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Effectiveness of Neurodynamic Mobalization on Pain and Functional Disability in Patients with Carpal Tunnel Syndrome'a Randomised Control Trial

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Abstract:

- ***Introduction***

Carpal tunnel is a very common dysfunction of wrist the incidence rate of wrist pain is seen up to 30% to 45%. Nerve gliding techniques along with conventional therapy has proven to be very beneficial in treating carpal tunnel syndrome.

- ***Methodology***

A pre-post experimental study was conducted on 40 participants aged 18–55 years with active wrist. Pain and disability were assessed using the Numerical Pain Rating Scale (NPRS) and Boston Carpal tunnel Questionnaire (BCTQ) before and after Treatment.

- **Results**

Patients in Group A showed a greater percentage decrease in NPRS scores (46.07%) compared to Group B (35.18%). Similarly, Group A demonstrated a higher percentage reduction in BCT scores (28.77%) than Group B (16.78%). These findings indicate that the intervention in Group A was more effective in reducing both pain and functional disability.

- ***Conclusion***

Both nerve gliding exercises and conventional physiotherapy interventions were effective in decreasing pain and disability. However, nerve gliding offered superior improvement in functional recovery and should be considered as an effective component of conservative CTS management.

Keywords: *Carpal Tunnel, Nerve Gliding, Ultrasound, Wr.*

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I. INTRODUCTION

The carpal tunnel is an osteofibrous canal located on the volar side of the wrist, bounded by the scaphoid tubercle and trapezium radially, the pisiform and hook of hamate ulnarly, the transverse carpal ligament palmarly, and the proximal carpal row dorsally. Within this narrow passage lie the median nerve, the flexor pollicis longus, and the flexor digitorum tendons. Carpal Tunnel Syndrome (CTS) arises when the median nerve is compressed within this space, leading to pain, paresthesia, numbness, and in severe cases, muscle atrophy and loss of grip strength. Patients often report nocturnal pain and functional limitations that interfere with daily activities. Repetitive wrist movements, prolonged computer use, and occupational activities that involve forceful hand actions increase the risk of developing CTS. The condition is also associated with systemic disorders such as rheumatoid arthritis, diabetes mellitus, gout, and osteoarthritis. Epidemiological studies estimate a global prevalence ranging between 7% and 19%, with a higher incidence among women (60–70% of cases), particularly those over the age of 40. While surgical decompression of the

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transverse carpal ligament is a well-established treatment for persistent cases, conservative physiotherapy approaches are increasingly emphasized as first-line management. Among the available techniques, nerve gliding (neurodynamic mobilization) has gained attention. This method aims to enhance the mobility of the median nerve within the carpal tunnel and forearm, thereby reducing intraneural pressure, improving blood flow, and minimizing adhesions. These effects not only relieve ischemic pain but also improve nerve conduction and hand function. In addition, conservative methods such as ultrasound therapy, cryotherapy, TENS, and kinesiotaping have also demonstrated positive outcomes in reducing symptoms.

Several clinical studies support the effectiveness of nerve gliding as a low-cost, easily applicable, and patient-driven exercise regimen that can complement conventional treatment. By facilitating venous return, decreasing mechanical compression, and reducing intraneural edema, nerve gliding exercises offer a comprehensive non-surgical alternative for managing CTS symptoms.

II. METHOD

This study adopted a pre–post comparative experimental design to evaluate the effectiveness of nerve gliding techniques in patients with Carpal Tunnel Syndrome (CTS). The research was carried out over a six-month period in the Department of Physiotherapy at Rashtrasant Janardhan Swami College of Physiotherapy, Kokamthan, in collaboration with SJS Hospital. A total of 40 participants (both males and females) aged between 18 and 55 years were recruited using a convenient sampling method. The majority of the sample population consisted of college students, office workers, and pregnant women, as these groups are more frequently exposed to repetitive wrist activities such as smartphone use and typing. All participants underwent a detailed screening process based on inclusion and exclusion criteria. Those presenting with wrist pain, tingling, or numbness, and positive findings on Phalen's and Tinel's tests, were considered eligible. Participants provided informed consent prior to study enrolment the primary outcome measure was the Numerical Pain Rating Scale (NPRS), which evaluates pain intensity on a 0–10 scale. The Boston Carpal Tunnel Questionnaire (BCTQ) was used as a secondary outcome measure to assess functional disability related to wrist pain. Both assessment tools are widely accepted for their clinical reliability and validity.Participants were evaluated before the intervention and again after completing six sessions of therapy. Pre- and post-treatment scores were analyzed statistically to determine the effectiveness of the intervention.

➢ *Inclusion Criteria:*

- Age between 18 and 55 years.
- Participants with acute and chronic wrist pain.
- Positive Tinel's and Phalen's test

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III. PROCEDURE

The intervention protocol included four specific nerve gliding techniques designed to enhance the mobility of the median nerve and alleviate symptoms:

➢ *Hand and Wrist Glide*

- Begin with the wrist in a neutral position while making a fist.
- Straighten the fingers, maintaining the wrist in neutral.
- Extend the wrist backward while keeping fingers straight.
- Spread the fingers apart and extend the thumb away from the palm.
- Rotate the palm upward toward the ceiling.
- Using the opposite hand, gently stretch the thumb downward.

➢ *Finger Stretch*

- With the elbow flexed or extended, spread the fingers wide apart and hold for 5 seconds.
- Bring the fingers back together.
- Repeat this movement for 5–10 repetitions.

➢ *Median Nerve Stretch*

- Performed with arms at shoulder height or slightly lower.
- The wrist may remain straight or be extended depending on comfort.
- The shoulders are kept back and relaxed while maintaining spinal alignment.
- A gentle stretch is held for 5–10 seconds, repeated several times, progressing gradually to 10 repetitions.

➢ *Median Nerve Slider*

- Involves alternating movements of the neck, elbow, and wrist to place the nerve under controlled tension.
- Start from a neutral position and move slowly into the stretched position while keeping shoulders relaxed.
- Return to the starting position and repeat 5–10 times.
- This technique was introduced once symptoms began to subside to avoid aggravation.

Each participant performed these exercises under supervision initially, followed by guided self-practice to ensure consistency and safety.

IV. OUTCOME MEASURES

To evaluate the effectiveness of the intervention, two standardized outcome measures were used before and after the nerve gliding treatment. The Numerical Pain Rating Scale (NPRS) was utilized to assess the intensity of neck pain, where participants rated their pain on a scale from 0 (no pain) to 10 (worst possible pain). Additionally, the Boston carpal tunnel Questionnaire (BCT) was used to evaluate functional disability related to wrist pain in daily activities such as, writing, working and typing, griping activities. Both outcome

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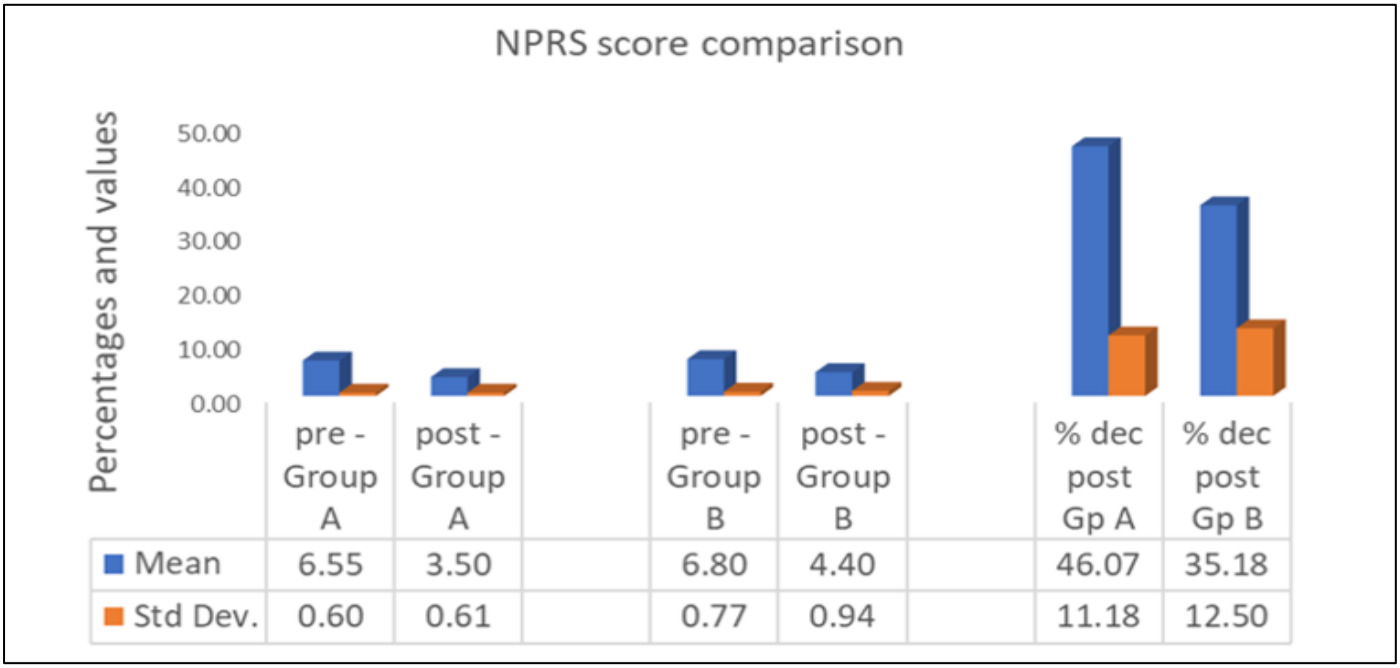
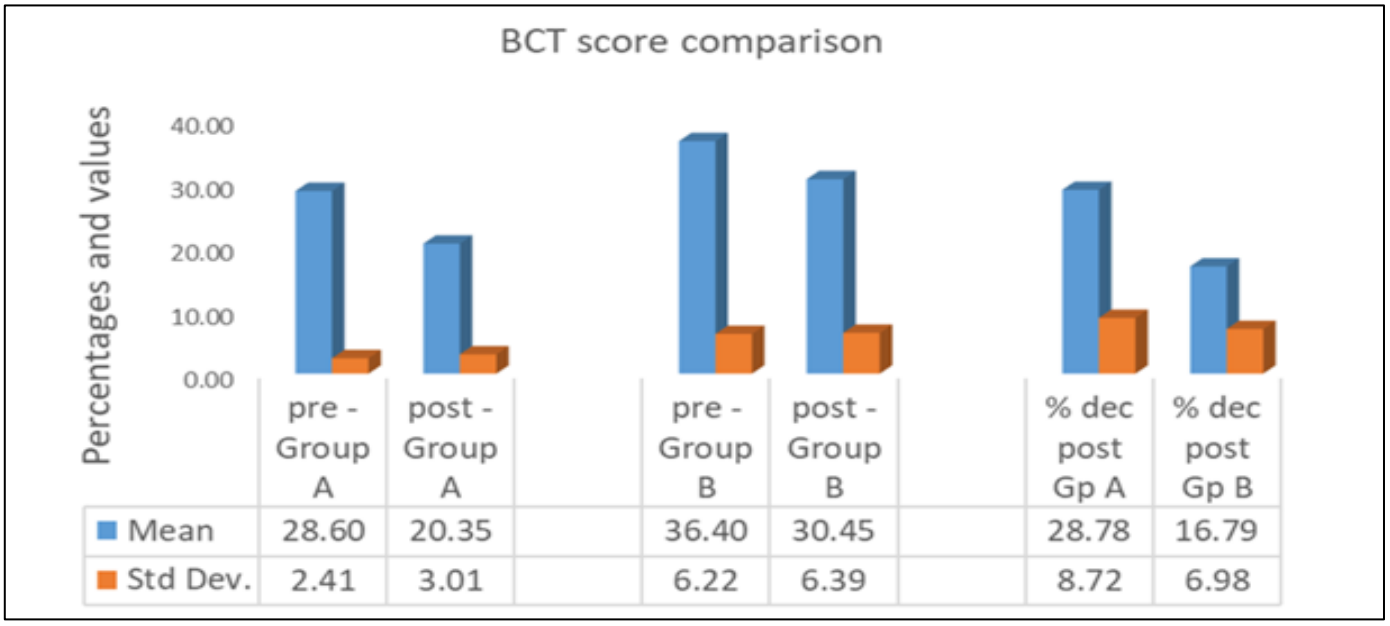
measures are widely accepted for their reliability, validity and clinical relevance in assessing neurogenic pain and functional limitations.

V. DATA ANALYSIS

To understand whether the treatment given was effective, we compared the scores before and after the treatment using the BOSTON questionnaire and the NPRS (Numerical Pain Rating Scale). For the BOSTON scores, the statistical test gave us a t value of 12.03, and the p value was <0.01, which means the result is highly significant. In simple words, there was a clear and important difference in the scores before and after the treatment. The average (mean) BCT score before the treatment was 28.60 and after the treatment, it dropped to 20.35. This shows that the participants improved after the treatment. Similarly, for the NPRS scores, the t value came out to be 6.55, with a p value of <0.01, again showing a significant change. The average NPRS score after the treatment was 3.50, which is lower than before, indicating that the participants experienced less pain after the intervention. These results clearly show that the treatment had a positive effect. Both functional improvement (BCT) and pain reduction (NPRS) were seen after the intervention and the changes were statistically significant. So, we can confidently say that the treatment worked well in helping the participants feel better.



Graph 1 Pre and post NPRS data of group A and B.



Graph 2 Pre and post BCT data of group A and B.

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VI. RESULTS

Both groups were evaluated using the Numerical Pain Rating Scale (NPRS) for pain and the Boston Carpal Tunnel Questionnaire (BCTQ) for functional disability before and after the treatment period.Pain Outcomes (NPRS) Group A: The average pain score decreased from 6.55 ± 0.60 before intervention to 3.50 ± 0.61 after therapy. The mean difference of 2.40 was found to be statistically significant ($t = 11.41$, $p < 0.01$). Group B: The mean NPRS score reduced from 6.80 ± 0.77 at baseline to 4.40 ± 0.94 post-intervention. The difference of 2.40 was also significant ($t = 12.16$, $p < 0.01$).These findings suggest that both interventions were effective in reducing pain, although nerve gliding produced slightly greater improvements. Functional Outcomes (BCTQ) Group A: Functional scores improved markedly, with mean values decreasing from 28.60 ± 2.41 pre-intervention to 20.35 ± 3.01 post-treatment. The mean difference of 8.25 was highly significant ($t = 13.23$, $p < 0.01$). Group B: Functional outcomes also improved, with mean BCTQ scores reducing from 36.40 ± 6.22 to 30.45 ± 6.38. The mean difference of 5.95 was statistically significant ($t = 12.03$, $p < 0.01$).

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VII. DISCUSSION

This study aimed to evaluate the effectiveness of nerve gliding exercises compared to conventional physiotherapy in individuals diagnosed with Carpal Tunnel Syndrome (CTS). The findings revealed that both interventions produced statistically significant improvements in pain reduction and functional ability, as measured by the NPRS and BCTQ.Although improvements were observed in both groups, participants who performed nerve gliding exercises (Group A) experienced greater reductions in pain intensity and functional disability compared with those receiving conventional therapy (Group B). This suggests that nerve gliding may provide additional therapeutic benefits beyond routine physiotherapy.The observed outcomes are consistent with previous research, which has highlighted the positive role of nerve gliding in reducing intraneural edema, enhancing axoplasmic flow, and decreasing mechanical sensitivity of the median nerve. By improving the nerve's mobility relative to surrounding structures, nerve gliding likely reduces compression-related ischemia and inflammation, resulting in better pain control and improved hand function.Moreover, the functional gains observed in Group A reinforce the view that nerve gliding addresses not only pain symptoms but also functional limitations, which are often the most disabling aspect of CTS. Compared to conventional approaches such as ultrasound, cryotherapy, and TENS, nerve gliding offers the advantage of being simple, cost-effective, and easily taught to patients for home-based practice. This may reduce reliance on frequent clinic visits and support long-term self-management.The inter-group comparison strengthens the argument that while conventional therapy contributes to recovery, nerve gliding serves as an essential component of conservative management for CTS, particularly in enhancing functional outcomes.

VIII. CONCLUSION

The findings of this study demonstrate that both nerve gliding exercises and conventional physiotherapy are effective in reducing pain and functional disability in individuals with Carpal Tunnel Syndrome (CTS). However, participants who performed nerve gliding exercises achieved comparatively greater improvements, particularly in functional outcomes.These results highlight the value of incorporating nerve gliding techniques into conservative treatment programs for CTS. As a low-cost, safe, and easily administered intervention, nerve gliding can serve as an important adjunct to conventional therapies and may reduce the likelihood of progression to more invasive procedures such as surgery. Further research with larger sample sizes and extended follow-up periods is recommended to establish standardized protocols and evaluate the long-term benefits of this intervention.

IX. ABBREVIATIONS

- *NPRS:*
  Numerical Pain Rating Scale
- *BCTQ :*
  Boston Carpal Tunnel Quest

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