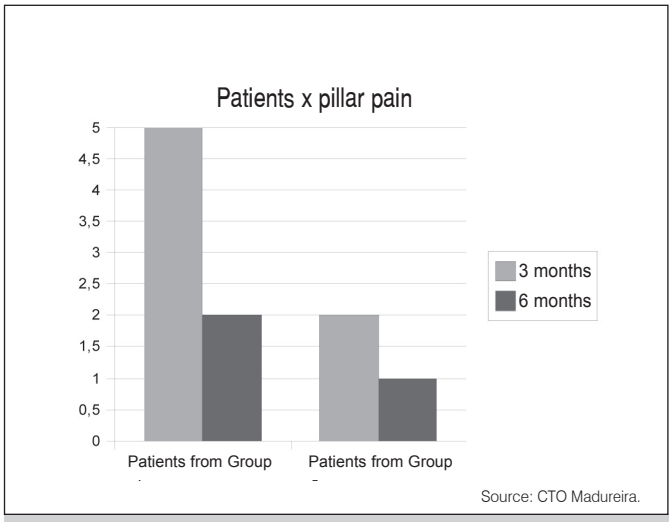

Figure 6. *Number of patients by Group presenting pillar pain.*

Table 2. *Patients from Group 2.*

Patients operated using mini incision	Operated side	Tinel	Phalen	Durkan	Enm	Age	Sex
1	Right	Yes	Yes	Yes	Bilateral	27	Female
2	Left	Yes	Yes	Yes	Bilateral	49	Female
3	Left	Yes	Yes	Yes	Bilateral	42	Female
4	Right	Yes	Yes	Yes	Bilateral	65	Female
5	Right	No	Yes	Yes	Bilateral	30	Female
5	Left	No	Yes	Yes	Bilateral	30	Female
6	Right	Yes	Yes	Yes	Bilateral	50	Female
6	Left	Yes	Yes	Yes	Bilateral	50	Female
7	Right	No	No	No	Bilateral	55	Female
7	Left	No	No	No	Bilateral	55	Female
8	Right	Yes	Yes	Yes	Bilateral	53	Female
8	Left	Yes	Yes	Yes	Bilateral	53	Male
9	Right	Yes	Yes	Yes	Bilateral	42	Male
9	Left	Yes	Yes	Yes	Bilateral	42	Female
10	Right	Yes	Yes	Yes	Bilateral	51	Female
11	Left	Yes	Yes	Yes	Bilateral	53	Female
12	Right	Yes	Yes	Yes	Bilateral	38	Female
13	Right	Yes	Yes	Yes	Bilateral	31	Female
14	Right	Yes	Yes	Yes	Bilateral	35	Female
15	Left	Yes	Yes	Yes	Bilateral	26	Female
16	Right	Yes	Yes	Yes	Bilateral	44	Female
17	Right	Yes	Yes	Yes	Right	33	Female
18	Left	Yes	Yes	Yes	Left	76	Female
19	Right	No	No	Yes	Right	86	Male
20	Right	Yes	Yes	Yes	Bilateral	50	Female
21	Right	No	No	Yes	Right	73	Female
22	Right	No	Yes	Yes	Bilateral	25	Female
23	Right	Yes	Yes	Yes	Bilateral	36	Female

Repeated numbers refer to patients that were operated bilaterally. Source: CTO Madureira. Caption: ENM = electroneuromyography.

Table 3. *Number of patients that presented complications related to the scar.*

Complication with the scar	1 week	2 weeks	1 month	2 months	3 months	6 months
Number of Pat from Group 1	4	8	11	8	5	1
Number of Pat from Group 2	4	5	3	3	2	1
Total	8	13	14	11	7	2

Source: CTO Madureira. Caption: Pat = Patients.

Table 4. *Number of patients with persistence of "pillar" pain.*

Pain at the pillar	3 months	6 months
Patients from group 1	5	2
Patients from group 2	2	1
Total	7	3

Source: CTO Madureira.

Table 5. *Time taken after surgery for return to daily living and/or work activities, and number of patients.*

Time taken	1 month	2 months	3 months	6 months
Number of patients from group 1	4	5	9	6
Number of patients from group 2	4	4	2	10
Total	8	9	11	16

There were cases in which the patient returned to daily living activities or to work only after the sixth postoperative month. Source: CTO Madureira.

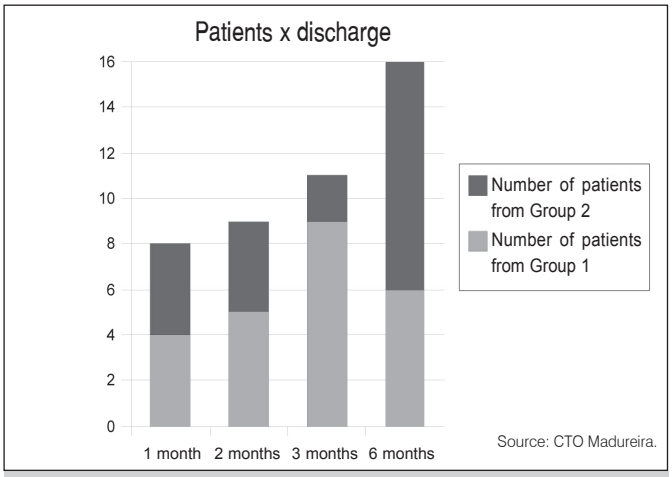

Figure 7. *Time elapsed after surgery until clearance for return to habitual or labor activities of the patients, by Group.*

In the sample group of this study, the observed predominance of female patients and bilaterality of the disease were consistent with literature.

Some postoperative conditions, such as "pillar" pain and scar hypertrophy, are frequently correlated to unsuccessful surgery, as these are relative signs and symptoms that are directly linked

to the patient's perceptions. Time taken to return to activities of daily living and/or work is also a determining factor for success in the surgical treatment of CTS. Release of the carpal canal is effectively achieved during surgery, but the subjective evaluation of the patients enables better assessment of the success of the procedure.[8,9]

It can be seen from literature that surgery via the classic open approach, in which the incision is made directly above the carpal canal, has greater potential for complications relating to the scar, such as hypertrophy and local hypersensitivity, besides causing a prolonged time of limitations relating to the habitual use of the operated hand, which means that patients take longer to return to work and to activities of daily living.[8,11,15,17] The main physiopathological mechanism for complications with the scar is probably lesions of the dermal sensory plexus and in the distal branches of the palmar cutaneous branch of the median nerve. Longer incisions cause more lesions to the neuron structures and more postoperative complications.[18] The use of endoscopic techniques or special materials for CTS surgery, with the intention of reducing these postoperative signs and symptoms and possible complications, has a long learning curve and increases the cost of the procedure.[3,12,15,16,19-21]

The aim of this study is to diminish morbidity due to the scar, thus reducing the discomfort and "pillar" pain caused by the conventional longitudinal incision, and to provide a faster return to habitual activities for the patients, without increasing the treatment cost. In a study in 2003, Klein and collaborators concluded that the mini-incision technique was an effective method for CTS surgery, associated with significant improvement in symptoms, lower incidence of complications relating to the scar and improvement of general hand function, although this would not allow additional procedures to be executed, if these were necessary.[22] Khalil et al.[18] are concerned about the fact that blindly opening the retinaculum of the flexors would produce injuries to the prime structures of the hand, but these lesions did not occur in the cases operated in this study. Use of a tentacannula was an essential factor for avoiding these complications.

In this study, it was observed that using the technique of a transverse mini-incision one centimeter from the wrist flexion fold and proximally to the retinaculum of the flexors provided less discomfort and a lower rate of persistence of pain in the "pillar", but did not show a significant difference in the general time taken after surgery for these patients to return to their daily living activities or work. One causal factor for the lack of significant difference between the groups over the course of the postoperative period for the patients' return to daily living or work activities, might have been the existence of labor legislation issues, which was not considered an excluding factor for the patients' participation in the study. The results were concordance with those of Fernandes et al.,[12] who carried out surgical treatment for CTS by means of retinaculotomy, in which the scar outside the hand pressure zone provides reduced pain in the prominent region above the retinaculum of the flexors. The occurrence of one case of postoperative complication (which was revised surgically using the conventional longitudinal approach) is compatible with the incidence of complications reported in literature.[6,17] The existence of this complication does not render surgery using this technique unviable as a valuable option in the surgical treatment of STC. There are few accounts of complications with the use of min-incisions, and these complications may occur irrespective of the technique used.[12,17] However, if the signs and symptoms of compression of the median nerve persist, together with the electrophysiological alterations, an assessment using magnetic resonance imaging of the wrist is recommended in order to evaluate the possible proximal division of the median nerve.

CONCLUSION

It is concluded that the technique of a transverse mini-incision located one centimeter proximally to the wrist flexion fold, for surgical treatment of CTS, is an important and effective option for this purpose, with lower incidence of discomfort in the scar and of pain in the "pillar" three months after surgery, than shown by the conventional longitudinal technique, but that this technique is not free from complications.

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