A Comparison of Treatment Approaches Used After Carpal Tunnel Release Surgery

Elin J. Groves, Barbara A. Rider

Key Words: carpal tunnel syndrome • hand function • hand occupational therapy • progressive resistive exercise • therapeutic exercise

Two treatment approaches used by two hand clinics were compared for patients who had undergone carpal tunnel release surgery. One of the clinics used an exercise program consisting of progressive resistive exercise; the other clinic used limited activity and no specific exercise program. Measurements of grip strength and active and passive wrist flexion and extension were taken 3 weeks and 6 weeks after surgery and then analyzed to determine if significant differences existed between the two treatment approaches. A significant difference was found only in active wrist extension, which increased after 3 weeks of a progressive resistive exercise program. Grip strength was also greater after 3 weeks of exercise; however, the increase was not statistically significant. The study raises a question about the efficacy of postoperative treatment for patients who have had carpal tunnel release surgery.

Carpal tunnel syndrome is a common condition caused by pressure on the median nerve at the wrist, which produces symptoms of pain, tingling, and numbness in the hand (Miller, 1980). If left untreated, the thenar eminence can atrophy and the hand may become incapacitated (Davne, 1982; Miller & Gregory, 1983).

Initial treatment of carpal tunnel syndrome usually consists of a conservative management program of splints and injection of steroids into the carpal tunnel area. If this program fails, then carpal tunnel release surgery is usually performed (Hirsh & Thanki, 1985).

Carpal tunnel release surgery is a widely performed procedure used in severe cases for the treatment of carpal tunnel syndrome. It relieves 75% to 100% of symptoms in 81% of cases (Pickett, 1984).

Most physicians and therapists agree that splinting and sutures are necessary for 10 to 14 days after surgery. Patients are instructed to rest and to limit the use of their hand (Miller & Gregory, 1983) for one week after suture and splint removal. However, no studies were found that describe postsurgical rehabilitation programs.

This study compares two treatment programs used after carpal tunnel release surgery.

Literature Review

Etiology

Carpal tunnel syndrome has been linked to several etiological factors, including malalignment of fractures, chronic trauma, rheumatoid arthritis, Paget disease of the bone, neoplasms, neuromas of the median nerve, gout, myxedema, amyloidosis, multiple myeloma, obesity, acromegaly, pregnancy, diabetes mellitus, and Raynaud disease (Cryer & Kissane, 1979; Kulick, Gordillo, Javidi, Kilgore, & Newmeyer, 1986).

Carpal tunnel syndrome is found twice as frequently in women as in men (Davne, 1982; Haas, Nord, & Bome, 1981; Hirsh & Thanki, 1985). It has been theorized that any condition that increases the volume of structures within the carpal tunnel structure can create pressure and compression on the median nerve and thus be a causal factor (Kulick et al.).

Although there are many known etiological factors associated with carpal tunnel syndrome, it has been documented that many industrial workers are afflicted and that occupation is probably a causal factor (Reinstein, 1981). Several authors have commented on the role of manual activity, particularly frequent wrist flexion, in the etiology of carpal tunnel syndrome (Birbeck & Beer, 1975; Cannon, Bernacki, & Walter, 1981; Smith, Sonstegard, & Anderson, 1977). Hansford, Blood, Kent, and Lutz (1985) found that workers who performed repetitive and sustained
manual movements experienced significant blood flow changes in the two main arteries in the wrist. They found that blood flow velocity in the wrist decreased after 1½ hr of work while wrist blood pressure remained constant. This suggested that manual activity can create an increase in intramuscular pressure in the wrist, which, if sustained, may predispose workers to carpal tunnel syndrome. Additionally, Cryer and Kissane (1979) concluded that chronic occupational stretch of the median nerve at the wrist by flexion or extension movements may be a causal factor in certain persons. Other authors have commented on the increase in the incidence of carpal tunnel syndrome. T. C. Jaeger and R. M. Schneider (personal communication, September 15, 1986) attributed the rise in the incidence of the disorder to the number of women employed in high-technology manufacturing industries where repetitive flexion and extension are required. They theorized that these repetitive motions ultimately aggravate the area around the carpal tunnel and increase the pressure, which causes the median nerve to stretch.

**Diagnosis**

Classic symptoms of carpal tunnel syndrome are nocturnal pain and tingling of the fingers in the affected hand, which, in the early stages of the disease, are often nonspecific and intermittent. As the disease progresses, the pain and tingling sensations become more severe and subsequent loss of sensation along the median nerve often occurs (Miller & Gregory, 1983). When carpal tunnel syndrome has been present for a long time, assessment shows atrophy of the thenar eminence because of decreased motor function of the median nerve (Miller & Gregory). Clinical diagnostic tests can be performed at any stage of the disease. The most common of these tests are the Tinel test and the Phalen wrist flexion test (Miller & Gregory). The Tinel test is performed by tapping the area over the median nerve at the transverse carpal ligament. The test result is considered positive when a tingling sensation occurs in the fingers and hand (Phalen, 1972). The Phalen test is performed by having the patient hold his or her forearm vertically. The patient then passively allows the hand to fall into flexion at the wrist. This position is held for 1 minute, and if pain, tingling, or discomfort occurs, the test result is considered positive (Phalen, 1966). Although Tinel and Phalen signs are often seen in patients with carpal tunnel syndrome, relatively little is known about their specificity or how often they are seen in patients who show no symptoms of the disorder (Pickett, 1984).

Electromyographic studies are also used to detect and verify carpal tunnel syndrome (Hirsh & Thanki, 1985). They determine the amount of time it takes nerve impulses to travel from the wrist through the carpal tunnel canal to the thenar muscles or fingers. The earliest change is a decrease in sensory nerve conduction velocity above the wrist after stimulation of the little finger with a ring electrode (Hirsh & Thanki). Motor conduction velocity is then measured by distal motor latency, and severe cases show signs of thenar muscle denervation (Hirsh & Thanki). Conduction studies detect over 90% of symptomatic wrists in patients with carpal tunnel syndrome (Reinstein, 1981).

**Treatment**

After a diagnosis of carpal tunnel syndrome has been confirmed, the patient is usually given a conservative management program, which can include injection of steroids into the carpal tunnel area, use of a stabilizing splint, or both (Groneman, 1985; Kulick et al., 1986). If this is not effective, carpal tunnel release surgery is usually performed.

Carpal tunnel release surgery consists of a longitudinal incision made between the thenar and hypothenar eminences to expose the transverse carpal tunnel ligament and underlying median nerve (Miller & Gregory, 1983). The transverse carpal tunnel ligament is divided, which allows more room for the median nerve. This has the effect of decreasing the pain and tingling sensation (Groneman, 1985).

After surgery, the hand is elevated for approximately 24 hr to minimize wrist edema and is immobilized in a plaster splint for 10 to 14 days (Miller, 1980; Tountas, MacDonald, Meyerhoff, & Bihrle, 1983). After 3 weeks (1 week after the sutures and splint are removed), passive and active exercises may be initiated (Miller). A review of the literature produced no published articles that addressed treatment programs initiated at the 3-week postsurgical stage.

Some physicians advocate a program of rest and limited activity that consists of warm soaks, passive exercise, and gentle range of motion exercises to prevent the formation of adhesions during the initial postoperative period (J. Sebright, MD, personal communication, September 15, 1986). This approach is based on the assumption that aggressive flexion, extension, and gripping were what led to the carpal tunnel syndrome and therefore would not be beneficial in a treatment program (J. Sebright, MD, personal communication, September 15, 1986). One occupational therapist stated that she previously used an aggressive exercise program that consisted of flexion, extension, and gripping exercises, but then modified her treatment approach to include only isometric exercise when it was thought that an aggressive approach might ultimately aggravate the condition (L.
The subjects were 6 men (2 from Clinic A and 4 from Clinic B) and 19 women (9 from Clinic A and 10 from Clinic B) between the ages of 18 and 55 years who were being treated for carpal tunnel syndrome in two private hand rehabilitation clinics in Grand Rapids, Michigan. Of these subjects, 3 from Clinic A and 1 from Clinic B had bilateral carpal tunnel syndrome. This yielded a total of 29 cases—14 from Clinic A and 15 from Clinic B. Patients who had a history of wrist fractures and previous carpal tunnel release surgery were excluded from the study. Additional data were obtained by questionnaire and a review of medical records and included age, sex, affected hand, prefered hand, and predisposing conditions such as obesity, diabetes, rheumatoid arthritis, and osteoarthritis.

Method

Subjects

The subjects were 6 men (2 from Clinic A and 4 from Clinic B) and 19 women (9 from Clinic A and 10 from Clinic B) between the ages of 18 and 55 years who were being treated for carpal tunnel syndrome in two private hand rehabilitation clinics in Grand Rapids, Michigan. Of these subjects, 3 from Clinic A and 1 from Clinic B had bilateral carpal tunnel syndrome. This yielded a total of 29 cases—14 from Clinic A and 15 from Clinic B. Patients who had a history of wrist fractures and previous carpal tunnel release surgery were excluded from the study. Additional data were obtained by questionnaire and a review of medical records and included age, sex, affected hand, prefered hand, and predisposing conditions such as obesity, diabetes, rheumatoid arthritis, and osteoarthritis.

Procedure

Both clinics used the same surgical procedure but had different treatment approaches after surgery. Clinic A advocated patient participation in a structured program that included progressive resistive exercise. Clinic B advocated restricted use of the affected hand and used no structured exercise program after surgery.

A data collector at each site (an occupational therapist at Clinic A and a nurse at Clinic B) measured grip strength and active and passive wrist flexion and extension at 3 weeks and 6 weeks after surgery. Interrater reliability was established between the principal investigator and each data collector before the study. Both data collectors were familiar with the use of goniometers and dynamometers, because these instruments were used commonly in their respective clinics. The Jamar hand dynamometers used for the grip strength measurements were professionally calibrated before the study and set at the third setting. The average of three measurements was reported.

One week after sutures were removed and splinting was no longer required (at approximately 3 weeks after surgery), wrist flexion, wrist extension, and grip strength were measured. Subjects from Clinic A participated in a 3-week exercise program, 3 times per week for 1/2 hr. The program used the Baltimore Therapeutic Equipment (BTE) work simulator unit. The BTE is designed for the rehabilitation and testing of upper extremity injuries and is equipped with a variety of tool attachments that provide specific upper extremity repetitive motions against gravity (Curtis, Clark, & Snyder, 1984). Each subject followed the same exercise protocol, which consisted of the following motions (tool attachments for the BTE are listed in parentheses): wrist flexion and extension (701), gripping (162), thumb pinching (162), pronation and supination (601), pushing (802), and finger pinching (162). The number of repetitions and the amount of resistance varied, depending on such factors as the subject’s overall strength.

Subjects from Clinic B were given informal instructions at the 3-week postoperative stage and were not seen again until the 6-week postoperative stage. They were instructed to use warm soaks, gently bend the wrist, and perform simple daily tasks. They were also instructed to avoid heavy lifting and not to perform repetitive motions such as squeezing, gripping, or forceful pinching.

At 6 weeks, subjects from both groups were re-measured in all categories.

Data Analysis

A simple pretest–posttest design was used with one categorical independent variable (exercise vs. no exercise) and five dependent variables (passive and active wrist flexion, passive and active wrist extension, and grip strength after 3 weeks of treatment).

A t test was performed to determine if significant differences existed between the 3-week pretest mean scores and the 6-week posttest mean scores in the categories of grip strength, active range of motion, and passive range of motion of the wrist.

Results

Results indicated no significant differences in grip strength, passive wrist flexion, passive wrist extension, and active wrist flexion. Significant differences
The purpose of this study was to determine whether a particular treatment approach used after carpal tunnel release surgery affected clinical outcomes. The American Journal of Occupational Therapy discussed that patients from Clinic A showed a greater mean increase in grip strength than did subjects from Clinic B. On the basis of norms from the Sister Kenny Institute in Minneapolis, all subjects from both clinics had achieved measurements within normal limits for active wrist flexion at 6 weeks. Although no significant differences were found in the grip strength category, subjects from Clinic A showed a greater mean increase in grip strength than did subjects from Clinic B. The results may be of particular interest to therapists and physicians who promote the idea of rest and limited use of the hand after surgery. Almost all subjects involved in this type of program achieved measurements within normal limits for passive and active wrist flexion and also showed some gains in grip strength without a specific exercise program. It is likely that hand use for daily living tasks and the natural healing process contributed to this finding.

It is interesting to note that although Clinic A used progressive resistive exercise 3 times a week in a program designed to increase strength, no significant differences were found between subjects from the two clinics in grip strength 6 weeks after surgery. However, clients from Clinic A did demonstrate greater mean increases in grip strength. Since progressive resistive exercise has been shown to increase endurance and strength in patients with various injuries (Trombly, 1983), it is possible that if the treatment had been longer than 3 weeks, greater improvement would have been achieved.

Carpal tunnel syndrome patients from both clinics were still functioning below the 25th percentile in grip strength at the 6-week postoperative stage, which raises questions about their ability to function effectively in manual labor jobs requiring continuous repetitive motions. In fact, returning to work at this stage could delay a full recovery by exacting undue stress in the carpal tunnel area. This study also raises a question about the efficacy of providing costly time-intensive postoperative treatment if routine activity and warm soaks are equally effective. Shortcomings of the study include (a) the small sample size ($N = 29$), (b) number of data collectors used, and (c) number of treatment settings used. A larger sample size might have produced significant differences. Use of one treatment center rather than two would have been preferable; however, this was not possible because representatives from each clinic stated that it would be unethical for them to implement a program that was not used commonly in their clinic. Also, one data collector in one treatment setting, rather than two in two settings, might have more effectively controlled for bias from each clinic.

Future research might compare other exercise regimens and include measures of endurance as well as strength and flexibility. Differences in frequency of recurrence after different postoperative treatments should also be studied.

**Table 1**

<table>
<thead>
<tr>
<th></th>
<th>Clinic A $^a$ (n = 14)</th>
<th>Clinic B $^b$ (n = 15)</th>
<th>$p^*$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grip strength</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$M$</td>
<td>14.6</td>
<td>7.1</td>
<td>.102</td>
</tr>
<tr>
<td>$SD$</td>
<td>8.5</td>
<td>14.2</td>
<td></td>
</tr>
<tr>
<td><strong>Passive wrist flexion</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$M$</td>
<td>3.2</td>
<td>7.3</td>
<td>.292</td>
</tr>
<tr>
<td>$SD$</td>
<td>8.0</td>
<td>12.1</td>
<td></td>
</tr>
<tr>
<td><strong>Passive wrist extension</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$M$</td>
<td>13.9</td>
<td>8.3</td>
<td>.184</td>
</tr>
<tr>
<td>$SD$</td>
<td>10.9</td>
<td>11.1</td>
<td></td>
</tr>
<tr>
<td><strong>Active wrist flexion</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$M$</td>
<td>6.1</td>
<td>9.3</td>
<td>.350</td>
</tr>
<tr>
<td>$SD$</td>
<td>9.0</td>
<td>9.4</td>
<td></td>
</tr>
<tr>
<td><strong>Active wrist extension</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$M$</td>
<td>12.9</td>
<td>4.0</td>
<td>.046</td>
</tr>
<tr>
<td>$SD$</td>
<td>13.0</td>
<td>9.7</td>
<td></td>
</tr>
</tbody>
</table>

Note. Satterthwaite's Approximation to the $t$ test when variances are unequal was applied to test for equality of variances. Two-sided t test for equality of variances at $p = .05$ show that the variances are not significantly different (Snedecor & Cochran, 1980).

$^a$ Subjects performed progressive resistive exercises. $^b$ Subjects did not exercise.

$^*$ $p < .05$.

**Discussion**

The purpose of this study was to determine whether a particular treatment approach used after carpal tunnel release surgery would result in increased wrist range of motion and grip strength. The results may be of particular interest to therapists and physicians who promote the idea of rest and limited use of the hand after surgery. Almost all subjects involved in this type of program achieved measurements within normal limits for passive and active wrist flexion and also showed some gains in grip strength without a specific exercise program. It is likely that hand use for daily living tasks and the natural healing process contributed to this finding.

It is interesting to note that although Clinic A used progressive resistive exercise 3 times a week in a program designed to increase strength, no significant differences were found between subjects from the two clinics in grip strength 6 weeks after surgery. However, clients from Clinic A did demonstrate greater mean increases in grip strength. Since progressive resistive exercise has been shown to increase endurance and strength in patients with various injuries (Trombly, 1983), it is possible that if the treatment had been longer than 3 weeks, greater improvement would have been achieved.

Carpal tunnel syndrome patients from both clinics were still functioning below the 25th percentile in grip strength at the 6-week postoperative stage, which raises questions about their ability to function effectively in manual labor jobs requiring continuous repetitive motions. In fact, returning to work at this stage could delay a full recovery by exacting undue stress in the carpal tunnel area. This study also raises a question about the efficacy of providing costly time-intensive postoperative treatment if routine activity and warm soaks are equally effective. Shortcomings of the study include (a) the small sample size ($N = 29$), (b) number of data collectors used, and (c) number of treatment settings used. A larger sample size might have produced significant differences. Use of one treatment center rather than two would have been preferable; however, this was not possible because representatives from each clinic stated that it would be unethical for them to implement a program that was not used commonly in their clinic. Also, one data collector in one treatment setting, rather than two in two settings, might have more effectively controlled for bias from each clinic.

Future research might compare other exercise regimens and include measures of endurance as well as strength and flexibility. Differences in frequency of recurrence after different postoperative treatments should also be studied.

**Acknowledgment**

We thank Judith B. Leonard, OTR, ASHT, for critically reviewing this study.

---

1 These norms are no longer considered valid because of the method used to obtain them.
References


