ORIGINAL RESEARCH

Effect of neural mobilization and splinting on carpal tunnel syndrome

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Abstract

Study objective: To evaluate the clinical benefit of neural mobilization and splinting compared with splinting alone in carpal tunnel syndrome (CTS).

Methods: Patients were randomized into two groups using Pre/Post-test experimental design. On day 0 and 21st (i.e. pre and post treatment), patients were administered Boston Questionnaire. Grip strength, pain intensity, and sensory testing were completed using validated outcomes measures. Both groups were advised to wear full-time neutral angle wrist splint for three weeks. Neuromobilisation technique for the median nerve was performed, the protocol included treatment of total three weeks, with six days per week management for only one group additionally and they were encouraged by the therapist to complete the self mobilisation home exercise program once a day. Independent t-test was used to compare VAS, sensory testing at three sites name as site 1(tip of the thumb), site 2(proximal index finger), site 3(tip of the index finger) and grip strength between the groups on 0 and the 21st day. Mann-Whitney Test was used to compare the score of Boston Questionnaire Symptom Severity Scale and Functional Status Scale between the groups on 0 and the 21st day.

Results: The data showed that with the use of three weeks protocol there was a significant difference ($p<0.05$) between post treatment values of VAS score, Boston Questionnaire Symptom Severity Scale , Functional Status Scale taken and Sensory testing at three sites i.e site 1,site 2 and site 3 on 21st day between group A and group B but more improvement was seen in the group B. The data of this study showed that there was non-significant difference between post treatment values of Grip strength on 21st day between group A and group B i.e. there was no improvement in grip strength.

Conclusion: This study demonstrated that patients suffering from CTS can have substantial improvement with the combined treatment of neural mobilisation and splinting.

Keywords: Neuromobilisation; Splinting; Carpal tunnel syndrome

Background

The carpal tunnel syndrome (CTS) is the compression of median nerve at the wrist, is considered to be the most common entrapment neuropathy (Gerritsen et al,2002).The carpal tunnel syndrome condition more typically develops when daily activities subject the wrists to long periods of repeated flexion or abnormal positions. Carpal tunnel syndrome often occurs in butchers, hairdressers, truck drivers and typists (Zimmerman,1994).

Carpal tunnel syndrome is the most common form of Repetitive Trauma Disorder (RTD) which affects mainly middle-aged women .The risk of CTS is high in occupations where there is exposure to high pressure, high force, repetitive work and vibrating tools (Aroori and Spence,2008).

On the basis of clinical symptoms and Nerve Conduction Tests (NCT), overall prevalence of 2.1-3.9 among women and 1.3-3.0% among men have been found in general population samples (Atroshi et al,1999).The gross incidence rate was 1.3 per 1000 in 1987, and 1.8 per 1000 in 2001 (Bongers et al,2007).

The exact pathogenesis of CTS is yet not clear but several theories like mechanical compression;micro-vascular insufficiency and vibration theories have been put forward to explain the symptoms and impaired nerve conduction studies. The symptoms vary depending upon the severity of the disease. In early stages, patients usually have sensory symptoms followed by motor symptoms in the later stage (Aroori and Spence,2008).

Clinically,it appears that there are vulnerable sites in the body like soft tissue, fibro-osseous or osseous tunnels such as the carpal tunnel or the intervertebral foramen where lesions that affect the elasticity and movement of the nervous system often begin (Butler,1989).

The primary theoretical objective of the Neural mobilization for the treatment of adverse neurodynamics is to attempt to restore the dynamic balance between the relative movement of neural tissues and surrounding mechanical interfaces, thereby allowing reduced intrinsic pressures on the neural tissue and thus promoting optimum physiologic function. The hypothesized benefits from neural mobilisation include facilitation of nerve gliding, reduction of nerve adherence, dispersion of noxious fluids, increased neural vascularity, and improvement of axoplasmic flow (Ellis and Hing,2008).

A search to identify randomized control trial investigating neural mobilization yielded few studies which concluded a positive benefit from neural mobilization in the treatment of altered neurodynamics or neurodynamic dysfunction(Akalin et al,2002;Baysal et al, 2006;Ellis and Hing, 2008).

Considering the results of the extensive literature search carried out for this review indicated an obvious paucity of research concerning the therapeutic use of neural mobilization (Ellis and Hing,2008).Hence the purpose of this study is to find out the appropriate interventions for the carpal tunnel syndrome.

Methods

Study Design

The study was conducted at Tertiary Hospital, North India from August 2009 to February 2010; using a randomized two groups Pre/Post-test experimental design. The effect of Neuromobilisation along with splinting was compared with splinting alone. The permission for the study was granted from hospital authority before the commencement.

Subjects

Informed consent was taken from all the subjects prior to their enrolment. Twenty eight subjects of ages between 35-50 years participated in the study. The inclusion criteria was -subjects suffering from CTS less than 6 months, up to grade 4 based on Clinical CTS scoring (Mondelli et al, 2001),with NCT and Phalen's test positive, sensation below Grade 5 over median nerve distribution (tested by using the semmes-weinstein monofilament)(Szabo et al,1984;Bell-Krotoski ,2002).

The subjects were excluded if they had any metabolic disorders such as Diabetes mellitus or Thyroid disease, Rheumatoid Arthritis, cervical radiculopathy, pregnancy, systemic peripheral neuropathy, history of steroid injection to carpal tunnel, used splint as a treatment, previous surgery for carpal tunnel syndrome, thenar atrophy and history of trauma and if they were on regular analgesics or anti-inflammatory drugs.

Intervention

Patients were randomly assigned to one of the two treatment groups:

Group A:-Full-time neutral angle wrist splinting alone.

Group B:- Neuromobilisation and Full-time neutral angle wrist splinting

On the 0 day and 21st day i.e. pre and post treatment, patients were given to fill the Boston Questionnaire. Grip strength was measured using T.K.K.Grip D Digital Dynamometer. Pain intensity was assessed by VAS and Sensory testing was done using the Semmes-Weinstein monofilament.

The protocol of the study was of three weeks which included 'Group A' with a total of 13 patients who were advised to wear full-time neutral angle wrist splint. Physiotherapist performed neuromobilization technique (Kostopoulos,2004) for the median nerve on the 'Group B' with a total of 15 patients which includes 3 sets of 10 repetitions in each set, at a moderate pace and a 3 second hold at the final stretched position. They were also advised to wear full-time neutral angle wrist splint, same as group A. The protocol included treatment of total three weeks, with six days per week management (i.e. once a day neuromobilization).

A pamphlet with text and illustration of the self mobilization technique (Jepsen and Thomsen,2008) for the median nerve was handed out to the patients included in group B who were encouraged by the therapist to complete the home exercise program once a day over a 3 weeks period.

Procedure

The Boston Questionnaire include Functional Status Scale consists of eight common tasks involving the hands and Symptoms Severity Scale consists of eleven items. Each question was answered on a scale of 1 to 5 arranged in an increasing order of severity. The patients were asked to rate their pain intensity on Visual Analog Scale. Grip strength using digital Dynamometer measurement was started with the right hand, continued with the left, and then the right and left hands again for a total of four measurements. The mean value of the highest values of the forces of both hands was recorded.

Sensory testing with the monofilaments began with filament in the normal threshold level and progressed to filaments of increasing pressure until touch is identified by the patient. Sites for median nerve monitoring were the tip of the thumb, index and proximal index.

Sequence for Median Nerve Neuromobilisation Technique based on Upper limb Tension test(ULTT 1):

1. Shoulder Depression and abduction (110º).
2. Wrist Extension.
3. Supination
4. Shoulder lateral rotation.
5. Elbow Extension.
6. Neck lateral bending to opposite side.

The subjects were instructed to do self-mobilisation of the median nerve. They were asked to place their hand flat on a wall with fingers pointing backwards, elbow stretched, and shoulder lowered (kept down by the other hand) and if possible flex the head away from the arm for approximately 20 seconds.

All the data were analyzed using statistical tests which were performed using SPSS 15.00 software package. Independent t-test was used to compare VAS, sensory testing at three sites name as site 1, site 2, site 3 and Grip strength between the groups on 0 and 21 day. Mann-Whitney Test was used to compare the score of Boston Questionnaire Symptom Severity Scale and Functional Status Scale between the groups on 0 and 21day.

Results

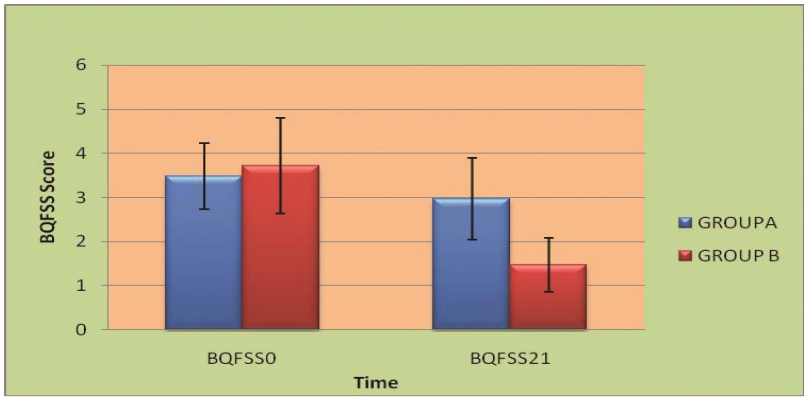
A total no of 28 subjects (19 females and 9 males) participated in the study. Group A includes 13 subjects and Group B includes 15 subjects. Each subject was evaluated at the 0 day of the study for age, duration since patients suffering from CTS.

	No of Subjects	Age (Mean±SD)	Duration of C.T.S (Mean±SD)
A(9F+4 M)	113	42.92±5.58	95.00±53.27
B(10F+5M)	115	43.07±5.73	86.67±66.94

Table 1: Descriptive statistics

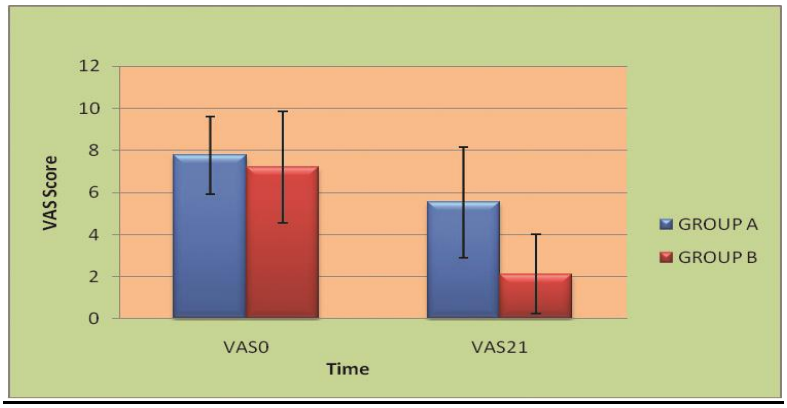
Boston Questionnaire Symptom Severity Scale (BQSSS)

BQSSS was measured on day 0 (baseline data as BQSSS0) and on 21st day (represented as BQSSS21). The reading on 21st day i.e. BQSSS21 was found to be significant between the two groups (p=0.002).



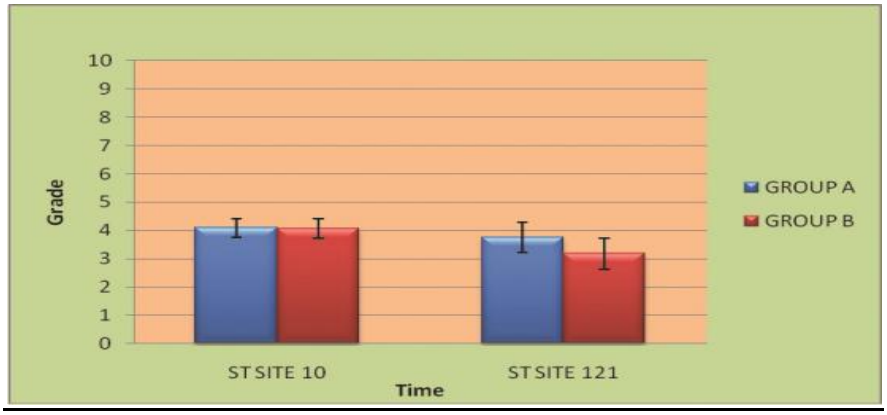
Pain Intensity (VAS)

The pain intensity was measured on day 0 (base line data as VAS0) and on 21st day (represented as VAS21). The reading on 21st day i.e. VAS21 found to be significant between the two groups (p=0.001).



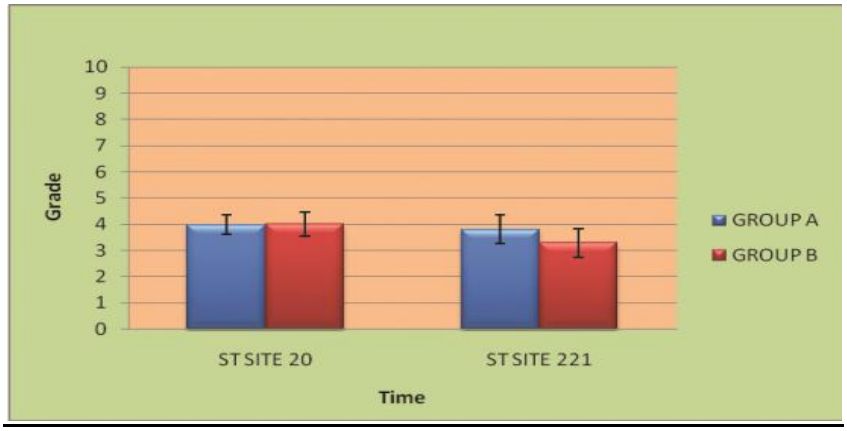
Sensory Testing (SITE 1)

The Sensory testing was done on day 0 at SITE 1 (base line data as ST SITE10) and on 21st day (represented as ST SITE121). The reading on 21st day i.e ST SITE121 was found to be significantly different between the two groups (p=0.010).



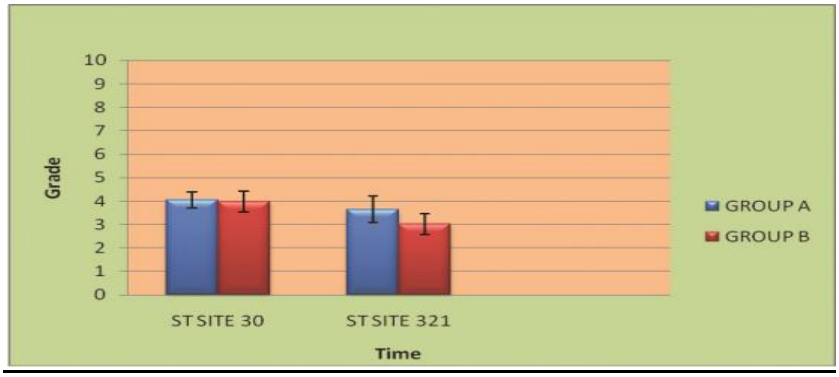
Sensory Testing (SITE 2)

The Sensory testing was done on day 0 at SITE 2 (base line data as ST SITE20) and on 21st day (represented as ST SITE221). The reading on 21st day i.e. ST SITE221 was found to be significantly different between the two groups (p=0.018).



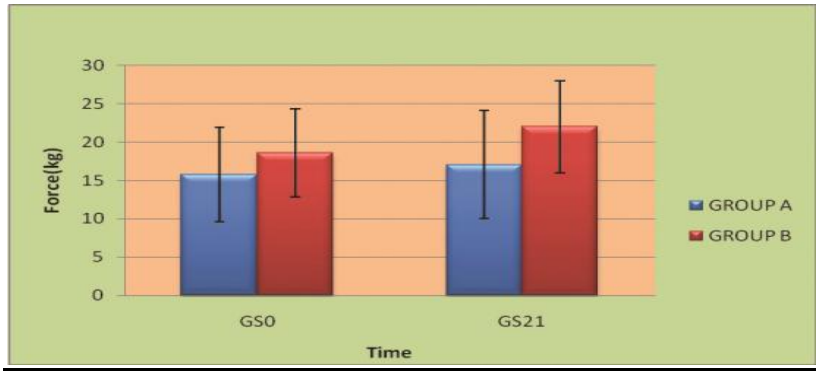
Sensory Testing (SITE 3)

The Sensory testing was done on day 0 at SITE 3 (base line data as ST SITE30) and on 21st day (represented as ST SITE321). The reading on 21st day i.e. ST SITE321 was found to be significantly different between the two groups (p=0.003).



Grip Strength (GS)

The Grip strength was measured on day 0 (base line data as GS0) and on 21st day (represented as GS21). The reading on 21st day i.e. GS21 found to be non-significant between the two groups (p=0.055).



Discussion

This study was designed to determine whether a clinical benefit of neuromobilisation and splinting could be concluded in CTS .The results of the study demonstrated that a combination of neuromobilisation and splinting brought greater gains in outcome measures i.e. Pain intensity, Boston questionnaire score, sensory testing.There was substantial improvement observed during the 3 weeks of treatment period. However, non-significant results were found in Grip Strength measurement.

The data showed that with the use of three weeks protocol there was a significant difference between post treatment values of VAS score(p=0.001) and Boston Questionnaire Symptom Severity Scale(p=0.002) and Functional Status Scale(p=0.001) taken on 21st day between group A and group B but more improvement was seen in the group B. Butler in 1991, Elvey and Shacklock in 1995 have investigated the effects of nervous system mobilization on nerve entrapment problems .The rationale in treating patients with nervous system mobilization is an attempt to improve axonal transport and by this mechanism to improve nerve conduction. Mobilization of a nerve may reduce the pressure existing within the nerve and could therefore result in an improvement of blood flow to the nerve. Consequently, regeneration and healing of an injured nerve may also occur (Tal-Akabi and Rushton,2000).

Tal-Akabi and Rushton(2000) investigated the effectiveness of manual therapy intervention i.e. carpal bone mobilization and mobilization of the nervous system in CTS patients and found VAS results for both the interventions were highly significant ,suggesting some improvement after three weeks and the Functional Box Scale (FBS) showed non-significant results for both interventions which suggested further development of methodology and in particular utilisation of a large sample size in exploring this effect further so in this study Boston Questionnaire was used since it explain the condition of the patient in more descriptive way as it includes Symptom Severity Scale (SSS) evaluates symptoms regarding severity, frequency, time, kind and Functional Status Scale (FSS) evaluates how the syndrome affects daily life (Meirelles et al,2006).Large sample size and fixed protocol was also used to explore the effect of neuromobilisation and found that there was a significant difference in Boston questionnaire score between Group A and group B.

The data of this study showed that there was non-significant difference between post treatment values of Grip strength on 21st day between group A and group B ($p=0.055$) i.e. there was no improvement in grip strength which might be due to short duration protocol of three weeks. Akalin et al (2002) compared the treatment of CTS i.e wrist splint alone to the wrist splint in combination with nerve and tendon gliding exercises and evaluated with clinical parameters, a Functional Status Scale, and a Symptom Severity Scale to find out the efficacy of the treatment and found that the improvement in grip strength was slightly greater in wrist splint in combination with nerve and tendon gliding exercises at the 8th week follow-up.

The data showed that with three weeks of protocol there was a significant difference between post treatment values of Sensory testing at three sites i.e site 1,site 2 and site 3($p=0.010$, 0.018, 0.003 respectively) taken on 21st day between group A and group B but more improvement was observed in the group B. As Aroori and Spence (2008) stated that the micro-vascular insufficiency leads to depletion of nutrients and oxygen to the nerve causing it to slowly lose its ability to transmit nerve impulses, scar and fibrous tissue eventually develop within the nerve produces symptoms particularly tingling, numbness and acute pain, along with acute and reversible loss nerve conduction.As Ellis and Hing (2008) stated that when neural mobilization is used for treatment of adverse neurodynamics, the primary theoretical objective is to attempt to restore the dynamic balance between the relative movement of neural tissues and surrounding mechanical interfaces, thereby allowing reduced intrinsic pressures on the neural tissue and thus promoting optimum physiologic function. The hypothesized benefits from such techniques include facilitation of nerve gliding, reduction of nerve adherence, dispersion of noxious fluids, increased neural vascularity, and improvement of axoplasmic flow.

It is likely that patients with CTS would be benefitted with the addition of neuromobilisation to standard treatment like splinting. This approach reduces pain, improves sensation and function which makes it a reasonable therapeutic option for clinicians in treating individuals with CTS.

Conclusion

This study demonstrated that patients suffering from CTS can have substantial improvement with the combined treatment of neuromobilisation and splinting and recommend the use of neuromobilisation along with splinting in the conservative management methods for treating

patients with CTS. The results of the study demonstrated that a combination of neuromobilisation and splinting brought greater gains in outcome measures i.e. Pain intensity, Boston questionnaire score, sensory testing. Similar kind of study can be performed with larger sample size for longer duration and with adequate follow-ups. Nerve Conduction Tests (NCT) could be utilised as an outcome measure along with other clinical parameters to draw more valid and significant conclusion out of it. Study may be planned to compare the effects of different manual therapy techniques on CTS and draw conclusion based on better therapeutic outcome.

Key Points

There are vulnerable sites in the body like osseous tunnels such as the carpal tunnel where lesions that affect the elasticity and movement of the nervous system often begin.

The benefits from neural mobilisation include facilitation of nerve gliding, reduction of nerve adherence, dispersion of noxious fluids, increased neural vascularity, and improvement of axoplasmic flow.

The results of the extensive literature review indicated an obvious paucity of research concerning the therapeutic use of neural mobilization. It is likely that patients with CTS would be benefitted with the addition of neuromobilisation to standard treatment like splinting. This approach reduces pain, improves sensation and function which makes it a reasonable therapeutic option for clinicians in treating individuals with CTS.

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