A STUDY TO EVALUATE THE EFFECTIVENESS OF NERVE GLIDING EXERCISE WITH TENS AND ULTRASOUND FOR PATIENTS WITH CARPAL TUNNEL SYNDROME

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Abstract: BACKGROUND OF THE STUDY: Carpal tunnel syndrome is a medical condition due to compression of the median nerve as it travels through the wrist, causing disabling pain which leads to limitations in daily life activities, discomfort and sleep disturbance. (1) Carpal tunnel syndrome (CTS) was first described by Sir James Paget in 1854. (2) CTS is the most well known and frequent form of median nerve entrapment for 90% of all entrapment neuropathies. (3) This syndrome is characterized by pain in the hand, numbness, and tingling in the distribution of median nerve. This sensation may be felt in the thumb, index finger, middle finger, and radial side of the ring finger. (1, 2, 3) Occupational groups such as carpenters, musicians, dentists, shoemakers, butchers, tailors, computer operators, and clerks are at high risk for CTS due to repetitive hand movements. (4, 5) Nerve gliding exercises is provided for stretching the adhesion in the carpal tunnel, broadening the longitudinal area of contact between the median nerve at the transverse carpal ligament, reducing tenosynovial edema, improving venous return from the nerve bundles, and reducing pressure inside the canal. (11) Transcutaneous electrical nerve stimulation (TENS) is applied for pain relief. Based on gait control theory in CTS (12), a transcutaneous electrical nerve stimulator (TENS) sends electrical pulses through the skin to start body’s own painkillers. The electrical pulses can release endorphins and other substances to stop pain signals in the brain. TENS can reduce pain. Ultrasound is provided in CTS to decrease soft issue inflammation, increase soft tissue healing, decrease pain, decrease swelling. (13) Purpose of the study to evaluate the effectiveness of nerve gliding exercises with tens and ultrasound for patients with carpal tunnel syndrome. (7, 9) CONCLUSION: The study was conducted to compare the effectiveness of nerve gliding exercises with Tens and ultrasound for patient with carpal tunnel syndrome. 30 subjects were included in this study and were randomly divided into two groups. The group A was treated with nerve gliding exercises with Tens and Group B treated for nerve gliding exercises with ultrasound. From the results, it can be concluded that there is significant difference in reducing pain and improving functional ability in both groups but when comparing the mean value it is found out that the group B treated with nerve gliding exercises with ultrasound is more effective than group B nerve gliding exercises with tens.

Keywords: nerve gliding exercise, ultrasound, TENS, carpal tunnel syndrome, visual analog scale, Boston carpal tunnel questionnaire

1. INTRODUCTION
Carpal tunnel syndrome is a medical condition due to compression of the median nerve as it travels through the wrist, causing disabling pain which leads to limitations in daily life activities, discomfort and sleep disturbance. (1) Carpal tunnel syndrome (CTS) was first described by Sir James Paget in 1854. (2) CTS is the most well known and frequent form of median nerve entrapment for 90% of all entrapment neuropathies. (3) This syndrome is characterized by pain in the hand, numbness, and tingling in the distribution of median nerve. This sensation may be felt in the thumb, index finger, middle finger, and radial side of the ring finger. (1, 2, 3) Occupational groups such as carpenters, musicians, dentists, shoemakers, butchers, tailors, computer operators, and clerks are at high risk for CTS due to repetitive hand movements. (4, 5) The carpal tunnel (CT) is found at the base of the palm. It is bounded partly by the eight carpal bones and partly by a tough fibrous roof called the transverse carpal ligament (TCL). The tunnel gives passage to: eight digital flexor tendons (two for each of the medial four fingers); flexor pollicis longus (FPL) tendon for the thumb; their flexor synovial sheaths; and the...
median nerve (MN) (6) The prevalence of carpal tunnel syndrome is estimated to be 2.7 - 5.8% of the general adult population of with lifet ime incidence of 10-15% depending on occupational risk. Carpal tunnel syndrome usually occurs between age 25 and 55 and is more common in women. (7,8)

Pathophysiology of CTS involves a combination of mechanical trauma, increased pressure, and ischemic damage to the median nerve within the carpal tunnel. (4,5) Test for CTS can be performed during physical examination. Tapping the nerve in the Carpal Tunnel to elicit pain in the Medial Nerve Distribution (Tinel's Sign) Holding the wrist in flexion for 60 seconds to elicit numbness and pain in the Medial Nerve Distribution (Phalen Test). (9) There are various causes of carpal tunnel syndrome (CTS) being with most importance among them. Apart from the various conventional therapies are available for management of CTS these include steroid injection, night splint, ultrasound therapy, manual therapy, acupuncture, yoga exercise, and soft tissue mobilization. (10) Nerve gliding exercises is provided for “stretching the adhesion in the carpal tunnel, broadening the longitudinal area of contact between the median nerve and the transverse carpal ligament, reducing tenosynovial edema, improving venous return from the nerve bundles, and reducing pressure inside the canal.

(11) Transcutaneous electrical nerve stimulation (TENS) is applied for pain relief. Based on gait control theory in CTS (12) A transcutaneous electrical nerve stimulator (TENS) sends electrical pulses through the skin to start body's own pain killers. The electrical pulses can release endorphins and other substances to stop pain signals in the brain. TENS can reduce pain. Ultrasound is provided in CTS to decrease soft tissue inflammation, increase soft tissue healing, decrease pain, decrease swelling. (13) Purpose of the study to evaluate the effectiveness of nerve gliding exercises with tens and ultrasound for patients with carpal tunnel syndrome. (7,9)

2 AIM AND OBJECTIVES

2.1 AIM OF THE STUDY
To find out the effectiveness of nerve gliding exercise with tendon and ultrasound for carpal tunnel syndrome.

2.2 OBJECTIVES OF THE STUDY

- To evaluate the effectiveness of nerve gliding exercise and TENS for patient with carpal tunnel syndrome.
- To evaluate the effectiveness of nerve gliding exercise and ultrasound for patient with carpal tunnel syndrome.
- To compare the effectiveness of nerve gliding exercise with tens and ultrasound for patient with carpal tunnel syndrome.

3. HYPOTHESIS

3.1 NULL HYPOTHESIS:
It is hypothesized that there is no significant effect of nerve gliding exercise with TENS and ultrasound for patients with carpal tunnel syndrome.

3.2 ALTERNATE HYPOTHESIS:
It is hypothesized that there is a significant effect of nerve gliding exercise with TENS and ultrasound for patients with carpal tunnel syndrome.

4 REVIEW OF LITERATURE

Bartkowiak et al, (2019) A study to evaluate effectiveness of Nerve and Tendon Gliding Exercises Combined with Low-level Laser or Ultrasound Therapy in Carpal Tunnel Syndrome. A total of seventy patients with mild to moderate CTS, divided into two groups, were included in this study. Group 1 received ultrasound treatment, whereas Group 2 underwent LLLT. The treatment lasted 2 weeks (5 sessions/week). The measurement of grip strength, Phalen test, Tinel sign, and the Boston Carpal Tunnel Questionnaire were used. The assessment was performed before and after the treatment. The results of this study may suggest the clinical efficacy of LLLT or ultrasound combined with gliding exercises in patients with mild to moderate.

Mohammad Anwar hossian (2019) Validity and reliability of a visual analog scale (VAS) for pain measurement. A critical review was done for the study total 10 students were included in the study. The majority of the studies showed that visual analog scale (VAS) for pain measurement is more valid and reliable than other methods.

Marryam (2018) A study to evaluate the effectiveness of full Neurowave dynamic versus nerve and tendon gliding exercises alone in patients of carpal tunnel syndrome by Single blinded randomized controlled trial.

Mehboob alam (2018) To compare the effectiveness of neural mobilization and ultrasound therapy on pain severity in carpal tunnel syndrome (CTS). This randomized controlled trial was conducted on 48 CTS patients. The CTS patients were randomly allocated into 2
equal groups by simpler randomization method. Group 1 received neural mobilization; Group 2 received ultrasound therapy with a predetermined intensity. A total of 12 sessions were given over a period of 4 weeks. Pre and post intervention data were collected from both groups.

Sina Jassemi, et al. (2017) This study aimed to compare the short term effects of low level laser therapy (LLLT) and transcutaneous electrical nerve stimulation (TENS) on hand pain and function in patients with low or moderate levels of carpal tunnel syndrome. The study was included 24 patients with CTS. The study documented that LLLT might be effective in reducing pain and improving function in patients with mild to moderate CTS. TENS might have been effective in controlling pain in these patients.

Tomasz Wolny et al. (2017) Efficacy of manual therapy including neurodynamic techniques for the treatment of carpal tunnel syndrome: A randomized controlled trial. In this study, 140 subjects with carpal tunnel syndrome were included. The study concluded that the results regarding pain reduction, subjective symptoms, and functional status were better in the manual therapy group.

Ruth Ballestero-Perez (2017) Effectiveness of nerve gliding exercises on carpal tunnel syndrome: A systematic review. Standard conservative care is seen as the most appropriate option for pain relief although neural gliding might be a complementary option to accelerate recovery after intervention.

Sang-Dol Kim (2015) Efficacy of tendon and nerve gliding exercises for carpal tunnel syndrome: A systematic review randomized control trial. The study included 24 patients with carpal tunnel syndrome. The study concluded that ultrasound treatment proved to be more effective than laser therapy.

Arul Retina et al. (2011) To compare the effectiveness of nerve gliding exercise and splinting versus ultrasound and splinting in improving functional activities of carpal tunnel syndrome. It appears that the nerve gliding exercise may aid in reduction of symptoms and improvement of function in patients with CTS while the efficacy of nerve gliding techniques for the treatment of CTS is not clear. Trend to what pain and symptom reduction improved sensation and improved functional and strength.

Lamia Pinar et al. (2005) A study investigated the effectiveness of nerve gliding exercises used in combination with conservative treatment approaches in patients with carpal tunnel syndrome. A total of 35 hands of 26 patients with carpal tunnel syndrome were divided into two groups. The first group received ultrasound therapy and the second group received laser therapy. This study concluded ultrasound treatment proved to be more effective than laser therapy.

Vikranth G R, Vinod Kumar C, Lawrence Mathias, et al. (2005) Comparative effect of carpal bone mobilization vs neural mobilization in improving pain functional status and symptoms severity in patients with carpal tunnel syndrome. 30 subjects with carpal tunnel syndrome were randomized into two groups with 15 subjects each. In the experimental group, nerve gliding exercises were applied to the affected hand. In the control group, ultrasound treatment was applied to the affected hand.

Jk Wilson and T L Sevier (2003) Trail suggest that ultrasound treatment has good short term effectiveness and even results.
5. MATERIALS AND METHODOLOGY

5.1 STUDYTYPE: Quasi experimental design.

5.3 SAMPLINGMETHOD: Randomised sampling Method

5.4 STUDYSETTING: physiotherapy outpatient Department, Aarupadai veedu medical collegeandhospital, Pondicherry.

5.5 TOTALSTUDYDURATION: 1 months.

6. MATERIALS USED FOR THIS STUDY

- Therapeuticultrasoundmachine
- Therapeutictensmachine
- Ultrasoundgel
- Electrodes
- Cotton
- Couch
- Pillow
- Towel
- chair

7. SELECTION CRITERIA

7.1 INCLUSION CRITERIA
- Agegroup between 25-50
- Bothmaleandfemale
- UnilateralCTS
- Positivetinnel test
- Positivephalentest

7.2 EXCLUSION CRITERIA
- Highlevelmediannerveinjury
- Carpalbonefracture
- Historyoftraumato thewristerhand thatincludedbrokenbones
- Known history of other neurological disorders such as cervical radiculopathy,cervicalspondylosis

8. OUTCOME MEASURE

- Visual analogue scale
- Boston carpal tunnel questionary

9. PROCEDURE

30 participant will be included in the study after fulfilling selection criteria consent form will besinged and information sheet will be given pre test will be taken at zero week. they will be divided into two groups [groups A and group B]. group A, n=15participants will be received nerve glidingexercise with tens and group B, n=15participants will be received nerve gliding exercise withultrasound forthreeweeks.
GROUPRECEIVEDNERVEGLIDINGEXERCICEWITHTENSFOR4WEEK.

Nerve gliding exercise will be performed 3 times a day. Each position in the nerve gliding exercise will be maintained for 7 seconds and repeated 5 times. The nerve gliding exercise involved maintaining the fingers and the hand in 6 consecutive positions: 1. The wrist in neutral and the fingers in flexion. 2. Wrist in neutral position, finger extension and thumb straight in line with the finger. 3. Wrist and finger extension and extend the wrist back. 4. The fingers and the wrist extended back, move the thumb forward away from the finger. 5. Maintaining the fourth position with the forearm in supination and the palm toward the face. 6. Maintaining the fifth position and the other hand gently stretching in thumb.

TENS:
Before the start of the treatment, the patient was instructed about the use and the harmful effects of TENS. The patient was also instructed about the time of application and the duration of treatment. The patient was made to sit on a chair or couch with comfortable position and shoulder with abduction and elbow flexion or wrist should be neutral and resting on a pillow which was applied over table. Tens current with pulse duration of 80 um and frequency 100 hz time of application of was 15 minutes over the area of the carpal tunnel.

GROUP B RECEIVED NERVE GLIDING EXERCISE WITH ULTRASOUND FOR 4 WEEKS PER WEEK FOR 4 WEEK

ULTRASOUND:
Before the start of the treatment, the patient was instructed about the use of ultrasound and the harmful effects of ultrasound. The patient was also instructed about the time of application and the duration of time. The patient was made to sit on a chair or couch with comfortable position. The shoulder slightly abduction and elbow flexion or wrist should be neutral position and resting on a pillow which was placed over the table. Skin and transducer were coated with a gel. The application is moved in small concentric circular movement. The transducer head was applied to the region at right to ensure maximum absorption. At a frequency 1 mhz, the intensity of 1 w/cm2, pulsed mode duty cycle of 1:4 and with a hand held transducer of 5 cm2, the time of application was 6 minutes over the area of the carpal tunnel.

11. STATISTICAL ANALYSIS

Statistical Formula
In this study, pre and post interventional differences within the two groups were analyzed using paired ‘t’ test and between the two groups were analyzed using unpaired ‘t’ test for each of the outcome measures. Statistical significance was set at p<0.001.

The paired “t” test is formulated as:  
\[
t = \frac{\bar{d}}{S/\sqrt{n}} \\
\begin{align*}
\bar{d} &= \text{mean difference, } d \\
\bar{d} &= \text{mean,} \\
n &= \text{total no. of sample.}
\end{align*}
\]

For the between group analysis, unpaired ‘t’ test is used.

The unpaired “t” test is formulated as:  
\[
t = \frac{x_1-x_2}{S\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \\
\begin{align*}
S &= \sqrt{\frac{n_1s_1^2 + n_2s_2^2}{n_1 + n_2 - 2}} \\
\text{Where,} \\
x_1 &\text{and } x_2 \text{ are means of group A and group B;} \\
n_1 \text{ and } n_2 \text{ are sample sizes of two groups. Variance of sample 1 } (s_1^2) = \frac{\Sigma(x_1-\bar{x})^2}{n_1-1} \\
\text{Variance of sample 2 } (s_2^2) = \frac{\Sigma(x_2-\bar{x})^2}{n_2-1}
\end{align*}
\]

The outcomes values obtained were manually calculated.
In this study, to find out the effects of circuit training program and stretching in Spastic diplegia was founded by comparing the significant difference between the both groups. The pre-test and post-test interventional differences within the two groups were analyzed using paired test „,GMFM 88& 66” for outcome measures. Statistical significance was set at p < 0.01 was considered as a significancedifference.

The p-value was chosen as per the description given by research book.

12. RESULT

30 subjects with carpal tunnel syndrome patient. The subjects were randomly divided into two groups.

Group A was treated with nerve gliding exercises with Tens. Group B was treated with nerve gliding exercises with ultrasound.

The patient was treated for three session per week for 4 weeks. Before starting the treatment, FSS was graded by functional ability and the pain was graded by VAS. The measurement was repeated at the end of the study session.

Analysis of dependent variable pain Group A:

The calculated paired ‘t’ value is 7.250 at 0.001 level. Hence, calculated ‘t’ value is greater than the table ‘t’ value here is significant difference in pain following nerve gliding exercises with Tens for carpal tunnel syndrome.

Analysis of dependent variable pain Group B:

The calculated paired ‘t’ value is 19.179 at 0.001 level. Hence, calculated ‘t’ value is more than ‘t’ table value, there is significant difference in pain following nerve gliding exercises with ultrasound for carpal tunnel syndrome.

Dependent variable pain between Group A and Group B:

The calculated unpaired ‘t’ value is 1.000 and table value is 0.001 level of significance. Hence, the calculated ‘t’ value is more than ‘t’ table value, there is significant difference between nerve gliding exercises with Tens and ultrasound for carpal tunnel syndrome.

Analysis of dependent variable FSS in Group B:

The calculated paired ‘t’ value is 27.448 and ‘p’ value is 0.001 level of significance. Hence, the calculated ‘t’ value is more than ‘t’ table value, there is significant difference in FSS following nerve gliding exercises with ultrasound for carpal tunnel syndrome.

Dependent variable FSS between Group A and Group B:

The calculated unpaired ‘t’ value is 0.318 and table value is 0.001 level of significance. Hence, the calculated ‘t’ value is more than ‘t’ table value, there is significant difference in nerve gliding exercises with Tens and ultrasound for carpal tunnel syndrome.

When comparing the mean values of group A and group B, group A subjects treated with nerve gliding exercises with Tens showed more difference than group B. Hence, it is concluded that nerve gliding exercises with ultrasound are more effective than nerve gliding exercises with Tens in reducing pain and improving functional ability for carpal tunnel syndrome.

13. DISCUSSION:

In the study was selected for the purpose of the finding the effectiveness of the nerve gliding exercises with Tens and ultrasound for patient with carpal tunnel syndrome.

So, in this study, the order to reduce pain and improve functional ability.

CTS is a entrapment neuropathy combines phenomena of compression and traction. Nerve compression and traction may cause disorders of the intra neural microcirculation, lesion in the myelin sheath and the axon as well as alteration in the supporting connective tissue. The entrapment of a peripheral nerve occurs as a result of passage through an anatomical compartment that as become too tight, resulting in altered function with in the nerve and dysfunction and damage of the nerve from the site of compression and beyond.
Nerve gliding exercises "stretching the adhesions in the carpal tunnel, bordening the longitudinal area of contact between the median nerve and the transverse carpal ligament, reducing tenosynovial edema, improving venous return from the bundle, and reducing pressure inside the canal.

Transcutaneous electrical impulses can reduce the pain signals going to the spinal cord and brain, which may help relieve pain and relax muscle. They may also stimulate the production of endorphins and other substances to stop pain signals in the brain.

Ultrasound increase blood flow, decrease soft tissue information, increased soft tissue healing, decrease pain, decreases swelling.

Sina Jassemizadeh et al; this study aimed to compare the short term effects of low level laser therapy (LLT) and transcutaneous electrical nerve stimulation (TENS) on hand pain and function in patient low or moderate levels of carpal tunnel syndrome. The study documented that LLT might be effective in reducing pain and improving functions in patient with mild to moderate CTS. TENS might have been effective in controlling pain in these patients.

Bartkowiak et al. stated in their study that there is evidence to support the use of this study may suggest the clinical efficacy of LLT or ultrasound combined with gliding exercises in patients with mild to moderate CTS. The study concluded ultrasound treatment improved to be more effective to reduce pain with carpal tunnel syndrome. Both techniques are effective for this study.

In this study results that nerve gliding exercises with ultrasound is more effective than nerve gliding exercises with Tens for patient with carpal tunnel syndrome.

14. CONCLUSION

The study was conducted to compare the effectiveness of nerve gliding exercises with Tens and ultrasound for patient with carpal tunnel syndrome. 30 subjects were included in this study and were randomly divided into two groups.

The group A was treated with nerve gliding exercises with Tens and Group B treated for nerve gliding exercises with ultrasound. From the results, it can be concluded that there is significant difference in reducing pain and improving functional ability in both groups but when comparing the mean value it is found out that the group B treated with nerve gliding exercises with ultrasound is more effective than group B nerve gliding exercises with tens.

15. LIMITATIONS AND RECOMMENDATIONS

LIMITATIONS:

- Study samplesize was small
- Short duration study for 4 weeks.
- The study was performed only for subject with carpal tunnel syndrome.
- The age group selected was 25-50

RECOMMENDATIONS:

- Features study with longer duration. Pain and disability measures using more objective outcome are recommended.
- Further study with carpal tunnel syndrome using difference technique are recommended.
- Larger sample size can be analysed.
16. REFERENCES

[7] Lamia Pinar, PhD, prof; can we use Nerve Gliding Exercises Tunnelsyndrome; 2005.
[9] Zuzanna Bartkowiak; The effects of Nerve and Tendon Gliding Exercises combined with Low-level laser or ultrasound Therapy in carpal tunnel syndrome.