

PROSPECTIVE COMPARATIVE STUDY BETWEEN PROXIMAL TRANSVERSE INCISION AND THE CONVENTIONAL LONGITUDINAL INCISIONS FOR CARPAL TUNNEL RELEASE

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ABSTRACT

Carpal tunnel syndrome (CTS) is a pathological condition frequently seen in orthopedic consultation offices. It is most common compressive neuropathy and also the one most often treated surgically. CTS is usually diagnosed clinically, through the clinical history, physical examination (Tinel, Phalen and Durkan tests) and complementary examinations, and more specifically, nerve conduction studies. Ultrasound scans and magnetic resonance imaging may also be used. Conservative treatment is reserved for patients presenting with mild symptoms, with little incapacitation, who show good response to non-steroidal or steroidal anti-inflammatory

drugs, physiotherapy and lifestyle changes. Surgical treatment is more frequent, and a variety of techniques are used. The goal of the surgery is to decompress the carpal tunnel and, by sectioning the transverse carpal ligament, release the median nerve. The aim of this paper was to compare surgical treatment of CTS by means of a transverse mini-incision made proximally to the carpal canal, with the classic longitudinal incision over the carpal canal. The mini-incision technique was shown to be less invasive and equally effective for treating CTS, with less morbidity than with the classic longitudinal incision.

Keywords - Carpal Tunnel Syndrome/surgery; Median Nerve

INTRODUCTION

Carpal tunnel syndrome (CTS) is a condition in which the median nerve is compressed as it crosses the wrist, which causes a number of signs and symptoms. CTS 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 when opposing the thumb⁽¹⁾.

CTS is the most common compressive neuropathy, and it occurs in 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 extreme flexion of the thumb at work⁽¹⁻⁴⁾. According to Souza, CTS is the compressive neuropathy that is most associated with repetitive strain injury⁽⁵⁾.

CTS is usually diagnosed clinically, based on the clinical history and physical examination, and is confirmed by means of electroneurophysiological studies. Souza⁽⁵⁾ stated that the clinical diagnosis with the Tinel and Phalen tests was sufficient, in conjunction with patients' complaints. Other pathological conditions such as cervical radiculopathy, brachial plexus lesions, thoracic outlet syndrome, apical pulmonary neoplasia, pronator syndrome, cubital tunnel syndrome, ulnar tunnel syndrome and peripheral neuropathy may cause paresthesia in the hand and should be excluded from

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Declaramos inexistência de conflito de interesses neste artigo

the diagnosis^(6,7). A combination of findings from the clinical history and physical examination is more trustworthy than just one sign or symptom alone. CTS is accurately diagnosed in most cases when nocturnal pain, a positive Tinel test, a painful carpal tunnel compression test (Durkan test) and a positive Phalen test are found in association^(1,3,6,8,9). According to Howard, the Durkan test has the highest sensitivity for detecting CTS in the physical examination⁽²⁾.

Electrophysiological tests (neuroconduction speed and electromyography) are used to confirm the clinical diagnosis. Pathological neuroconduction speed tests include evaluating decreased action potential amplitude, increased distal latency and diminished speed. Distal motor latency of more than 4.5 ms and sensory latency of more than 4.2 ms are abnormal⁽²⁾. Abnormal electromyographic findings include diminished insertion activity, fibrillation at rest, positive acute waves, complex repeated discharges and diminished motor unit recruitment. The clinical condition is sometimes so classic that the signs and symptoms are enough to establish the diagnosis⁽⁶⁾, but electroneuromyography should be considered in the preoperative planning, even though it is uncomfortable for patients. It is also a way of documenting the patient's case for legal purposes^(4,7).

The treatment may be conservative or surgical. Several surgical techniques for decompression exist⁽⁴⁾. The conservative treatment for CTS includes modification of activities, nighttime immobilization of the thumb, corticosteroid injection into the carpal canal and oral medications^(1,2). Corticosteroid injection into the carpal canal combined with nighttime immobilization has an early success rate of around 80% for symptom improvement. However, after 12 to 18 months, only 22% of the patients remain free from symptoms⁽¹⁾. Howard stated that 40% of the patients remained free from symptoms after corticosteroid injection into the carpal canal when the symptoms had been present for at least one year⁽²⁾.

Surgical treatment is indicated for patients who have not achieved any improvement 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 amount of symptom relief and some functional recovery⁽⁴⁾. Several well-controlled studies have shown that there are no benefits from micro-neurolysis, epineurectomy or tenosynovectomy for idiopathic CTS⁽¹⁻³⁾, and these procedures should be car-

ried out only in selected cases⁽⁴⁾.

Independent of the surgical technique used, the many anatomical variations in the region demand accuracy in the techniques used for releasing the carpal canal. The complications from the surgery are well documented in the literature and may occur with any 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 taken to return to work^(4,10).

The incidence of persistent symptoms after the surgery ranges from 1% to 25%(1), and may even reach 40%(2). The most common cause is incomplete release of the carpal canal^(1,12).

The aim of the present study was to compare surgical treatment for CTS performed by means of a 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) characteristics of the operative wound (pain, discomfort and hypertrophy); 2) presence or absence of pain in the "pillar"; and 3) time taken to return to work or to activities of daily living.

SAMPLE AND METHODS

Between May 2007 and December 2008, a prospective study comparing two surgical techniques for releasing the carpal canal was conducted: a conventional longitudinal incision and a proximal transverse incision centered one centimeter proximally to the wrist flexion skinfold.

Forty-seven patients with carpal tunnel syndrome (diagnosed clinically and electroneuromyographically) who were attended at the Hand Surgery Outpatient Clinic of the Madureira Traumatology-Orthopedic Clinic were evaluated in this study. They were divided into two groups and were treated surgically. All the patients were always evaluated and operated by the same surgeon (the author). This was done consecutively, and the surgical technique to be used was decided randomly for each patient. All the patients agreed to participate in the study by signing a free and informed consent statement furnished by the investigator.

No infiltration with corticoids was made in any of the patients before the operation, because it was considered that this would not produce any significant improvement in the symptoms in medium to long-term evaluations⁽⁴⁾.

None of the patients was immobilized after the operation. Bathia *et al*⁽¹³⁾ stated that this procedure is ineffective in decreasing the postoperative pain.

Group 1 was formed by 24 patients (28 hands) who were operated using the classic longitudinal access route over the carpal canal. Group 2 was formed by 23 patients (28 hands) who were operated by means of 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, in accordance with the investigator's decision. Factors relating to labor law issues were not considered to be excluding factors, and such patients were included in both groups so that there would not be any discrepancy in the evaluation.

Group 1 was composed of 21 women and three men, and group 2 was composed of 21 women and two men. The right hand was operated in the cases of 13 patients in group 1 and in the cases of 13 patients in group 2. The surgery was bilateral for four patients in group 1 and five patients in group 2. It was shown by electro-neuromyography that both sides were affected in 18 patients in group 1 and 20 in group 2.

The two groups were compared in relation to the characteristics of discomfort of the healing wound, presence or absence of pain in the "pillar" and time taken to return to activities of daily living or work without any restrictions on the patients.

SURGICAL TECHNIQUE

The surgery was carried out under Bier anesthetic block, using a pneumatic tourniquet, after draining the blood from the arm that was to be operated. The patients in 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 described by Ortiz and Lobet⁽¹⁴⁾ (Figure 1). Careful dissection was performed, and the transverse ligament of the carpus was identified by direct viewing. This was sectioned completely in order to identify the median nerve. The wound was cleaned using 0.9% physiological serum, the hemostasis was reviewed and the skin was sutured using 4-0 mononylon. A compressive dressing was applied, without immobilization of the wrist. The patients in group 2 were operated using a minimally invasive technique with a transverse access located one centimeter proximally to the wrist flexion skinfold, of 2 cm in length (Figure 2). The long palmar tendon was



Figure 1 – Conventional incision.



Figure 2 – Mini-incision.

identified laterally to the median nerve on the anterior face of the wrist (Figure 3) and the proximal edge of the transverse ligament of the carpus (Figure 4). The median nerve was protected by using a metal spacer (tentacannula), in order to avoid injuring it. The transverse ligament of the carpus was sectioned and the median nerve was brought into view. The wound was cleaned using 0.9% physiological serum, the hemostasis was reviewed and the skin was sutured using 4-0 mononylon. No wrist immobilization was applied.

RESULTS

All the patients were always evaluated by the same examiner in the first and second weeks after the ope-



Figure 3 – Mini-incision and long palmar tendon.



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

ration and in the first, second, third and sixth months after the operation. Pain in the “pillar” was evaluated in the third and sixth months after the operation. It was evaluated as present or absent on palpation, carried out 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.

Female patients predominated (87.5% in group 1; 91.3% in group 2), and electroneuromyography showed that most patients were affected bilaterally (75% of the patients in group 1; 86% of the patients in group 2). The surgery was bilateral in 16% of the patients in group 1 and 21% of the patients in group 2. Bilateral surgery was carried out using the same technique for both hands.

Tables 3, 4 and 5 relate to the parameters evaluated in the present study: numbers of patients who complained about discomfort in the healing wound, number of patients who presented pain in the “pillar” and the time taken after the operation for patients to be discharged from the treatment and for them to return to their activities at home and/or at work.

The complications observed in the operative wound were basically seen at the evaluations in the first and second weeks: superficial infection of the operative wound, inflammatory reaction at the suture stitches and, possibly, dehiscence of the suture (observed in one patient in group 1). These complications were resolved immediately. At the subsequent evaluations (in the first, second, third and six months after the operation), the complications related to pain in the scar and hypertrophy of the scar. As a way of generalizing occurrences of complications relating to the scar, such patients in both groups were listed as complication cases. In Table 3 and Figure 5, the numbers of patients in each group who presented complications relating to the scar are reported.

Pain in the “pillar” (Table 4) was found to be more frequent among the group 1 patients in the three-month evaluation. However, this complication was found to have equal presence in the two groups in the six-month evaluation (Figure 6).

Table 5 shows that the numbers of patients released from treatment, i.e. in a discharge condition such that they were fit to return to work, were similar in the two groups. A greater number of group 1 patients were released three months after the operation, but this was 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 the operation were similar. Figure 7 shows the progression of the numbers of patients discharged.

In one case in group 2, the painful symptoms and the electroneurophysiological abnormalities persisted, despite a long period of physiotherapy treatment and treatment with anti-inflammatory drugs. Magnetic resonance imaging showed the presence of a bifid median nerve. This patient subsequently underwent an operation for a second 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

Table 1 – Patients in group 1.

Patients operated using classic approach	Side operated	Tinel	Phalen	Durkan	Electroneuromyography	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	53	Male
5	Right	Yes	Yes	Yes	Bilateral	56	Female
6	Right	Yes	Yes	Yes	Bilateral	52	Female
7	Right	Yes	Yes	Yes	Bilateral	41	Female
8	Right	Yes	Yes	No	Bilateral	40	Female
8	Left	Yes	Yes	No	Bilateral	42	Female
9	Left	Yes	Yes	Yes	Left	24	Female
10	Left	Yes	Yes	Yes	Bilateral	30	Female
11	Left	Yes	Yes	Yes	Bilateral	29	Female
12	Right	Yes	Yes	Yes	Bilateral	54	Female
13	Left	Yes	Yes	Yes	Bilateral	55	Male
14	Right	Yes	Yes	Yes	Bilateral	47	Female
15	Left	No	Yes	Yes	Normal	51	Female
16	Right	Yes	Yes	Yes	Bilateral	38	Female
17	Right	Yes	Yes	Yes	Bilateral	39	Female
18	Right	Yes	Yes	Yes	Right	53	Female
19	Left	Yes	Yes	Yes	Bilateral	46	Female
19	Right	Yes	Yes	Yes	Bilateral	46	Female
20	Right	No	Yes	Yes	Right	39	Female
21	Left	Yes	Yes	Yes	Bilateral	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

Source: Madureira Traumatology-Orthopedic Clinic. Repeated numbers refer to patients who were operated bilaterally.

in the first operation. After this procedure, there was a significant improvement in this patient’s pain and paresthesia. There was no need for reoperations among the group I patients.

DISCUSSION

CTS is a frequently seen pathological condition in orthopedics outpatient clinics, especially in hand surgery clinics. It is the most common and most studied compressive neuropathy among human beings, with a prevalence ranging from 51 to 125 cases per 100,000 individuals⁽⁷⁾. CTS surgery is a routine procedure carried out around the world, often on an outpatient basis^(2,15,16). It is usually indicated because of low rates of clinical improvement with conservative treatment⁽¹²⁾.

In the sample of the present study, the observed pre-

dominance of cases among females and bilaterality of the disease were in agreement with the literature.

Some postoperative conditions such as pain in the “pillar” and hypertrophy of the scar have frequently been correlated with unsuccessful surgery, since these are relative signs and symptoms that are directly linked to patients’ perceptions. The time taken to return to activities of daily living and/or work is also a determining factor for success in surgically treating CTS. Release of the carpal canal is fully achieved through the operation, but patients’ subjective evaluations enable a better assessment of the success of the procedure^(8,9).

It can be seen from the literature that surgery using the classic open approach, in which a direct incision is made above the carpal canal, has greater potential for complications relating to the scar, such as hypertrophy

Table 2 – Patients in group 2.

Patients operated using mini-incision	Side operated	Tinel	Phalen	Durkan	Electroneuromyography	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	Female
9	Right	Yes	Yes	Yes	Bilateral	42	Male
9	Left	Yes	Yes	Yes	Bilateral	42	Male
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	No	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

Source: Madureira Traumatology-Orthopedic Clinic. Repeated numbers refer to patients who were operated bilaterally.

Table 3 – Number of patients who presented complications relating to the scar.

Complication relating to the scar	1 week	2 weeks	1 month	2 months	3 months	6 months
Number of patients in group 1	4	8	11	8	5	1
Number of patients in group 2	4	5	3	3	2	1
Total	8	13	14	11	7	2

Fonte: CTO Madureira. Legenda: Pac = Pacientes.

and local hypersensitivity, as well as causing a prolonged time of limitations relating to the habitual use of the operated hand. This makes it longer for patients to return to work and to their activities of daily living^(8,11,15,17). The main physiopathological mechanism for complications relating to the scar probably involves lesions of the dermal sensory plexus and of 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 aim of diminishing these postoperative signs and symptoms and the possible complications, has a long learning curve and increases the cost of the procedure^(3,12,15,16,19-21).

The purpose of this study was to diminish the morbidity due to the scar, thereby reducing the discomfort and the pain in the “pillar” that were caused by the conventional longitudinal incision, and to provide a faster return to habitual activities for the patients, without in-

Table 4 – Numbers of patients with persistent pain in the “pillar”.

Pin in the pillar	3 months	6 months
Patients in group 1	5	2
Patients in group 2	2	1
Total	7	3

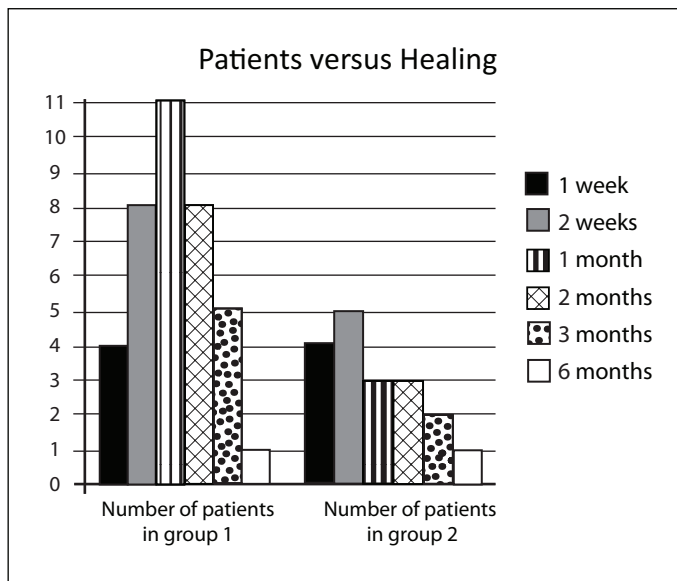
Source: Madureira Traumato-Orthopedic Clinic.

Table 5 – Time taken after the operation for patients to return to daily activities and/or to work, and numbers of patients*.

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

Source: Madureira Traumato-Orthopedic Clinic.

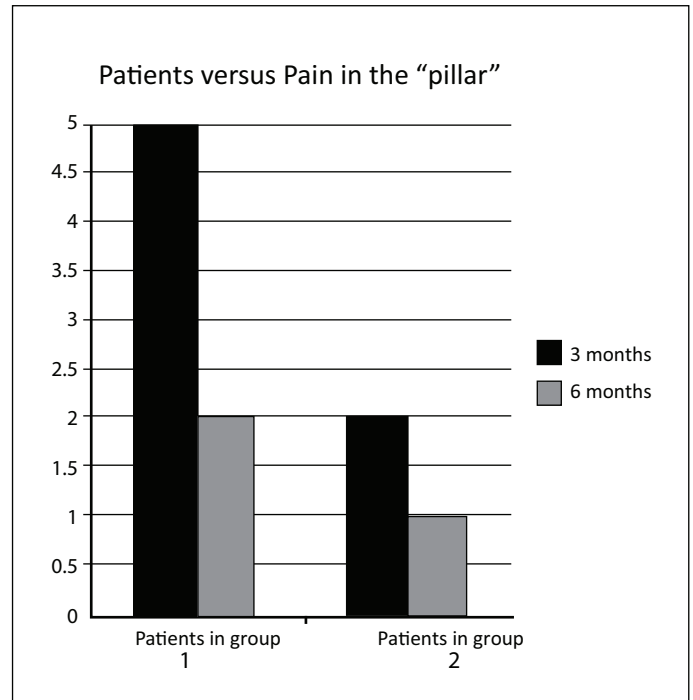
*There were cases in which the patient returned to daily activities or to work only after the sixth postoperative month.



Source: Madureira Traumato-Orthopedic Clinic.

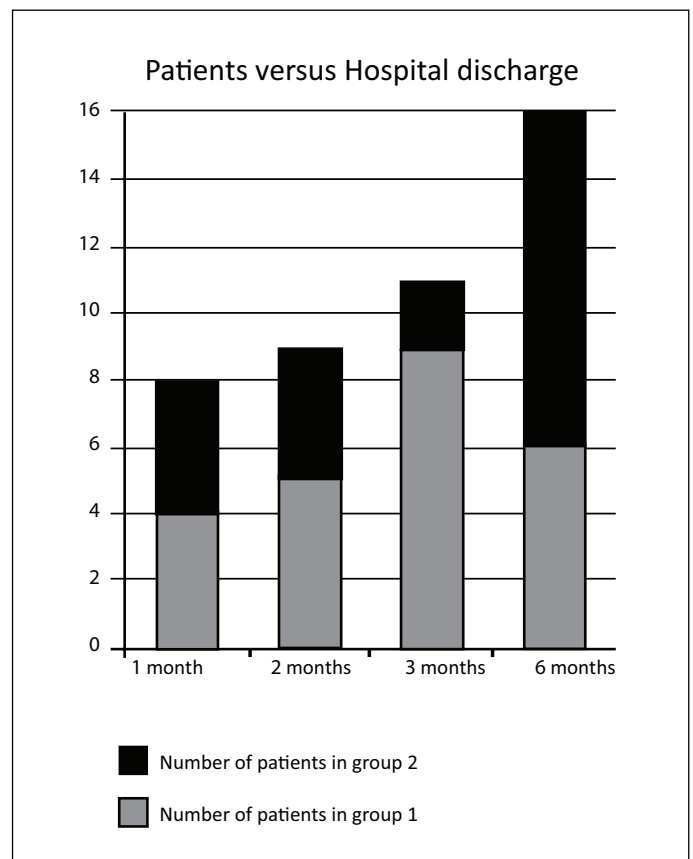
Figure 5 – Numbers of patients in each group who presented complications relating to the scar.

creasing the cost of the treatment. In a study in 2003, Klein *et al*⁽²²⁾ concluded that the mini-incision technique was an effective method for CTS surgery that provided a significant improvement in symptoms, lower incidence of complications relating to the scar and improvement in general hand function, although this approach would not allow additional procedures to be undertaken, if they became necessary. Khalil *et al*⁽¹⁸⁾ were concerned about the fact that blindly opening the retinaculum of the flexors would give rise to injuries to the prime structures of the hand, but no such lesions occurred in the cases



Source: Madureira Traumato-Orthopedic Clinic.

Figure 6 – Numbers of patients in each group who presented pain in the “pillar”.



Source: Madureira Traumato-Orthopedic Clinic.

Figure 7 – Time taken after the operation for patients to be released to return to their habitual activities or to work, per group.

operated in the present study. Use of a tentacannula was a fundamental 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 skinfold and proximally to the retinaculum of the flexors provided less discomfort and a lower rate of persistence of pain in the “pillar”, but it did not show any significant difference in the general time taken after the operation for these patients to return to their daily activities or to work. It is possible that one causal factor for the lack of significant difference between the groups over the course of the postoperative period, regarding the patients’ return to their daily activities or to work was the existence of labor law issues, which were not considered to be an excluding factor for patients’ participation in the study. The results were concordant with those of Fernandes *et al*⁽¹²⁾, who carried out surgical treatment for CTS by means of retinaculotomy, in which the scar outside of the pressure zone of the hand provided diminished 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) was

compatible with the incidence of complications reported in the literature^(6,17). The existence of this complication does not make surgery using this technique unviable as a technique of value for surgical treatment of CTS. There are few reports of complications from the use of mini-incisions, and these complications may occur independent of the technique used^(12,17). However, if the signs and symptoms of compression of the median nerve persist, along with persistence of the electrophysiological abnormalities, an assessment using magnetic resonance imaging of the wrist is recommended, in order to evaluate whether there might be a proximal division of the median nerve.

CONCLUSION

It was concluded that the technique of a transverse mini-incision located one centimeter proximally to the wrist flexion skinfold, 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 the operation than shown by the conventional longitudinal technique, but that this technique was not free from complications.

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