

Manual Physical Therapy Versus Surgery for Carpal Tunnel Syndrome: A Randomized Parallel-Group Trial

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Abstract: This randomized clinical trial investigated the effectiveness of surgery compared with physical therapy consisting of manual therapies including desensitization maneuvers in carpal tunnel syndrome (CTS). The setting was a public hospital and 2 physical therapy practices in Madrid, Spain. One hundred twenty women with CTS were enrolled between February 2013 and January 2014, with 1-year follow-up completed in January 2015. Interventions consisted of 3 sessions of manual therapies including desensitization maneuvers of the central nervous system (physical therapy group, n = 60) or decompression/release of the carpal tunnel (surgical group, n = 60). The primary outcome was pain intensity (mean pain and the worst pain), and secondary outcomes included functional status and symptoms severity subscales of the Boston Carpal Tunnel Questionnaire and the self-perceived improvement. They were assessed at baseline and 1, 3, 6, and 12 months by a blinded assessor. Analysis was by intention to treat. At 12 months, 111 (92%) women completed the follow-up (55/60 physical therapy, 56/60 surgery). Adjusted analyses showed an advantage (all, $P < .01$) for physical therapy at 1 and 3 months in mean pain ($\Delta -2.0$ [95% confidence interval (CI) -2.8 to -1.2]/ -1.3 [95% CI -2.1 to $-.6$]), the worst pain ($\Delta -2.9$ [-4.0 to -2.0]/ -2.0 [-3.0 to $-.9$]), and function ($\Delta -0.8$ [-1.0 to $-.6$]/ $-.3$ [$-.5$ to $-.1$]), respectively. Changes in pain and function were similar between the groups at 6 and 12 months. The 2 groups had similar improvements in the symptoms severity subscale of the Boston Carpal Tunnel Questionnaire at all follow-ups. In women with CTS, physical therapy may result in similar outcomes on pain and function to surgery.

Trial registration: <http://www.clinicaltrials.gov>, ClinicalTrials.gov, NCT01789645.

Perspective: This study found that surgery and physical manual therapies including desensitization maneuvers of the central nervous system were similarly effective at medium-term and long-term follow-ups for improving pain and function but that physical therapy led to better outcomes in the short term.

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Key words: Carpal tunnel syndrome, surgery, physical therapy, manual therapy, pain.

Carpal tunnel syndrome (CTS) is a pain disorder of the upper extremity caused by compression of the median nerve at the carpal tunnel, with a preva-

lence ranging from 6.3% to 11.7%.²⁵ The societal burden of CTS is substantial, and the income loss per patient over 6 years is \$45,000 to \$89,000.¹¹

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Treatment of this condition may consist of conservative or surgical approaches, but scientific evidence for each therapeutic option is conflicting.^{21,27} Current knowledge supports the effectiveness of conservative interventions in the short term, but there is sparse evidence on mid-term and long-term effects.¹³ The most up-to-date review analyzing surgical versus conservative management in CTS showed that both interventions may achieve benefits for CTS but that surgical treatment seems to be slightly superior to conservative treatment for improving symptoms and function at 6 and 12 months.²⁴ Nevertheless, Jarvik et al¹⁵ observed that 61% of individuals with CTS tried to avoid surgical interventions. Because carpal tunnel release had the highest utilization rate of surgical procedures performed in the United States for the upper extremity,¹⁴ more trials including short-term (1 month), mid-term (3 or 6 months), and long-term (12 months) results are needed to further determine the efficacy of both surgical and conservative interventions.

Although CTS is primarily considered a peripheral neuropathy, increasing evidence suggests that it represents a complex pain syndrome including sensitization effects in the central nervous system.^{9,29} Sensitization processes seem to be independent of electrodiagnostic findings.⁶ Previous studies comparing the use of physical therapy and surgical interventions for the management of CTS applied localized treatments, including exercises, mainly focused on the hand.^{13,15,21,24,28} However, preliminary data suggest that manual therapy can modulate sensitization mechanisms by integrating the physiology of pain and sensitization procedures into its therapeutic approach.^{3,20} No study has applied manual physical therapy interventions with this consideration in patients with CTS. Our objective was to conduct a randomized clinical trial to compare the 1-year effectiveness of manual physical therapies including desensitization maneuvers of the central nervous system and surgery in patients with CTS.

Methods

Study Design

This pragmatic, randomized, parallel-group clinical trial compared 2 treatments for CTS: physical therapy and surgery. The primary end point was 1-year improvements in the intensity of pain (mean pain and the worst pain experienced the previous week). Secondary outcomes included functional status and symptoms severity scales of the Boston Carpal Tunnel Questionnaire (BCTQ) and self-perceived improvement with a Global Rating of Change (GROC). The current report follows the Consolidated Standards of Reporting Trials (CONSORT) extension for pragmatic clinical trials.³⁰ The study was approved by the Hospital Universitario Fundación Alcorcón (HUFA) institutional review board (PI01223-HUFA12/14), and the trial was registered (ClinicalTrials.gov: NCT01789645).

Participants

Consecutive women diagnosed with CTS according to clinical and electrophysiologic findings from a local

regional hospital (Madrid, Spain) were screened for eligibility criteria. To be eligible, patients had to exhibit all the following clinical signs: pain and paresthesia in the median nerve distribution, increasing symptoms during the night, positive Tinel sign, and positive Phalen sign. Symptoms had to have persisted for at least 12 months. Furthermore, the electrodiagnostic examination had to reveal deficits of sensory and motor median nerve conduction according to the guidelines of the American Association of Electrodiagnosis, the American Academy of Neurology, and the American Physical Medicine and Rehabilitation Academy: that is, median nerve sensory conduction velocity <40 m/s and median nerve distal motor latency >4.20 milliseconds.² Patients were classified as having minimal (abnormal segmental-comparative tests only), moderate (abnormal median nerve sensory velocity conduction and distal motor latency), or severe (absence of median nerve sensory response and abnormal distal motor latency) CTS.² Participants were excluded if they exhibited any of the following criteria: 1) any sensory/motor deficit in the ulnar or radial nerves; 2) age >65 years; 3) previous hand surgery or steroid injections treatment; 4) multiple diagnoses on the upper extremity (eg, cervical radiculopathy); 5) cervical, shoulder, or upper extremity trauma; 6) any systemic disease causing CTS (eg, diabetes mellitus, thyroid disease); 7) comorbid musculoskeletal medical conditions (eg, rheumatoid arthritis or fibromyalgia); 8) pregnancy; 9) presence of depressive symptoms (Beck Depression Inventory II [BDI-II] >8 points); or 10) male sex. All participants signed an informed consent before their inclusion in the study.

Randomization and Masking

Patients were randomly assigned to receive physical therapy or a surgical procedure. Concealed allocation was conducted using a computer-generated randomized table of numbers created by a statistician who was not otherwise involved in the trial and did not participate in the analysis or interpretation of the results. Individual and sequentially numbered index cards with the random assignment were prepared. The index cards were folded and placed in sealed opaque envelopes. Another researcher opened the envelope and proceeded with allocation. Treatment allocation was revealed to the participants after collection of baseline outcomes. We blinded the clinicians who obtained the follow-up information to the allocation. Five physical therapists provided the manual therapy protocol, and 4 surgeons conducted the surgical procedure.

Interventions

Patients allocated to the physical therapy group received 3 treatment sessions of manual therapies including desensitization maneuvers of the central nervous system of 30 minutes duration, once per week. All treatment sessions were applied by physical therapists with more than 6 years of clinical experience in manual therapy approaches. The desensitization maneuvers consisted of several soft tissue mobilization and nerve/tendon gliding exercises including manual techniques

directed at anatomical sites of potential entrapment of the median nerve (scalene [Fig 1A], pectoralis minor, bicipital aponeurosis [Fig 1B], pronator teres, transverse carpal ligament [Fig 1C], and palmar aponeurosis).¹⁹ All these interfaces were explored by the clinician and then treated according to the following clinical findings: pain on palpation and reproduction of sensory or motor symptoms of the patients. In addition, lateral glides to the cervical spine and tendon and nerve gliding interventions were also applied. The intention of the tendon/nerve gliding intervention is to produce a gliding movement of the nerve/tendon in relation to adjacent soft muscle tissues and involves the application of joint movements to the targeted structure proximally while releasing movement distally followed by a reverse combination.⁵ The sequence of the nerve/tendon gliding exercise was as follows: shoulder girdle depression; glenohumeral abduction and lateral rotation; supination of forearm; and wrist, thumb, and finger extension (Fig 1D). In this position, concurrent elbow flexion and wrist extension were alternated dynamically with concurrent elbow extension and wrist flexion. The therapist alternated the combination of movement depending on the tissue resistance. Speed and amplitude of movement were adjusted such that no pain was produced during the technique. The intervention was completed over 5 to 10 minutes in 2 sets of 5 minutes each with 1 minute's rest between sets. A previous study suggested a potential desensitization effect of this intervention on patients with CTS.⁴ The last treatment appointment included an educational teaching session on doing the tendon and nerve gliding exercises as homework if necessary. Patients were asked to not modify any work or activity levels.

Patients randomly allocated to the surgery group underwent open or endoscopic decompression and release of the carpal tunnel. For pragmatic reasons and because no evidence supports one particular surgical procedure, surgery was based on each surgeon's and patient's pref-

erences.²³ All surgeons were highly experienced, with at least 15 years of practice and habitual practices focusing on hand surgery. Surgeons referred patients for hand therapy after the operation as their usual routine if necessary. Patients allocated to this group received the same educational session for performing tendon and nerve gliding exercises as did the physical therapy group.

Outcomes

The clinical records of all participants included questions regarding the location of the symptoms, aggravating and relieving factors, intensity, duration, and previous treatments. They also completed the BDI-II for assessing symptoms of depression. Outcomes were assessed in blinded fashion at baseline and 1, 3, 6, and 12 months after the end of therapy.

Our primary outcome was the intensity of hand pain. An 11-point Numerical Pain Rating Scale (NPRS; 0 = no pain, 10 = maximum pain) was used to assess the patients' current level of hand pain and the worst level of pain experienced in the preceding week.¹⁶ No minimal clinically important difference (MCID) has yet been published for hand-related pain, but a change of 2 points or a 30% decrease in pain intensity from baseline can be considered as an MCID in patients with chronic pain.⁸ For patients with bilateral symptoms, we assigned the study hand as the hand with more self-reported symptoms; if symptoms were equivalent, the mean pain of both hands was considered.

Secondary outcomes included both functional status and severity subscales of the BCTQ²² and the self-perceived improvement with a GROC from -7 (a very great deal worse) to +7 (a very great deal better). Higher scores within the BCTQ indicate worse function and greater severity, with an MCID of .74 points in the function subscale and 1.14 points in the symptom subscale.¹⁸ Furthermore, scores of +4 and +5 on the GROC are

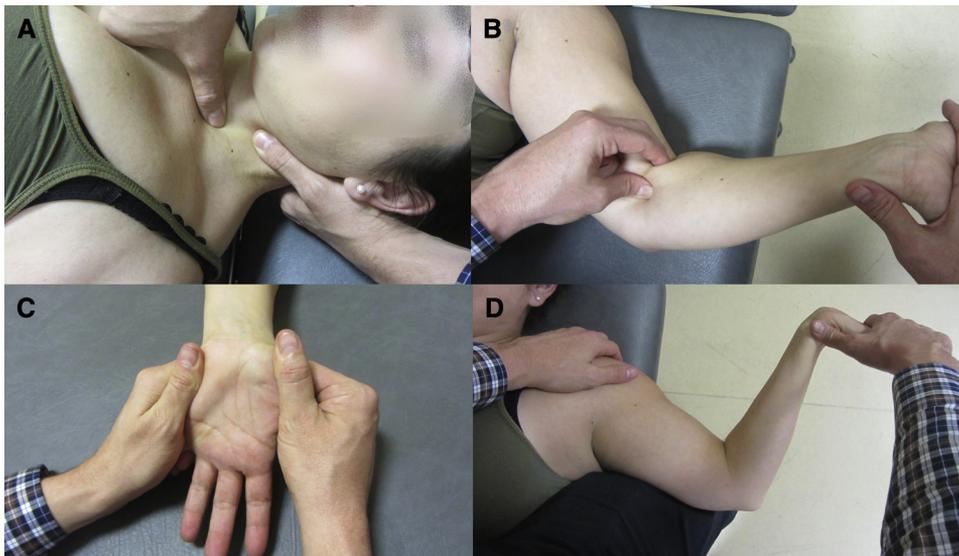


Figure 1. Manual therapies targeting anatomical sites of potential entrapment of the median nerve to desensitize central nervous system pain circuits. (A) Soft tissue manipulation of the anterior scalene muscle; (B) soft tissue manipulation of the bicipital aponeurosis; (C) soft tissue stretching of the transverse carpal ligament; (D) tendon and nerve gliding interventions to the median nerve.

indicative of moderate changes in patient status, whereas scores of +6 and +7 indicate large changes in the self-reported status of the patient.²⁸ We also defined a successful outcome when at least 1 of the following items was present: reduction $\geq .7$ points or 30% improvement from baseline in BCTQ function or symptom severity subscales, or decrease ≥ 2 points on the intensity of hand pain.

Treatment Side Effects

Patients were asked to report any adverse event that they experienced either after the intervention or during any other part of the study. In the current study, an adverse event was defined as sequelae of medium-term duration with any symptom perceived as distressing and unacceptable to the patient and requiring further treatment.

Sample Size Determination

The sample size calculations were based on pilot data to detect treatment differences of 2.0 units on the main outcome, assuming a standard deviation of 3.0, a 2-tailed test, an α level of .05, and a desired power (β) of 90%. The estimated desired sample size was calculated to be at least 50 participants per group. A dropout rate of 15% was expected, so 60 patients were included in each group.

Statistical Analysis

Statistical analysis was performed using SPSS software, version 18.0 (SPSS, Chicago, IL) and it was conducted according to intention-to-treat analysis for patients in the group to which they were allocated. When data were missing, the last value of each patient was used. Baseline demographic and clinical variables were compared between both groups using independent Student *t*-tests for continuous data and χ^2 tests of independence for categorical data. Our primary evaluation included mixed-model repeated measured analyses of covariance (ANCOVAs) with time as the within-subject factor and group as the between-subject factor and adjusted for baseline outcomes for evaluating between-group differences in all the outcomes. We used χ^2 tests to compare self-perceived improvement and success rate at 6 and 12 months in both groups. To enable comparison of effect sizes, standardized mean score differences (SMDs) were calculated by dividing the mean score differences between groups by the pooled standard deviation.

Results

Between February 2013 and January 2014, 200 consecutive patients with CTS were screened for eligibility criteria. One hundred twenty (60%) satisfied all criteria, agreed to participate, and were randomly allocated to the physical therapy ($n = 60$) or the surgical ($n = 60$) group. Randomization resulted in similar baseline characteristics for all variables (Table 1). Of patients allocated to the physical therapy group, 2 were lost at 6 months of follow-up for personal reasons and 3 received surgery in the studied hand at 12 months. Similarly, 4 patients allo-

Table 1. Baseline Characteristics by Treatment Assignment

	PHYSICAL THERAPY GROUP (N = 60)	SURGERY GROUP (N = 60)
Age, y	47 \pm 10	46 \pm 9
Years with pain	3.1 \pm 2.7	3.5 \pm 3.1
Occupation		
Work at home, n (%)	33 (55)	35 (58)
Secretary/office, n (%)	27 (45)	25 (42)
Unilateral/bilateral arm distribution, n (%)		
Unilateral symptoms: right side	10 (17)	15 (25)
Unilateral symptoms; left side	3 (5)	5 (8)
Bilateral symptoms	47 (78)	40 (67)
Severity, n (%)		
Minimal CTS	16 (26)	17 (28)
Moderate CTS	23 (39)	20 (34)
Severe CTS	21 (35)	23 (38)
Mean intensity of the pain (NPRS, 0–10)	4.8 \pm 1.5	4.9 \pm 2.2
Worst pain experienced last week (NPRS, 0–10)	6.6 \pm 1.7	7.0 \pm 2.0
Function status scale CTS (1–5)	2.3 \pm .5	2.4 \pm .6
Severity status scale CTS (1–5)	2.5 \pm .7	2.7 \pm .6
BDI-II (0–21)	4.2 \pm 2.9	3.8 \pm 2.7

NOTE. Values are expressed as mean \pm SD unless otherwise indicated.

cated to the surgical group were lost at 1-year follow-up because they received surgery in the other hand. None of the participants in either group reported any other intervention during the study, excluding the sporadic use of nonsteroidal anti-inflammatory drugs. There were no clinically important adverse events, and no surgical complications were reported. No patient in the surgery group received specific hand therapy after surgery. The reasons for ineligibility are shown in Fig 2, which provides a flow diagram of patient recruitment and retention.

Adjusting for baseline outcomes, the mixed-model ANCOVA observed significant Group \times Time interactions for mean pain ($F = 6.767$; $P < .001$) and the worst pain ($F = 10.844$; $P < .001$) intensities: patients receiving physical therapy exhibited higher decreases at 1 and 3 months in mean current pain ($\Delta -2.0$ [95% confidence interval [CI] -2.8 to -1.2]) and -1.3 [95% CI -2.1 to $-.6$], respectively; $P < .001$) and the worst pain intensity ($\Delta -2.9$ [-4.0 to -2.0] and -2.0 [-3.0 to $-.9$], respectively; $P < .001$) than did patients who received surgery (Fig 3). Between-group effect sizes were large ($1.1 > \text{SMD} > 1.8$) at 1 and 3 months in favor of the physical therapy group. No significant between-group differences were observed at 6 and 12 months ($P > .1$, Table 2). Both groups exhibited large within-group effect sizes ($1.1 > \text{SMD} > 1.4$) at 6 and 12 months.

The intention-to-treat analysis also revealed a significant Group \times Time interaction for function ($F = 7.684$; $P < .001$) but not for the severity subscale ($F = .283$; $P = .596$) of the BCTQ. Again, patients who received physical therapy showed higher increases in function at 1 and 3 months ($\Delta -.8$ [-1.0 to $-.6$], $P < .001$; and $-.3$ [$-.5$ to $-.1$], $P < .01$) than did those patients receiving surgery

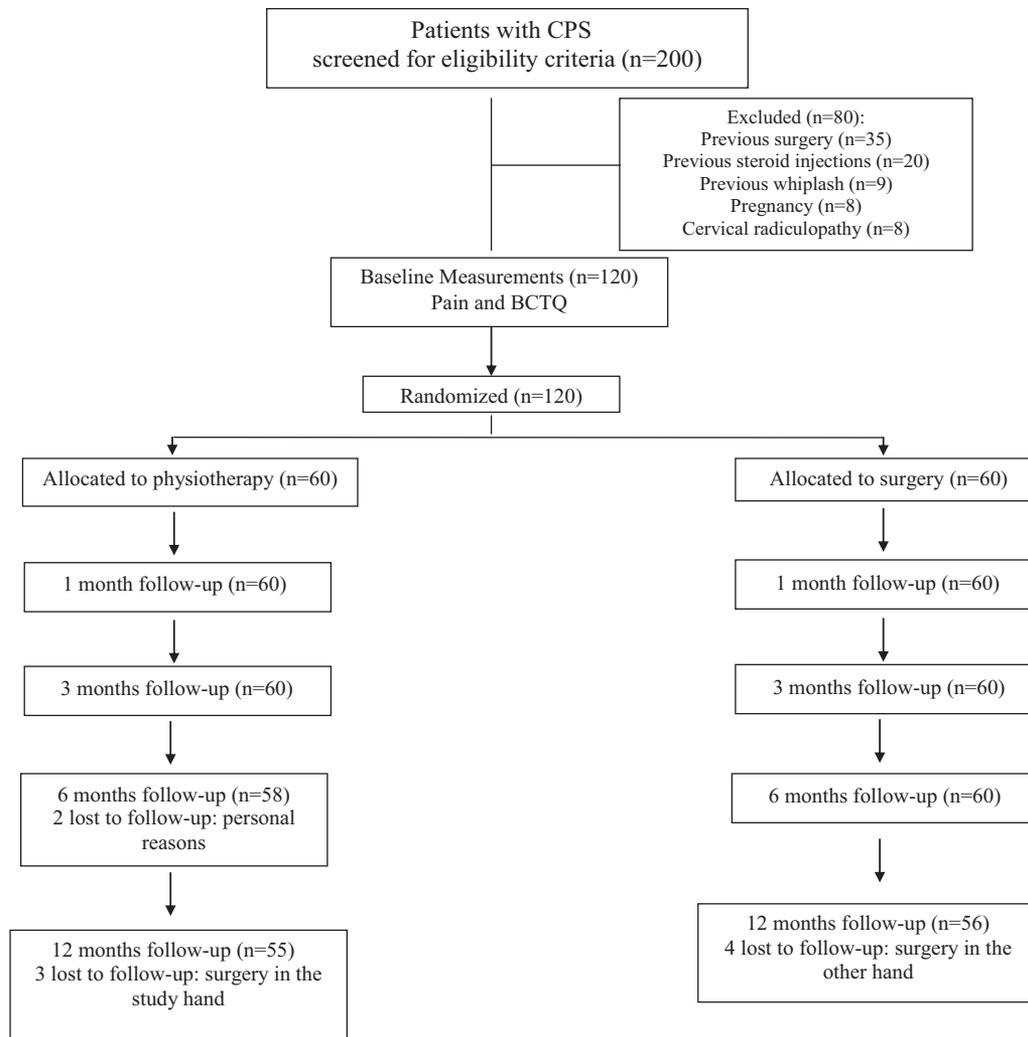


Figure 2. Flow diagram of patients throughout the course of the study.

(Fig 3). Between-group effect sizes were large at 1 month (SMD = 1.2) and moderate at 3 months (SMD = .8) in favor of the physical therapy group. Changes in function were similar between groups at 6 and 12 months ($P > .3$), and both groups exhibited similar improvements in severity symptoms at all follow-up periods (Table 2). Again, within-group effect sizes were large for both groups (SMD > 1.3).

Physical therapy and surgical groups did not differ significantly on success criteria in the intention-to-treat analyses at 6 ($P > .381$) and 12 ($P > .264$) months, although rates of success were slightly higher in the surgical group for both criteria at each time point (10%). Self-perceived improvement assessed by a GROG was also similar at 6 ($P = .663$) and 12 ($P = .169$) months in both groups (Table 3).

Discussion

This randomized clinical trial found that surgery and physical therapy consisting of manual therapies including desensitization maneuvers of the central nervous system resulted in similar outcomes on pain and function in women with CTS at 6 and 12 months, but

patients assigned to physical therapy experienced significantly greater relief of symptoms and improvements in hand function at 1 and 3 months. Both groups experienced significant and clinically important improvements from baseline to follow-up periods, particularly at 6 and 12 months. The magnitude of between-group differences was nonsignificant at 12 months.

Although some trials have compared nonsurgical versus surgical treatment in CTS, most of them have used physical modalities other than manual therapy (eg, hand splints^{12,26} or laser⁷). The only trial including manual therapies, particularly exercises, in a multimodal treatment approach found small differences between surgery and physical conservative management.¹⁵ The meta-analysis by Shi and MacDermid²⁴ concluded that both approaches were similarly effective at 3 months but that surgery was superior to nonsurgical treatment at 6 and 12 months for improving pain and function, with moderate between-group effect sizes (.22 < weighted mean difference < .56). These conclusions are different from those reported in our study because we observed that physical therapy was more effective than surgery at 1 and 3 months but equally effective at 6 and 12 months. A disadvantage for the

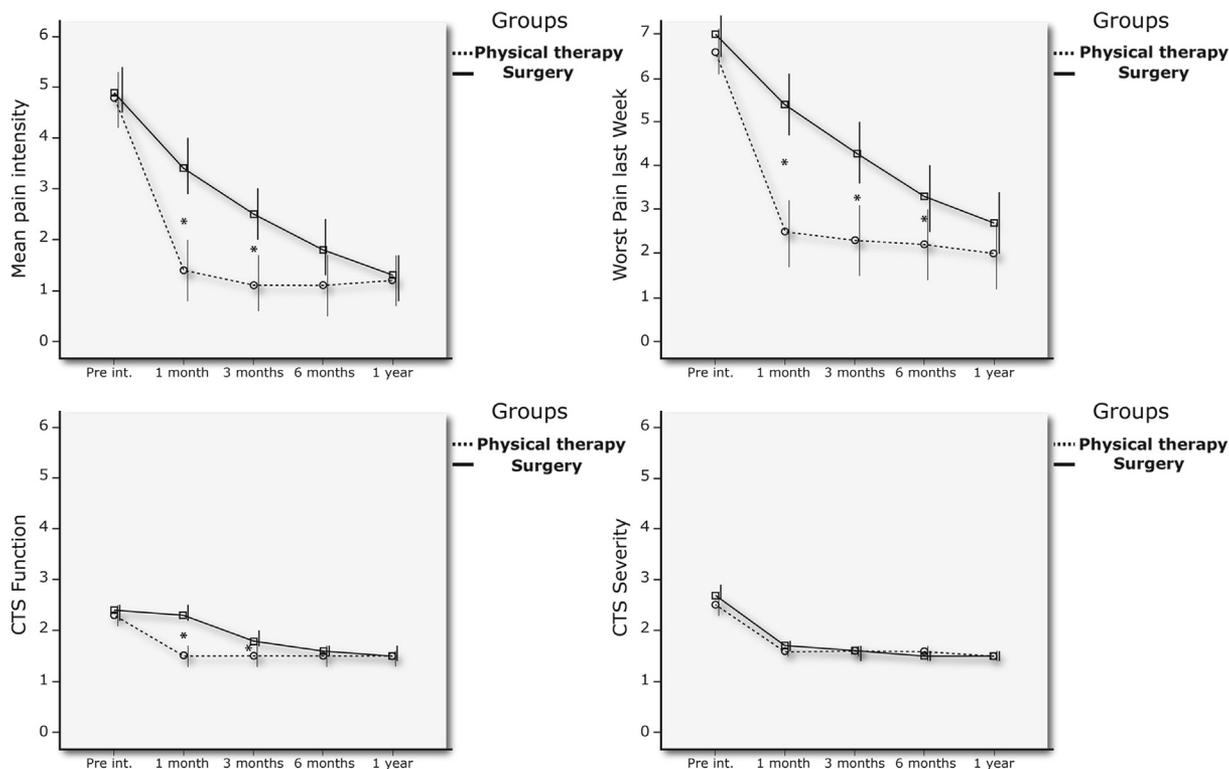


Figure 3. Evolution of all the outcomes (pain in upper panels and BCTQ in lower panels) throughout the course of the study stratified by randomized treatment assignment. Data are means (95% CI). Abbreviation: Pre int., preintervention.

surgery group in the short term could be expected because any surgical intervention needs some weeks for recovery. Otherwise, our results on the physical therapy arm could have been better than those of previous reports because we applied manual therapies including desensitization maneuvers of the central nervous system. Approaches including integrative manual therapies may be more effective than therapeutic interventions targeting only the hand/wrist area, but testing this hypothesis requires further randomized clinical trials.

Our data indicate that the 2 interventions seem to be equally effective in the medium term and long term because $\geq 75\%$ of the patients attained our rigorous

definition of treatment success. In addition, self-perceived recovery was also similar between groups in agreement with clinical outcomes of pain and function. Based on these results, our trial supports the use of conservative treatment, as applied in the current trial, as the first management option for CTS. Most individuals typically prefer conservative management as the first therapeutic option because of the higher rate of complications associated with surgery (pooled relative risk 2.03, 1.28–3.22).²⁴ Therefore, it seems that conservative management may be considered as a frontline treatment in mild to moderate and sometimes severe cases of CTS before subsequently considering surgery. This conclusion

Table 2. Primary and Secondary Outcomes at Baseline and 1, 3, 6, and 12 Months by Randomized Treatment Assignment

OUTCOME GROUP	BASELINE	1 MONTH	3 MONTHS	6 MONTHS	12 MONTHS
Mean level of hand pain (NPRS, 0–10)					
Physical therapy	4.8 ± 1.5 (4.2, 5.3)	1.4 ± 1.9 (.8, 2.0)	1.1 ± 1.8 (.6, 1.7)	1.1 ± 1.6 (.5, 1.7)	1.2 ± 1.8 (.7, 1.7)
Surgery	4.9 ± 2.2 (4.5, 5.4)	3.4 ± 2.3 (2.9, 4.0)	2.5 ± 2.1 (2.0, 3.0)	1.8 ± 2.5 (1.3, 2.4)	1.3 ± 1.9 (.8, 1.7)
Worst level of hand pain experiencing preceding week (NPRS, 0–10)					
Physical therapy	6.6 ± 1.7 (6.1, 7.1)	2.5 ± 2.7 (1.7, 3.2)	2.3 ± 2.6 (1.5, 3.1)	2.2 ± 2.5 (1.4, 3.0)	2.0 ± 1.6 (1.2, 2.7)
Surgery	7.0 ± 2.0 (6.5, 7.4)	5.4 ± 2.7 (4.7, 6.1)	4.3 ± 3.0 (3.6, 5.0)	3.3 ± 3.3 (2.5, 4.0)	2.7 ± 1.9 (2.0, 3.4)
Function subscale of the BCTQ (0–5)					
Physical therapy	2.3 ± .5 (2.1, 2.5)	1.5 ± .4 (1.3, 1.7)	1.5 ± .5 (1.3, 1.7)	1.5 ± .5 (1.3, 1.7)	1.5 ± .5 (1.3, 1.6)
Surgery	2.4 ± .6 (2.2, 2.5)	2.3 ± .7 (2.2, 2.5)	1.8 ± .7 (1.7, 2.0)	1.6 ± .6 (1.5, 1.7)	1.5 ± .6 (1.4, 1.7)
Severity subscale of the BCTQ (0–5)					
Physical therapy	2.5 ± .7 (2.3, 2.7)	1.6 ± .5 (1.5, 1.7)	1.6 ± .6 (1.5, 1.7)	1.6 ± .6 (1.4, 1.7)	1.5 ± .5 (1.4, 1.6)
Surgery	2.7 ± .6 (2.6, 2.9)	1.7 ± .5 (1.6, 1.8)	1.6 ± .4 (1.4, 1.7)	1.5 ± .5 (1.4, 1.6)	1.5 ± .5 (1.4, 1.6)

NOTE. Values are expressed as mean ± SD (95% CI).

Table 3. Follow-Up Self-Perceived Recovery and Successful Outcomes in Surgical and Nonsurgical Groups, n (%)

	6-MONTH FOLLOW-UP		12-MONTH FOLLOW-UP	
	PHYSICAL THERAPY (N = 58)	SURGERY (N = 60)	PHYSICAL THERAPY (N = 55)	SURGERY (N = 56)
Self-perceived improvement with a GROC (−7 to +7)				
Moderate changes (+4/+5)	18 (31)/13 (22)	20 (33)/11 (18)	7 (13)/15 (27)	10 (18)/12 (21)
Large changes (+6/+7)	7 (12%)/2 (3)	9 (15)/4 (6.5)	5 (9)/12 (22)	17 (30)/13 (23)
Successful outcomes (≥.6 points or 30% improvement BCTQ in function or severity; or ≥2 points on pain intensity)				
1 criteria	44 (75)	50 (83)	44 (80)	51 (91)
All criteria	31 (53)	27 (45)	32 (58)	31 (55)

is supported by the guidelines of the American Academy of Orthopedic Surgeons for the treatment of CTS.^{1,17}

The results of this study should be considered according to potential strengths and limitations. A major strength was that we compared surgery with a well-defined, nonsurgical, multimodal approach. The physical therapy program included manual therapies that could potentially benefit patients based on the neurophysiology of pain and current theories on CTS. In most of the patients allocated to either group, other conservative treatments such as nocturnal splinting had already failed some years previously. A second strength was that different physical therapists and surgeons were involved in either treatment group, although most patients were derived from local regional hospitals. Third, the trial had high retention rates at 12-month follow-up. Among the limitations, we recognize that multicenter studies would help to better generalization of the results. Multicenter studies controlling for site and clinician effects (cluster effects) in subsequent trials might enhance the generalizability of our results. Second, patients and clinicians were not blinded to the treatment intervention. Third, we did not consider the role of some psychological variables, including depression, anxiety, mood, or sleep disorders, because we excluded individuals with depressive symptoms. Patients

allocated to the physical therapy group received just 3 sessions based on the authors’ clinical experience because no current scientific data exist on the adequate frequency and dose of therapy. We do not know if a greater number of sessions would reveal differences between the interventions. Fourth, we included only women with CTS; therefore, we do not know if the same results would be obtained in men with CTS. Subgroups of patients who would benefit most from conservative or surgical interventions or factors associated with successful treatment in either management approach should be elucidated in future trials.¹⁰

Conclusions

These data indicate that physical therapy consisting of manual therapies including desensitization maneuvers of the central nervous system was more effective at 1 and 3 months, but equally effective at 6 and 12 months, than surgery for improving pain and function in women with CTS. Our results support the use of conservative treatment, as applied in the current study, as the first management option for patients with CTS before considering surgery because both interventions are equally effective in the long term.

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