CARPAL TUNNEL SYNDROME: REASSESSMENT OF LONG-TERM OUTCOMES WITH THE USE OF THE PAINE® RETINACULATOME DURING SURGERY THROUGH A PALMAR INCISION

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SUMMARY

Carpal tunnel syndrome (CTS) is the most commonly diagnosed and treated entrapment neuropathy. Surgical treatment involving the clearance of the flexor retinaculum is widely employed. Open, minimally-invasive and endoscopic surgical techniques have all been described as treatment options for CTS and short-term success with these methods is well established. Long-term studies, however, are scarce and usually evaluate only clinical signs and symptoms. The objective of this study is to evaluate patients treated by a palmar incision and by the use of the Paine retinaculatome (6 years post-op minimum; mean is 98 months). We assessed palmar, pulp to pulp, lateral and tridigital prehension strength using a dynamometer. Finger sensitivity was measured using nylon monofilaments. We observed that while sensitivity improved with time, grip and prehension strength remained unchanged.

Keywords:*Carpal tunnel syndrome; Hand strength; Sensation; Treatment outcome.*

INTRODUCTION

The most common nervous compression is that of the median nerve occurring in the area in which it passes across carpal region, characterizing the carpal tunnel syndrome (CTS). This may occur by a volume increase of structures comprised in it or by the reduction of tunnel inner space. According to anatomical studies, the narrowest region of the tunnel is at the hamate hamulus, and wrist flexion promotes nerve compression by proximal margin of flexors retinaculum.

Carpal tunnel is the region through which fingers flexor tendons and the median nerve towards hands fingers pass. Its floor is formed by the concave arch of carpal bones covered by ligaments. Tunnel ceiling is formed by flexors retinaculum, a fibrous band immediately above the median nerve, which has its insertion at the radial side, at the scaphoid bone tuberculum and at the trapezium bone, and, at the ulnar side, at the pisiform bone and hamate hamulus. In the tunnel, the nerve is located in a volar position to superficial flexor tendons of medium and annular fingers.

Surgery for releasing carpal tunnel is a current topic in literature, matter of many publications, especially from the 1950's on. Some studies report various kinds of complications[1,2,3,4] and many others report excellent outcomes and low complication rates[1,3,5,6].

In the past few years, there have been an increasing use of endoscopic methods for releasing carpal tunnel, with the objective of hastening patients' return to work and reducing morbidity[7]. The disadvantage of this technique is the high number of operative complications and the high cost of instruments and surgeon training [1,3,8,9].

This study aims to reassess long-term surgical treatment outcomes in 112 patients with carpal tunnel syndrome, operated through palmar incision, using the Paine® retinaculatome.

MATERIALS AND METHODS

From October to December, 2004, we reassessed patients operated within the period of March 1995 and March 1998, at the "Hand House", Discipline of Hand and Upper Limb Surgery - Department of Orthopaedics and Traumatology/ UNIFESP. A total of 112 hands of 89 patients were submitted to surgical release of the carpal tunnel by palmar incision and by using the Paine® retinaculatome. We managed to find and examine 45 patients, but the others have not responded to our attendance request and a patient was excluded due to an event of stroke resulting in lack of hand strength, which would compromise postoperative evaluation. At total, we could count on 44 patients, with 56 hands being reassessed.

Among the 44 patients assessed, 13 are shown twice in our case series because they have been submitted to surgery on both sides (11 and 29, 13 and 16, 14 and 15, 17 and 22, 18 and 27, 19 and 25, 24 and 53, 28 and 45, 30 and 31, 37 and 40, 38 and 39, 41 and 43, 48 and 50). Operated hands are sorted by surgery date and no hand was submitted to more than one surgical procedure.

Postoperative reassessment time ranged from 80 months to 117 months, with an average of 98 months.

Ages at reassessment time, ranged from 38 to 77 years old, with an average of 57 years old. By the time of surgery, ages ranged from 18 to 79 years old, with an average of 46 years old.

Study conducted by the Discipline of Hand and Upper Limb Surgery, Department of Orthopaedics and Traumatology, Federal University of São Paulo – DOT/UNIFESP

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Regarding gender, 2 (4.5%) were males and 42 (95.5%) were females.

Regarding the affected hand, 36 (81.8%) patients reported bilateral complaints, 8 (18.2%) on the right hand and 0 (0,0%) on the left hand. Right hand was dominant in 40 (89.5%) patients, the left hand was dominant for 1 (1.7%) and 3 (8.8%) were ambidextrous. Surgery was performed on the right hand in 25 (56.8%) patients, on the left hand in 6 (13.6%) and 13 (29.6%) bilaterally.

On Table 1, all data regarding patients according to sequence number, name initials, and evaluation of palmar, pulp-pulp, lateral, and tridigital prehension are described, and on Table 2, pre- and postoperative sensitivity evaluation of the 1st, 2nd, 3rd, 4th and 5th fingers by means of monofilaments are reported.

The preoperative evaluation of palmar, pulp-pulp, lateral and tridigital prehension strength was performed in 43 (76.8%) hands. At reassessment, the test was applied to 56 hands.

The preoperative evaluation of hand fingers sensitivity was performed by means of nylon monofilaments in 44 (78.6%) hands. At reassessment, the test was applied to 56 hands.

For measuring palmar, pulp-pulp, lateral and tridigital prehension strength, a hydraulic palmar prehension dynamometer, adjusted to the second position and a hydraulic digital prehension dynamometer, both Baseline (Irvington, N.Y., U.S.A.) brand were used. For evaluation, three measurements were taken with as much strength as possible, and the average recorded as kilogram-force. Individuals were asked to sit with adduced arm, parallel to trunk, flexed elbow in 90 degrees, with forearm and wrist in neutral position.

Sensitivity was probed by means of the nylon monofilaments test (Estesiômetro®), manufactured by SORRI, Bauru, Brazil. This consists of a set of seven tubes, each one containing a pair of monofilaments. The number of each thread precisely indicates the axial force required to bend the filaments, each one of a different color and corresponding to a grade in grams. Green - 0.05 g; blue - 0.20 g; violet - 2.00 g; dark red - 4.00 g; orange - 10.00 g; magenta - 300.00 g.

In order to hasten evaluation, only digital pulps of the hand fingers were assessed. The test was made in an area of the skin with normal sensitivity and the patient was asked to move the finger when touch was perceived. The patient was not able to visually notice the test performance, so that the monofilament was perpendicular to digital pulp skin surface. The strength applied was enough to bend the monofilament. The test begins with the lighter monofilament (0.05 g - green). In case no response was provided by the patient, the test proceeded with the next heavier monofilament (0.20 g - blue), and so on. Green and blue filaments (0.05g and 0.20 g) were applied up to three times to each site, with only one positive response being enough for confirming sensitivity. Other filaments were tested only once.

For all surgeries, we used a surgical instrument developed by Paine, manufactured in stainless steel, with a flat shaft at the frontal plane and with a base plate at the horizontal plane, forming an angle of 135°.

Sequence Number	Strength (Kgf) Preoperative				Strength (Kgf) Late postoperative			
	P	P-P	P-L	P-T	P	P-P	P-L	P-T
1					27	5.0	7.0	5.5
2					20	4.0	6.0	5.5
3					24	3.5	5.0	3.5
4					12	3.5	6.0	3.0
5					30	3.0	6.0	3.5
6					30	5.0	7.5	6.0
7					26	5.0	3.5	5.5
8					24	2.5	4.5	3.0
9					32	7.5	8.5	7.5
10					24	5.5	8.0	7.0
11					28	5.0	5.5	4.0
12					24	5.0	6.5	5.5
13					32	6.5	8.0	6.5
14	28	4.5	6.5	6	22	4.5	7.5	6.5
15	26	4	4	4.5	26	4.0	6.0	5.0
16	28	2.5	3	3.5	30	5.5	7.5	6.5
17	28	2.5	7	5	32	5.0	7.5	6.0
18	22	5.5	6	4	24	4.5	7.0	5.0
19	26	3	3.5	4	30	4.0	5.5	3.5
20	30	2.5	5	4.5	26	2.5	3.5	3.0
21	30	6.5	7.5	7	30	6.0	6.5	3.5
22	30	4.5	7.5	7	28	5.0	7.0	5.0
23	38	6	6.5	6.5	34	6.0	7.5	7.0
24	28	4.5	6.5	5.5	23	4.5	6.5	5.5
25	30	5	4	5.5	32	7.5	6.0	6.0
26	32	5.5	7	8	26	5.0	7.0	6.5
27	28	6	6	5.5	30	6.0	7.5	5.5
28	30	5	5	5	32	4.5	6.0	5.5
29	20	5	6	6.5	22	4.5	5.5	4.5
30	20	5	5	5.5	20	5.5	8.0	6.5
31	22	3.5	4.5	7.5	24	5.5	8.0	6.5
32	30	7	10	7	28	5.0	9.5	6.5
33	30	7	8	7	26	6.0	7.0	6.0
34	22	4.5	7	5.5	28	5.0	7.0	6.0
35	28	6	8	6	34	8.5	8.5	8.0
36	30	4	3.5	5	32	4.0	6.0	4.5
37	28	4.5	6.5	6.5	34	6.0	6.5	6.5
38	38	6	8.5	8.5	34	3.5	8.0	8.0
39	34	5	8	6.5	32	4.5	7.5	6.0
40	28	5.5	5.5	6.5	30	7.0	4.5	7.0
41	22	4	6	3.5	26	4.0	2.0	2.5
42	22	5	6	5.5	30	7.0	7.5	6.5
43	22	4.5	4.5	6.5	24	4.0	2.0	2.5
44	16	4	3.5	4	30	4.0	5.0	4.0
45	28	5.5	5.5	5.5	34	7.0	6.0	6.5
46	22	5.5	6	4.5	24	4.0	5.5	5.5
47	30	5	5.5	5.5	24	6.5	8.0	7.5
48	16	4.5	5.5	5	20	4.5	6.5	5.5
49	32	5.5	7.5	6	40	6.0	8.5	7.5
50	16	3.5	5.5	4.5	16	3.0	6.0	5.0
51	16	3.5	4	4	24	3.0	6.5	4.0
52	26	3	4.5	5	26	4.0	4.5	5.0
53	22	3.5	5.5	4	20	3.5	6.0	3.0
54	34	5	7	7	42	7.5	8.5	8.0
55	32	5.5	5	6	42	7.5	8.5	8.0
56	20	3.5	3.5	3.5	20	2.0	4.0	3.5

***Table 1** - Data corresponding to 56 hands of 44 patients with Carpal Tunnel Syndrome submitted to surgery, according to sequence number, name initials, palmar prehension strength (P), pulp-pulp (P-P), lateral (P-L) and tridigital (P-T), pre- and postoperatively.*

STATISTICAL METHOD

In order to assess the evolution of hands regarding the preoperative and postoperative periods for variables palmar, pulp-pulp, lateral and tridigital prehension strengths, the Wilcoxon's test was used because we wanted to check the evolution in the course of time.

The same test was used for the fingers sensitivity variable, where time was determined as pre- and postoperative in order to check how each finger would behave overtime. The significance level established in all cases was always equal or lower than 0.05 (5%).

When a calculated statistics presented a significant value, we used an asterisk (*) to characterize it. Otherwise, that is, if it was non-significant, a NS was used.

Averages were calculated and presented only for information purposes.

ANATOMY TERMINOLOGY

The "Anatomy Terminology" employed was that of the

Brazilian Society of Anatomy in Anatomy Terminology, 2001.

RESULTS

Table 1 shows measurements for palmar, pulp-pulp, lateral and tridigital prehension strengths of the 43 hands submitted to pre- and postoperative evaluations. Statistical analysis is shown on Table 3 and plotted on Graph 1 according to the palmar, pulp-pulp, lateral and tridigital prehension strengths, respectively.

Table 2 shows the results for fingers sensitivity in fingers of 44 hands submitted to pre and postoperative evaluations. The statistical analysis is shown on Table 4 and Graph 2 plots pre and postoperative sensitivity for each variable.

DISCUSSION

The Carpal tunnel syndrome is the most common compressive syndrome, and the flexors retinacula division is the surgery most often performed on the upper limbs worldwide.

There are just a few studies in literature describing a long-term follow-up of patients with carpal tunnel syndrome surgically treated. The postoperative follow-up time varies among the many studies, reaching up to 72 months[1,11,12]. No long-term follow-up study was found on CTS treatment uniquely using the Paine® retinaculatome. In this study, the average follow-up time of patients was 8 years and 2 months.

CTS usually occurs between the forth and sixth decade of life[6], and this datum agrees with our case series, by the time of surgery, in which 80% of the patients belonged to that age group.

We noticed a 95.5% incidence in females, fact that agrees with literature, in which the great majority of studies report a highest incidence of CTS among women[12,13].

Bilateral CTS is usually the mostly found in many studies, followed by right hand and left hand separately[14], which is in agreement with our case series, where we found 81.8% of bilateral cases and no left hand alone.

The method employed for evaluating hand sensitivity using monofilaments was well established for assessing the outcomes on the surgical release of the carpal tunnel[15,16]. Such evaluation is crucial for confirming the integrity of nervous structures and hand sensitivity changes following surgery.

Another useful method for assessing hand function is the measurement of strength made with dynamometers, and palmar, pulp-pulp, lateral and tridigital prehension strengths can be measured as well[17,18,19]. The comparison to the contralateral hand should not be used as a parameter due to the high incidence of bilateral cases[20].

In patients submitted to carpal tunnel release, hand strength returns to the maximal preoperative strength after six months, and 15% to 20% of the patients never achieve their original strength again due to a configuration change of carpal bones or because the retinaculum pulley effect is lost[21]. In those where a loss exists, this is of approximately 20%. Some authors report a late strength loss, after 10 months to 2 years in operated patients[12]. When strength recovery is evaluated by using the classical port, it was noticed that, when compared, the prehension strength and the pulp-pulp strength returned to the same preoperative levels between the 3rd and 6th months[20]. When the endoscopic port was used, a return of the palmar prehension strength and pulp-pulp strength was noticed around the 6th and 3rd weeks, respectively[22]. By comparing the classical incision to the double incision, an early recovery of strength was found with the double incision[23]. Standard open surgery for carpal tunnel release is the preferred method of treatment because it remains as effective as other alternatives, being technically easier and presenting a lower risk of complications and additional costs[1,2].

In this study, the averages for palmar prehension strength found were 26.51 kgf preoperatively and 28.16 kgf in the long term, with a statistically significant difference. The averages for lateral prehension strengths found were 5.82 kgf preoperatively and 6.50 kgf in the long term, with a statistically significant difference. The averages for tridigital prehension strengths found were 5.57 kgf preoperatively and 5.59 kgf in the long term, with no statistically significant difference. We can suggest that, in the long term, patients treated with a surgical approach by this technique present a global improvement of strengths in the long term.

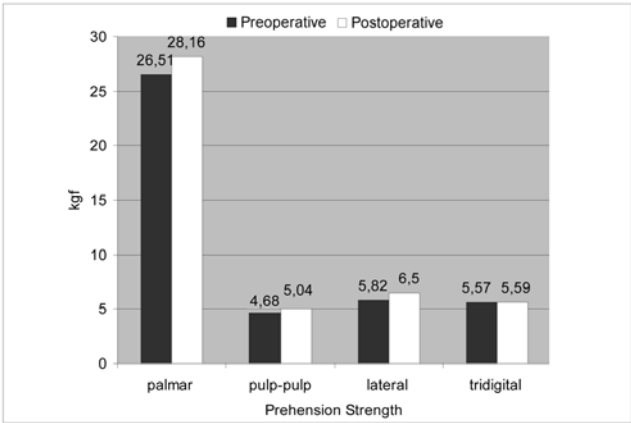
Among the many studies, the postoperative improvement of sensitivity ranges from 17% to 65%[16,20]. In a comparison of a group submitted

Sequence Number	Preoperative Sensitivity (g)					Late postoperative sensitivity (g)				
	1st	2nd	3rd	4th	5th	1st	2nd	3rd	4th	5th
1						0.05	0.05	0.05	0.05	0.05
2						2.00	0.20	0.20	0.20	0.20
3						0.20	2.00	0.05	0.05	2.00
4						0.05	0.05	0.05	0.05	0.05
5						0.20	0.05	0.05	0.05	0.05
6						0.05	0.05	0.05	0.05	0.05
7						0.05	0.05	0.05	0.05	0.05
8						0.05	0.05	0.05	0.05	0.05
9						0.05	0.05	0.05	0.05	0.05
10						0.05	0.05	0.05	0.05	0.05
11						2.00	2.00	2.00	2.00	2.00
12						0.05	0.05	0.05	0.05	0.05
13	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
14	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
15	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
16	0.20	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
17	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.20	0.20
18	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
19	0.20	0.20	0.05	0.20	0.20	0.05	0.05	0.05	0.05	0.05
20	10.00	10.00	10.00	0.20	0.20	0.20	0.20	0.20	0.05	0.05
21	0.05	0.05	0.05	0.20	0.05	0.20	0.05	0.05	0.05	0.05
22	0.20	0.20	0.20	0.20	0.20	2.00	0.05	0.05	0.20	0.20
23	0.20	0.20	0.20	0.20	0.20	0.05	0.05	0.05	0.05	0.05
24	0.20	0.20	0.20	0.20	0.20	0.05	0.05	0.05	0.05	0.05
25	0.20	0.20	0.20	0.05	0.05	0.05	0.20	0.20	0.05	0.05
26	0.20	0.20	0.20	0.20	0.20	2.00	0.05	0.20	0.20	0.20
27	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
28	2.00	2.00	2.00	2.00	2.00	0.05	0.05	0.05	0.05	0.05
29	0.20	0.20	0.20	0.20	0.20	2.00	2.00	2.00	2.00	0.20
30	2.00	2.00	2.00	2.00	2.00	0.05	0.05	0.05	0.05	0.05
31	2.00	2.00	2.00	2.00	2.00	0.05	0.05	0.05	0.05	0.05
32	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.05	0.05	0.05
33	0.20	0.20	0.05	0.20	0.05	0.05	0.05	0.05	0.05	0.05
34	0.20	0.20	0.20	0.20	0.20	0.05	0.20	0.20	0.20	0.20
35	0.20	0.20	0.20	0.20	0.20	0.05	0.05	0.05	0.05	0.05
36	2.00	2.00	2.00	2.00	0.20	0.20	0.20	0.20	0.20	0.05
37	0.20	0.20	0.20	0.20	0.20	0.05	0.05	0.05	0.05	0.05
38	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.05	0.05	0.05
39	0.20	0.05	0.20	0.05	0.05	0.05	0.05	0.05	0.05	0.05
40	0.20	0.20	0.20	0.20	0.20	0.05	0.05	0.05	0.05	0.05
41	10.00	4.00	4.00	0.20	0.20	4.00	-	-	0.05	0.05
42	0.20	0.20	0.20	0.20	0.20	2.00	2.00	0.20	0.20	0.20
43	4.00	10.00	10.00	0.05	0.05	2.00	-	-	0.05	0.20
44	0.20	0.20	0.20	0.20	0.20	0.05	0.05	0.05	0.05	0.05
45	0.20	0.20	0.20	0.20	0.20	2.00	0.05	0.05	0.05	0.20
46	0.20	0.20	0.20	0.20	0.20	0.05	0.05	0.05	0.05	0.05
47	0.20	0.20	0.20	0.20	0.20	2.00	2.00	2.00	0.20	0.20
48	4.00	4.00	4.00	0.20	0.05	0.05	0.05	0.05	0.05	0.05
49	0.20	0.20	0.20	0.20	0.05	0.05	0.05	0.05	0.05	0.05
50	0.20	0.20	0.20	0.20	0.20	0.05	0.05	0.05	0.05	0.05
51	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
52	2.00	2.00	2.00	0.20	0.05	0.20	0.20	0.05	0.05	0.05
53	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.20	0.05	0.05
54	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
55	4.00	0.20	0.20	0.20	0.20	0.05	0.05	0.05	0.05	0.05
56	4.00	4.00	4.00	2.00	2.00	0.20	0.20	0.20	0.20	0.20

Table 2 - *Data regarding 56 hands of 44 patients with Carpal Tunnel Syndrome submitted to surgery, according to sequence number, name initials and sensitivity of the 1st to 5th fingers preoperatively and at late postoperative period.*

Prehension strength	Preoperative	Postoperative	Statistical Analysis
palmar	26.51	28.16	zcalc= -2.035* p=0.042
pulp-pulp	4.68	5.04	zcalc= -1.706 NS p=0.088
lateral	5.82	6.5	zcalc= -2.742* p=0.006
tridigital	5.57	5.59	zcalc= -0.453 NS p=0.651

Table 3 - *Statistical analysis of the averages for palmar, pulp-pulp, lateral and tridigital strengths before and after carpal tunnel release surgery*

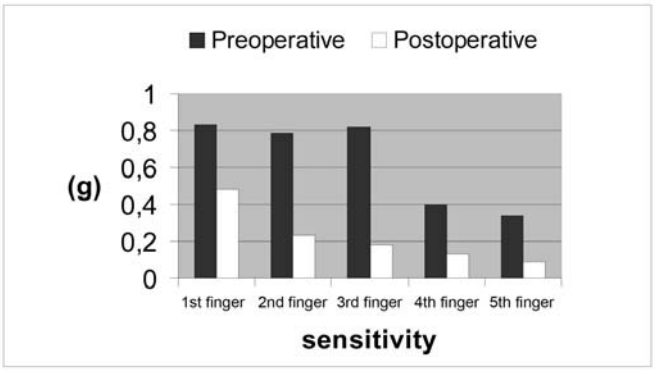


Graph 1 - *Average of palmar, pulp-pulp, lateral and tridigital strengths before and after carpal tunnel release surgery*

to endoscopic release to another one submitted to classical surgery, no statistically significant differences were found between the groups and between pre- and postoperative measurements[24]. In the group of hands studied here, all of them presented favorable and significant differences in the statistical analysis between pre and postoperative follow-up for the five fingers.

	Preoperative	Postoperative	Statistical Analysis
1st finger	0.83	0.48	zcalc= -2.704* p=0.007
2nd finger	0.79	0.23	zcalc= -3.161* p=0.002
3rd finger	0.82	0.18	zcalc= -3.424* p=0.001
4th finger	0.4	0.13	zcalc= -3.951* p=0.000
5th finger	0.34	0.09	zcalc= -3.620* p=0.000

Table 4 - *Statistical analysis of sensitivity averages before and after carpal tunnel release surgery*



Graph 2 - *Average sensitivity before and after carpal tunnel release surgery*

CONCLUSION

We conclude that, overtime, fingers sensitivity showed improvements compared to the preoperative period.
Muscular strength remained similar to preoperative period, after a long postoperative follow-up time.

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