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EFFECTIVENESS OF ULTRASOUND VS NERVE GLIDING EXERCISES FOR IMPROVING FUNCTIONAL ACTIVITY IN INDIVIDUALS WITH CARPAL TUNNEL SYNDROME

Physiotherapy

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ABSTRACT

Background And Purpose: Carpal Tunnel Syndrome (CTS), caused by median nerve compression at the wrist, leads to pain, numbness, and reduced hand function. While splinting is a standard treatment, nerve gliding exercises and therapeutic ultrasound are also used to enhance recovery. This study compares the effectiveness of nerve gliding with splinting versus ultrasound with splinting in managing acute unilateral CTS. **Methodology:** 60 individuals diagnosed with unilateral CTS were randomly assigned to one of the groups, which were Group A (Ultrasound + Splinting), Group B (Nerve Gliding + ScplinTING) and Group C (Splinter alone). All groups were subjected to 5-week interventions over a period of 4 weeks. Therapeutic ultrasound (1 month) was administered to Group A. MHz, 1.0. After pulsed for 1:4, 10 minutes, splinting was performed on W/cm2. Group B implemented standardized nerve gliding exercises and splinting techniques. Group C received only splinting. A questionnaire called the BCTQ, which included the Functional Status Scale (FSS) and Symptom Severity Scala (SSSS), was administered for testing at baseline and after 4 weeks. The analysis of the data involved paired t-tests for within-group comparisons and Tukey's post hoc test for between- group analysis using ANOVA. **Results:** The scores for FSS and SSS were significantly elevated among all groups (p0.05). Using between-group analysis, the results showed that Group B (Nerve Gliding + Splinting) had better improvements than Group A (Ultrasound + Sizzle), and Group C (Splinter alone) (p0.01) (which was considered statistically significant).All groups showed significant improvements in both FSS and SSS scores ($p<0.05$). **Conclusion:** Combined application of Repetitive Transcranial Magnetic Stimulation (rTMS) and task-specific trunk control training yields significant improvements in postural stability among individuals with Parkinson's disease.

KEYWORDS

Wrist; Carpal tunnel syndrome; Nerve gliding; Ultrasound; Splinting

INTRODUCTION

The wrist joint is a condyloid synovial joint that facilitates everyday tasks like holding, lifting weights (hands), and writing. It enables movement in two planes—flexion-extension and radial-ulnar deviation—for a wide range of functional hand movements. [1]

The most common wrist disorder that affects the function of the hand is Carpal Tunnel Syndrome (CTS), which is caused by a peripheral nerve entrapment syndrome. [2] CTS is characterized by the compression of the median nerve in the carpal tunnel, which is formed by both the bones of their respective palms and the flexor retinaculum. It often results in symptoms like numbness, tingling, and nocturnal pain in this area, but it can progress to progressive functional impairment if not treated.[3]

A thorough history and physical examination, including provocative tests like Tinel's sign and Phalen'S test, are frequently used to diagnose CTS, with electrophysiological studies serving as the foundation for electromyogram testing.[4] Thorough clinical evaluations and research studies, accurate information on symptom severity and functional limitations can be obtained.

Conservative treatment modalities have been developed to treat CTS, with the aim of reducing symptoms, restoring functional activity (CSF) and preventing surgical interventions.[5] Conservative management has relied on splinting the wrist in a neutral position to maximize carpal tunnel volume and minimize pressure on the median nerve. [6] However, patient outcomes with specialized stretches have been inconsistent, and complaints of discomfort or poor compliance have also been reported.[7] Nerve gliding exercises, also known as neural mobilization, have become increasingly promising adjunct therapies alongside splinting.[8]

The objective of these exercises is to promote greater movement and a decrease in adhesions and nerve compression symptoms within the carpal tunnel, potentially leading to improved hand function and pain relief for those with CTS.[9] The use of therapeutic ultrasound (US) is a common conservative intervention in physiotherapy practice for managing CTS. Thermal and mechanical mechanisms are believed to produce therapeutic effects when used with ultrasound therapy, which promotes soft tissue healing, enhances nerve conduction, and provides analgesic benefits.[10]

However, there is conflicting evidence supporting its use alone or in combination with other interventions.[11] Although several studies have examined the individual efficacy of splinting, nerve gliding, and ultrasound therapy for CTS, there are few comparative studies that have evaluated the relative efficiency of nerve-gliding and splinting to ultrasound and splinting with respect to ultrasound treatment alone. To optimize non-surgical treatment protocols for acute unilateral CTS, it is important to understand the optimal conservative combination.

This could be especially useful in this situation. By comparing the effectiveness of nerve gliding exercises with splinting and ultrasound therapy combined mitigating the gap in research, this study seeks to fill that gap. Evidence-based guidance from this research could be a valuable resource for therapists with CTS in making clinical decisions.

MATERIALS & METHODS

Initial Participant Screening: was performed using Carpal tunnel compression test, applying pressure over the carpal tunnel directly for about 30 sec and then noting any paraesthesia and pain in median nerve which are positive for the carpal tunnel syndrome.

Inclusion Criteria:

- Age: 20-40 years
- Gender: both males and females.
- Previously diagnosed as unilateral Carpal Tunnel Syndrome by positive carpal compression test

Exclusion Criteria:

- Chronic CTS who were referred for surgery.
- History of a steroid injection into the carpal tunnel.
- Thyroid disease
- Diabetes
- Systemic peripheral neuropathy
- Pregnancy
- Splint use
- Fractures in and around wrist joint

METHODS:

Participant informed consent was obtained prior to the study to indicate their willingness to participate in the study. Confidentiality was maintained throughout the study. A total of 60 individuals were selected based on the inclusion criteria, Group A (n=20) received ultrasound and splinting, Group B (n=20) received nerve gliding and splinting and Group C (n=20) received only Splinting, five times a week for four weeks.

Ultrasound was given for a duration of 10 minutes at a frequency of 1 MHz and intensity of 1.0W/cm^2, pulsed mode 1:4 with a transducer of 5 cm^2 and with aquasonic gel as the couplant. In Group B, the patients were instructed to perform nerve gliding exercises developed by Totten and Hinter. Patients were in sitting position, during the median

nerve gliding exercises the median nerve was mobilized by putting the hand and wrist in six different positions. For splinting A custom made neutral volar splint was given to the patient. Boston carpal tunnel questionnaire including FSS (Functional status scale - 8 points) and SSS (Symptom severity scale – 11 points) were measured at baseline and after treatment of 4 weeks.

Statistical Analysis

Data was analyzed using GraphPad and MsExcel (version 13). Parametric tests were used for data. A paired t-test was employed for parametric tests to compare values within the group whereas ANOVA was used for between group analysis.

RESULTS

The paired t- test for Group A revealed significant differences between pre-post values of FSS and SSS ($p<0.05$)

The paired t- test for Group B revealed significant differences between pre-post values of FSS and SSS ($p<0.05$).

The paired t- test for Group C revealed significant differences between pre-post values of FSS and SSS ($p<0.05$).

For between the groups analysis ANOVA was used, Tukey HSD interfence revealed highly significant differences in Group A vs B, A vs C and B vs C for FSS (Table 1).

For SSS, ANOVA revealed significant differences in A vs B and B vs C whereas in Group A vs C non-significant results were noted (Table 2).

Data collected showed significant improvement in BCTQ both in FSS and SSS in patients of unilateral Carpal Tunnel Syndrome. Thus, it can be concluded that Nerve gliding along with Splinting is beneficial in reducing symptoms and functional status more effectively in patients.

Table 1. Comparison Between Groups Of Post Test Of FSS

Treatments pair	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD inferfence
A vs B	4.7272	0.0041329	** p<0.01
A vs C	14.2618	0.0010053	** p<0.01
B vs C	18.9891	0.0010053	** p<0.01

p<0.01 means the values are highly significant

Table 2. Comparison between Groups of Post Test of SSS

Treatments pair	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD inferfence
A vs B	7.2486	0.0010053	** p<0.01
A vs C	9.2353	0.0010053	** p<0.01
B vs C	16.4840	0.0010053	** p<0.01

p<0.01 means the values are highly significant

DISCUSSION

In treating unilateral carpal tunnel syndrome (CTS), the current study examined the effectiveness of ultrasound therapy with splinting versus nerve gliding exercises with both methods. Findings indicated that there was a significant reduction in both severity and functional status across all three groups. Group B received nerve gliding exercises with splinting, but the results were not as impressive. Studies indicate that nerve mobilization techniques have been shown to effectively reduce perineural adhesion, increase axoplasmic flow, and decrease intraneuroneural edema, which are also supported by the improvements seen in the nerve gliding group.[8,12] Although ultrasound therapy is a common method for managing CTS, our study found that it had fewer significant benefits than nerve gliding. Despite reports of short-term improvements in mild to moderate CTS, studies have found no significant advantage in using therapeutic ultrasound over placebo, according to similar research.[8] The expected improvements in the splint-only group were consistent with existing literature, which suggests that wrist skeletons help stabilize the wrist to prevent compression of the median and nocturnal flexion during sleep.[13] As a first line of conservative intervention for patients with mild CTS or those with symptoms worsening at night, specialized lumbar interventions are recommended.[14] Despite the absence of research on manual therapy, carpal bone mobilization and soft tissue techniques have been suggested as adjunct therapies for relieving perineural pressure in CTS.[15] We found that while ultrasound and splinting have been shown to provide therapeutic benefits, nerve gliding combined with a skeleton insert appears to be more effective in improving clinical outcomes for CTS patients.

CONCLUSION

Based on the findings of this study, it can be concluded that while ultrasound therapy combined with splinting and splinting alone provide significant symptomatic relief in patients with unilateral CTS, nerve gliding exercises in conjunction with splinting demonstrated superior improvements in both functional status and symptom severity.

Previous studies have also examined the effects, Authors compared the effects of therapeutic ultrasound with nerve gliding exercises in 48 patients with CTS. The ultrasound group received 1 MHz frequency at 1 W/cm² for five minutes per session, while the nerve gliding group followed a structured exercise protocol. Both groups demonstrated significant improvement in pain reduction, hand function, and electro-diagnostic measures. Notably, the ultrasound group showed greater improvements in nerve conduction parameters, indicating its additional benefits for nerve health.[17] Similarly, a study investigated the combined effect of therapeutic ultrasound and nerve gliding with or without shock-wave therapy in patients with moderate CTS. Their results revealed that while both groups experienced significant improvements in pain, grip strength, and cross-sectional area (CSA) of the median nerve, adding shock-wave therapy did not yield any additional benefit.[18]

The alternate hypothesis is accepted, and the null hypothesis is rejected, affirming that nerve gliding with splinting is a more effective intervention compared to the other approaches studied.

The results suggest that nerve gliding exercises are a simple, cost-effective, non-invasive, and well-tolerated adjunct to splinting in the conservative management of CTS. However, future large-scale studies with longer follow-up periods are recommended to confirm these findings and explore the long-term benefits of combining nerve gliding with other conservative modalities.

Recommendations

Future research should be done to study the long-term effects. Follow-up can be carried out following both interventions to observe sustained effects.

Authors' Contributions

IG contributed to study conception and data collection, PS contributed to data interpretation and critical analysis of manuscript for important intellectual points, proofreading and revision of manuscript. Both authors have critically reviewed and approved the final draft and are responsible for manuscript's content.

Declaration Of Participant Consent

The authors certify that they have obtained all appropriate participant consent forms. In the form, the participants have given their consent for their images and other clinical information to be reported in the journal. The participants understand that their names and initials will not be published, and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Use Of Artificial Intelligence (AI) - Assisted Technology For Preparation Of Manuscript

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no image was manipulated using AI.

Conflict Of Interest

There are no conflicting relationships or activities.

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