

A COMPARITIVE STUDY TO FIND OUT EFFECTIVENESS OF NEUROMOBILIZATION VERSUS NERVE FLOSSING TECHNIQUE IN SUBJECTS WITH MILD TO MODERATE CARPAL TUNNEL SYNDROME

¹DR.S. SRIKANTH REDDY (PT), ²DR POORNIMA DEVI (PT), ³ DR CH BHUVANA

PROFFESOR , PROFESSOR , ASSISTANT PROFESSOR

DR.S.SRIKANTH REDDY,

LVTG COLLEGE OF PHYSIOTHERAPY, KURNOOL, ANDHRA PRADESH, INDIA

Abstract : **Background:** Carpal tunnel syndrome (CTS) is a widespread compressive peripheral neuropathy that involves the entrapment of the median nerve in its passage at the carpal tunnel in the wrist. The carpal tunnel is a small canal in the wrist, bordered by wrist bones and ligaments, that protects important nerves and tendons. It allows the tendons, ligaments and nerves pass through it to reach your hand. Median nerve passes, through carpal tunnel and reaches the palmar region. Normally, tissue called the synovium lines the tendon and helps lubricate it, which makes it easy to move your fingers smoothly. Strengthening exercises can help reduce the risk of developing carpal tunnel syndrome, and alleviate symptoms. “Exercises strengthen the finger flexors and extensors as well as the wrist flexors and extensors are most effective.

Methods: Pain and disability was measured Numeric Pain Rating Scale – Pain , Manual muscle testing – Strength, Boston Carpal Tunnel Syndrome Questionnaire (BCTQ). Subjects in group-A (n=15) received Neuromobilization and Subjects in group-B (n=15) received Nerve Flossing technique along with ultrasound and strengthening exercises in common for both groups. Summary of methodology, including participants, intervention, and data analysis.

Results: After 6 weeks of study neuromobilization group showed effectiveness compared with the nerve flossing technique group with p value <0.001. findings with significance levels.

Conclusion: The net result of the present study showed that there was statistically significant improvement in Group A when compared to Group B, so the alternative hypothesis was accepted there by rejecting the null hypothesis. Hence, we conclude that NEUROMOBILIZATION intervention (Group A) is more effective than the NERVE FLOSSING TECHNIQUE (Group – B) in subjects with mild to moderate carpal tunnel syndrome.

Keywords: CTS- Carpal tunnel syndrome, visual analogue scale (VAS), Ultrasound (US), manual muscle testing (MMT), Boston Carpal Tunnel Questionnaire (BCTQ), Nerve flossing technique (NFT)

INTRODUCTION

Carpal tunnel syndrome (CTS) is a widespread compressive peripheral neuropathy that involves the entrapment of the median nerve in its passage at the carpal tunnel in the wrist. The carpal tunnel is a small canal in the wrist, bordered by wrist bones and ligaments, that protects important nerves and tendons. It allows the tendons, ligaments and nerves pass through it to reach your hand. Median nerve passes, through carpal tunnel and reaches the palmar region. Normally, tissue called the synovium lines the tendon and helps lubricate it, which makes it easy to move your fingers smoothly.^[1] In the carpal tunnel pressure applied to synovial tissue can result in biomechanical changes in the underlying tissues which can thus elevate intracarpal pressure and increase symptoms.^[2]

The carpal tunnel is enclosed by wrist bones dorsally and a strong ligamentous structure on the palmar side. Normally, tissue called the synovium lines the tendon and helps lubricate it, which makes it easy to move your fingers smoothly.^[3]

CTS patients indicate signs and symptoms of pain, tingling, numbness in first 3 fingers and on the radial side of the affected hand along it. Clinical signs may include a decreased fine motor skills reduced hand motor function due to thenar muscle weakness, there is loss in grasping and squeezing strength of affected hand, in more severe cases, axonal sensory loss is some of the clinical indications of CTS due impair the nerve's flexibility and gliding ability.^[4]

Carpal tunnel syndrome develops when excessive pressure or irritation affects the median nerve within the carpal tunnel. This nerve plays an essential role in forearm and hand movements and supplies sensation to most of the fingers and hand. If it's damaged or pressed against the walls of your carpal tunnel, it can send extra or incorrect feelings to your hand and wrist.^[5]

In the carpal tunnel, mechanical pressure applied to synovial tissue can result in biomechanical changes in the underlying tissues, which can thus elevate intra carpal pressure and increase symptoms. CTS patients indicate signs and symptoms of tingling, numbness, and night-time burning aches of the affected hand.^[6]

Clinical signs may include a decreased fine motor skills and feeling light touch sensation. In severe cases, there is loss in grasping and squeezing strength of affected hand. Carpal tunnel syndrome (CTS) may be categorized as either idiopathic, with no identifiable cause, or secondary, resulting from associated medical conditions.. The majority of CTS cases are idiopathic, however repetitive hand movements or prolonged, improper wrist postures at work significantly increase the risk of CTS. Mechanical trauma, increased tunnel pressure, a smaller tunnel diameter, decreased blood flow to the nerve, delayed venous return, and protracted ischemia are all factors that contribute to the pathophysiology of CTS. Diabetes mellitus, obesity, hypothyroidism, pregnancy, and rheumatoid arthritis are additional risk factors.^[7]

Repetitive use of your hand, wrist, and forearm can cause inflammation in the synovium lining of the carpal tunnel area. This makes the carpal tunnel narrower and eventually puts pressure on the median nerve. It can result in pain, discomfort, and limited range of motion in your wrist's. Obesity, diabetes, and hypothyroidism have been associated with a double chance of developing CTS due to increased intra neural pressure in the carpal tunnel or vascular deficits.^[8]

CTS is usually diagnosed clinically by examining signs and symptoms, which are then assessed by Tinel's test and Phalen's test along with nerve conduction studies and electromyography, which can be valuable for deciding the severity of the median nerve lesion Scientific literature for the treatment of CTS has given conflicting results.^[9]

Neuromobilization is a manual therapy treatment that alters the physiological properties of nerves, and there is likelihood that its methods especially the sliding technique may have beneficial effects on patients with CTS.

Nerve sliding techniques can improve the symptoms when performed at the end of range of motion. Neuromobilization interventions reduce pain in CTS as per literature. CTS patients showing lower hyper excitability respond better to neuromobilization, but still evidence is not obvious according to different studies. There are improvements in pressure pain

threshold, pain, and function of CTS patients after nerve gliding, combined or not with supplementary therapies, when comparing nerve gliding with other therapies. Neural gliding is a treatment technique that improves the symptoms of CTS. Evidence demonstrates that median nerve excursion can be influenced by neural gliding technique. FT is a therapeutic intervention that seeks to reestablish equilibrium inside and around the neurological system. It has been suggested as an effective treatment for nerve entrapment because it enables decreased neural tissue intrinsic pressures, which advances appropriate physiological functions. It also improves the nerve's regular gliding movements, nutrition, and circulation through increased neural vascularity, decreased nerve adherence, and dispersion of noxious fluids.^[10]

NFT, often known as the “slider technique”, is one of the two popular varieties of neurodynamic operations that are carried out in a controlled, stepwise manner. NFT is a series of aggressive mobilizations intended to gradually realign inflamed nerves. It is an alternation of two joints moving in synchronous motions, one of which lengthens the neural bed and causes tension in the nerve, and the other of which shortens the neural bed. The second type of neurodynamic technique is the “tensioner technique,” which relies on tugging from both ends of the nerve. This technique is comparable to extending one end of a cord while leaving the other end loose and then changing the direction of the chord. NFT focuses on active nerve mobilization, which lowers the pressure in the perineurium and endoneurium, makes NFT more successful. As a result, NFT is intended to cure pain by lowering supraspinal sensitization, removing interneural edema, boosting nerve excursion, improving blood flow to the nerve, enabling venous return, and limiting ischemic discomfort. Each outcome revealed the normal mechanical characteristics of the nerve, reducing discomfort and enhancing nerve function.^[11]

Therapeutic ultrasound (US) is effective in reducing the symptoms of pain, improving sensory loss, and restoring power of wrist musculature in patients with CTS. In the intensity range of 0.5–2.0 W/cm², therapeutic US may have the potential to induce a variety of biophysical effects in tissues. Therapeutic US experiments on stimulation of nerve conduction and regeneration, and discoveries of its anti-inflammatory effects all support that therapeutic US may promote recovery of nerve compression.

Strengthening exercises can help reduce the risk of developing carpal tunnel syndrome, and alleviate symptoms. “Exercises strengthen the finger flexors and extensors as well as the wrist flexors and extensors are most effective.

Visual analog scale (VAS) The subjective pain level was described using the visual analog scale (VAS), a calibrated scale on which the cases could indicate their rating along a 10-cm line. The scale ranges from 0 to 10, with 0 representing no pain and 10 denoting unbearable pain. The cases were given instructions to record how much discomfort they were feeling. Before and after the treatment, it was done for every case in study groups

Boston Carpal Tunnel Questionnaire: Cases with CTS self-completed the Boston Carpal Tunnel Questionnaire (BCTQ), which assessed the functional status and the intensity of symptoms. The BCTQ had good validity, reliability, and responsiveness. Two scales were adopted in the questionnaire: the FSS, which has 8 items and describes how the syndrome impacts daily life and the degrees of difficulty in routine activities; and the SSS, which has 11 items and assesses symptoms

for severity, frequency, and timing. The average scores for each subscale ranged from 1 to 5. On a scale from 1 (no trouble) to 5 (extreme difficulty). The final score was determined by dividing the total scores by the number of items.

MMT was conducted with the therapist's index finger opposing the thumb abduction or index finger abduction MMT was scored on a scale of 0 to 5 based solely on resistance.

NEED OF THE STUDY.

As per the study done by Fatma Seddik Amin et. al 2023 on nerve flossing technique and multimodal approach has better result when compared to conventional physiotherapy alone in subjects with carpal tunnel syndrome and Muhammad Junaid Ijaz et.al 2022 has better effect of Neuromobilization with routine physical therapy, as there were no studies performed in comparing both techniques.

3.1 Population and Sample

The study was conducted on 30 subjects with mild to moderate carpal tunnel syndrome, with 15 participants assigned to each intervention group. **INCLUSION CRITERIA :** Both male and female, Pain in wrist in dominant hand, Mild to moderate CTS, Age 25-50 years, Less than a 3-month history of CTS, Vas score from 4 to 7, MMT of flexors with 2-3 grade, Positive Phalen Test, Positive Tinel sign

EXCLUSION CRITERIA: Wrist surgeries, Post surgical complication involving wrist, Earlier carpal tunnel release, Any sensory or motor deficit in the ulnar or radial nerve, Cardiovascular disease, Pregnant women, A steroid injection into the carpal tunnel, Presence of neurological conditions

3.2 Data and Sources of Data

For this study secondary data has been collected. Subjects were obtained from L.V.T.G College of Physiotherapy OP Department, Gowri Gopal Hospital, Government General Hospital, Kurnool.

IV. RESULTS AND DISCUSSION

4.1 Results of Descriptive Statics of Study Variables

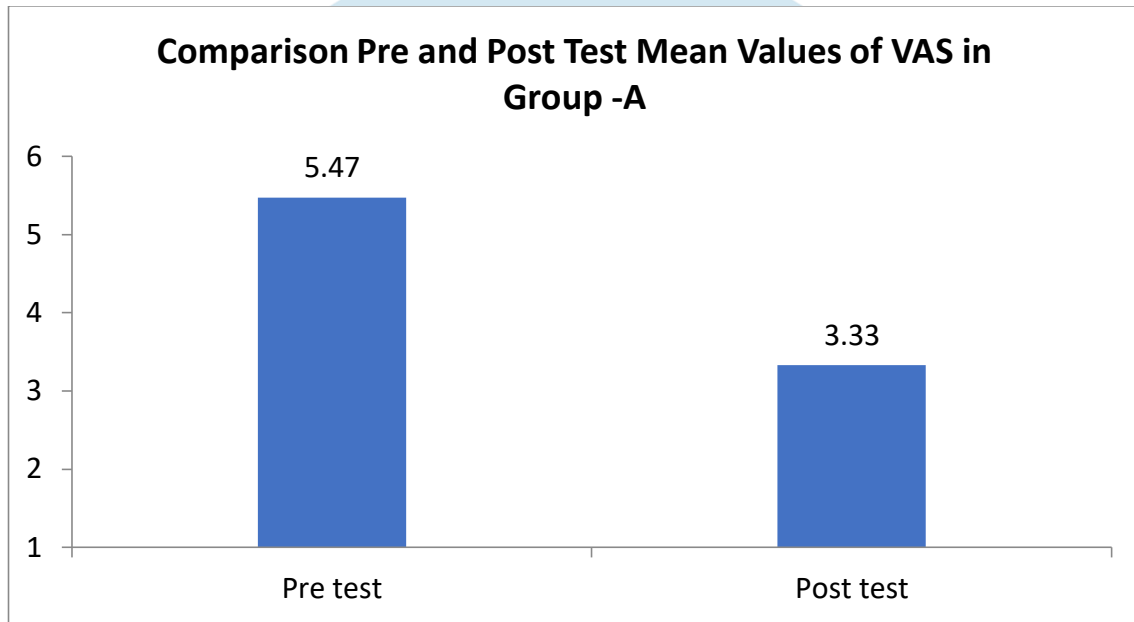
RESULTS

Variable	Minimum	Maximum	Mean	Std. Deviation	Jarque-Bera test	Sig
KSE-100 Index	-0.11	0.14	0.020	0.047	5.558	0.062
Inflation	-0.01	0.02	0.007	0.008	1.345	0.510
Exchange rate	-0.07	0.04	0.003	0.013	1.517	0.467
Oil Prices	-0.24	0.11	0.041	0.060	2.474	0.290

TABLE -1: MEAN AND STANDARD DEVIATION OF VISUAL ANALOGUE SCALE (VAS) IN GROUP – A

S.NO	GROUP A	VAS SCORE		't' value	P value	SIGNIFICANCE
		Pre test	Post test			
1.	MEAN	5.47	3.33	16.00	<0.0001	SIGNIFICANT
2.	SD	0.92	0.90			

TABLE 1: Shows mean and standard deviation of Visual analogue scale of Pre and Post in Group-A. The mean of Pretest of Visual analogue scale is 5.47 and SD is 0.92 and Post mean is 3.33 and SD is 0.90. It shows increased mean t value is 16.00 which is greater than 1% so that P value is less than 0.0001 and is highly significant.

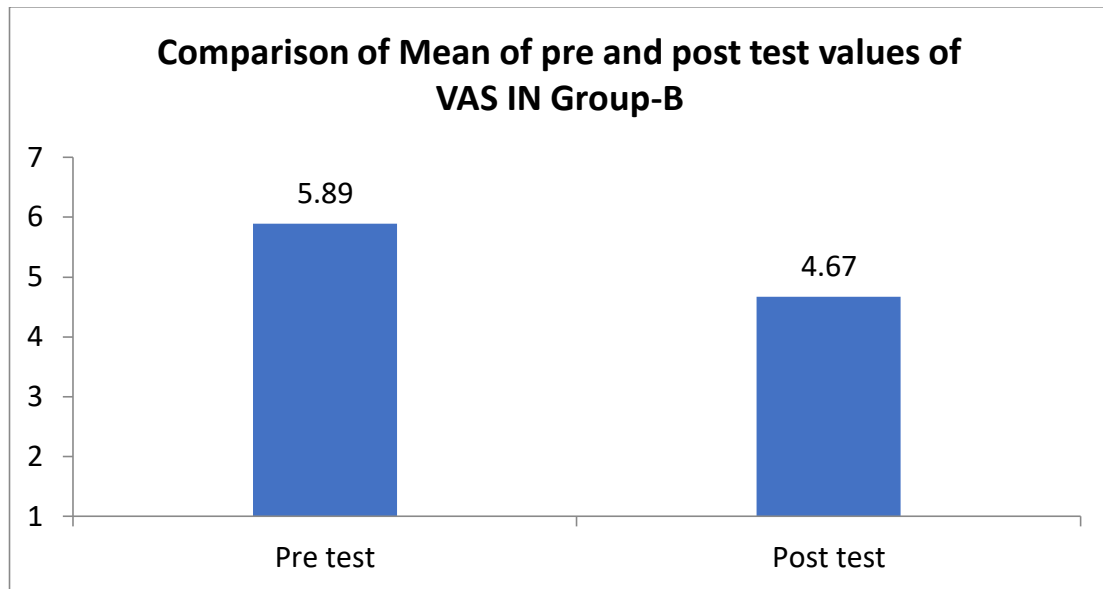


GRAPH 1: SHOWS PRE AND POST MEAN VALUES OF VAS IN GROUP A

TABLE-2: MEAN AND STANDARD DEVIATION OF VISUAL ANALOGUE SCALE (VAS) IN GROUP - B

S.NO	GROUP B	VAS SCORE		't' value	P value	SIGNIFICANCE
		Pre test	Post test			
1.	MEAN	5.89	4.67	5.2643	=0.0001	SIGNIFICANT
2.	SD	1.01	0.90			

TABLE 2: Shows mean and standard deviation of Visual analogue scale of Pre and Post in Group-B. The mean of Pretest of Visual analogue scale is 5.89 and SD is 1.01 and Post mean is 4.67 and SD is 0.90 It shows increased mean t value is 5.2643 which is greater than 1% so that P value is equals to 0.0001 and is statistically significant.

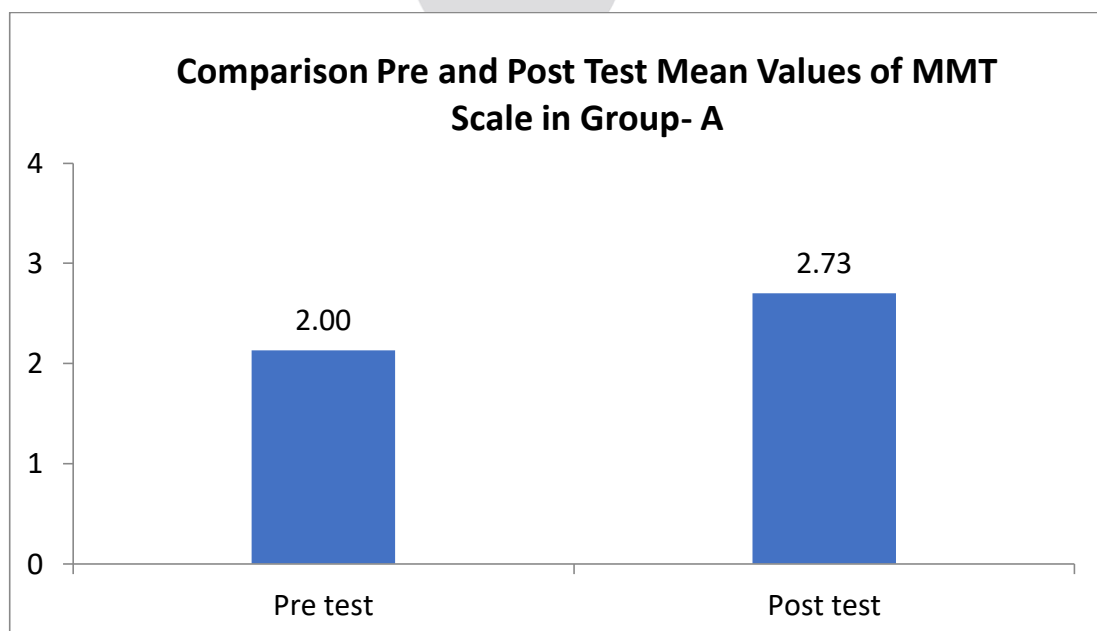


GRAPH 2: SHOWS PRE AND POST MEAN VALUES OF VAS IN GROUP B

TABLE-3: MEAN AND STANDARD DEVIATION OF MMT IN GROUP -A

S.NO	GROUP A	MMT SCORE		't' value	P value	SIGNIFICANCE
		Pre test	Post test			
1.	MEAN	2.00	2.73	6.2048	<0.0001	SIGNIFICANT
2.	SD	0.00	0.46			

TABLE 3: Shows mean and standard deviation of MMT scale in Group-A. The mean of Pretest of in MMT scale is 2.00 and SD is 0.00 and Post mean is 2.73 and SD is 0.46. It shows increased mean t value is 6.2048 which is greater than 1% so that P value is less than 0.0001 and is highly significant.

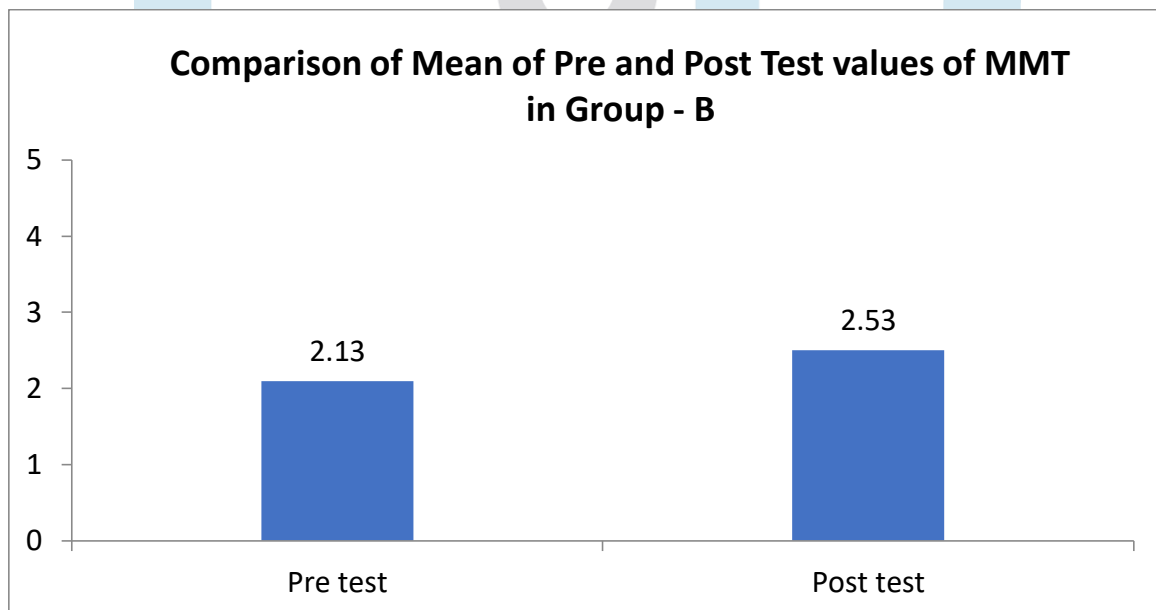


GRAPH 3: SHOWS PRE AND POST MEAN VALUES OF MMT ON GROUP A

TABLE - 4: MEAN AND STANDARD DEVIATION OF MMT IN GROUP -B

S.NO	GROUP B	MMT SCORE		't' value	P value	SIGNIFICANCE
		Pre test	Post test			
1.	MEAN	2.13	2.53	2.4495	<0.0281	SIGNIFICANT
2.	SD	0.35	0.52			

TABLE 4: Shows mean and standard deviation of MMT scale of pre and post in Group-B. The mean of pretest of MMT scale is 2.13 and SD is 0.35 and post mean is 2.53 and SD is 0.52. It shows increased mean t value is 2.4495 which is greater than 1% so that P value is less than 0.0281 and is statistically significant.

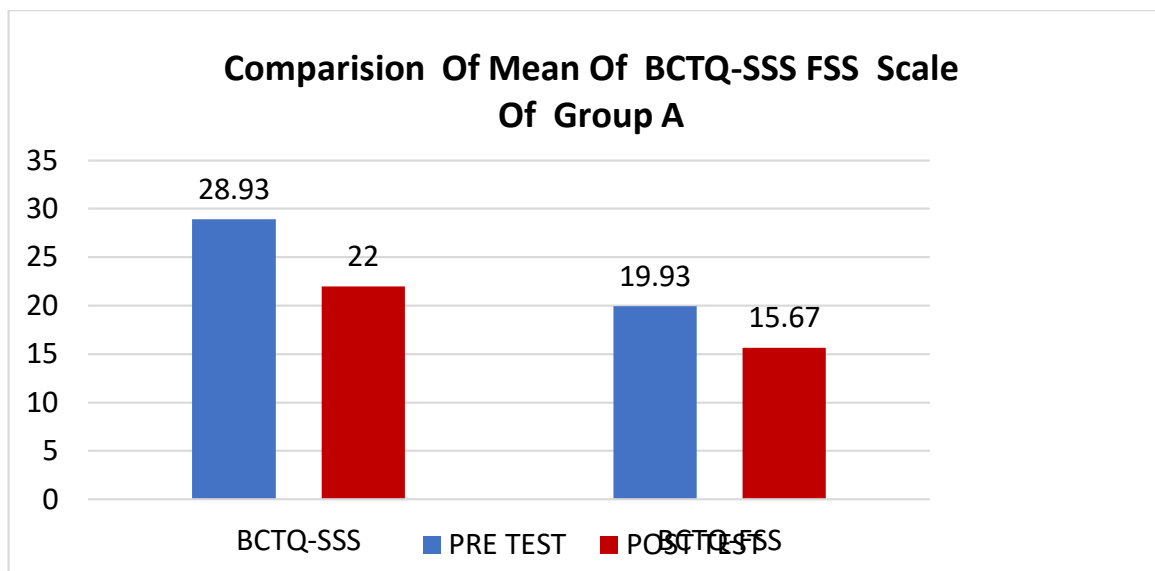
**GRAPH 4: SHOWS PRE AND POST MEAN VALUES OF MMT IN GROUP B****TABLE - 5: MEAN AND STANDARD DEVIATION OF BCTQ SCALE SCORE**

(SSS and FSS) VALUES IN GROUP - A)

S.No	BCTQ	GROUP A				‘t’ value	P value	SIGNIFICANCE
		MEAN		SD				
		Pre test	Post test	Pre test	Post test			
1.	SSS	28.93	22.00	2.87	2.56	7.5433	<0.0001	SIGNIFICANT
2.	FSS	19.93	15.67	3.06	2.58	12.9111	<0.0001	SIGNIFICANT

TABLE 5 : Shows mean standard deviation of BCTQ scale (along with SSS and FSS) of Pre and Post test in Group-A. The mean of pretest in Group-A of BCTQ scale for SSS scale is 28.93 and SD is 2.87 and for FSS Scale is Mean 19.83 and SD is 3.06. And

post mean for SSS is 22.00 and SD is 2.56 and for FSS Post test Mean is 15.67 and SD is 2.58. It shows increased mean t value for SSS is 7.5433 and FSS is 12.9111 which are greater than 1% so that P value is less than 0.0001, so it is statistically significant.

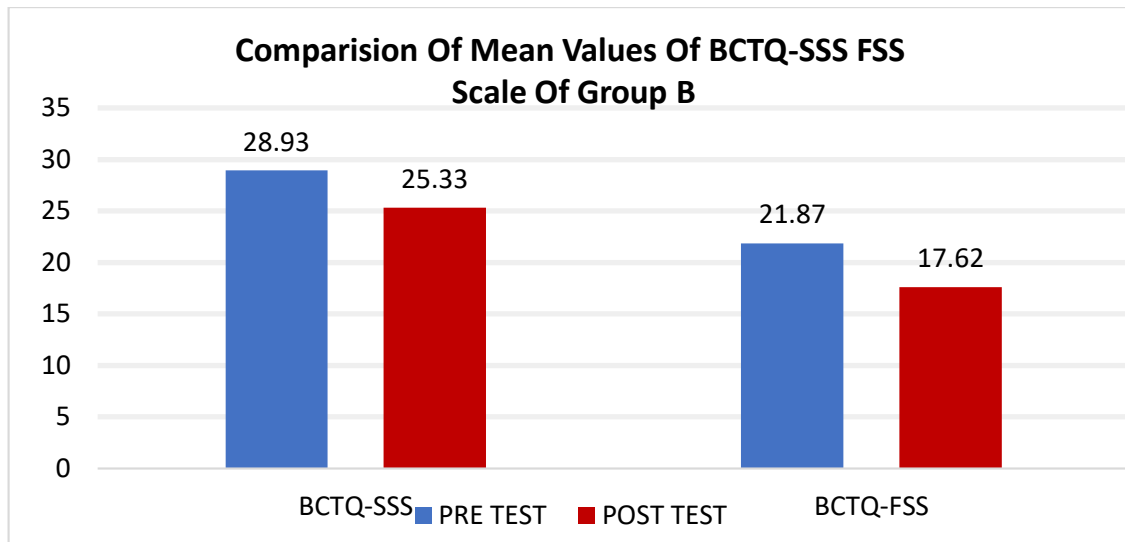


GRAPH 5: SHOWS PRE AND POST MEAN AND SD VALUES OF BCTQ SSS FSS SCALE IN GROUP A

TABLE – 6 : MEAN AND STANDARD DEVIATION OF BCTQ SCALE (SSS and FSS) SCORE IN GROUP-B

S.No	BCTQ	GROUP B				't' value	P value	SIGNIFICANCE
		MEAN		SD				
		Pre test	Post test	Pre test	Post test			
1	SSS	28.93	25.33	2.29	2.55	16.3280	<0.0001	SIGNIFICANT
2	FSS	21.87	17.62	3.005	2.59	4.149	<0.0003	SIGNIFICANT

TABLE 6: Shows mean and standard deviation of BCTQ scale (along with SSS and FSS) of Pre and Post test in Group-B. The mean of pre test in Group-B of BCTQ scale for SSS scale is 28.93 and SD is 2.29 and for FSS Scale Mean is 21.87 and SD is 3.005. And post mean for SSS is 25.33 and SD is 2.55 and for FSS Post test Mean is 17.62 and SD is 2.59. It shows increased mean t value for SSS is 16.3380 and FSS is 4.149 which are greater than 1% so that P value is less than 0.0003, so it is highly statistically significant.

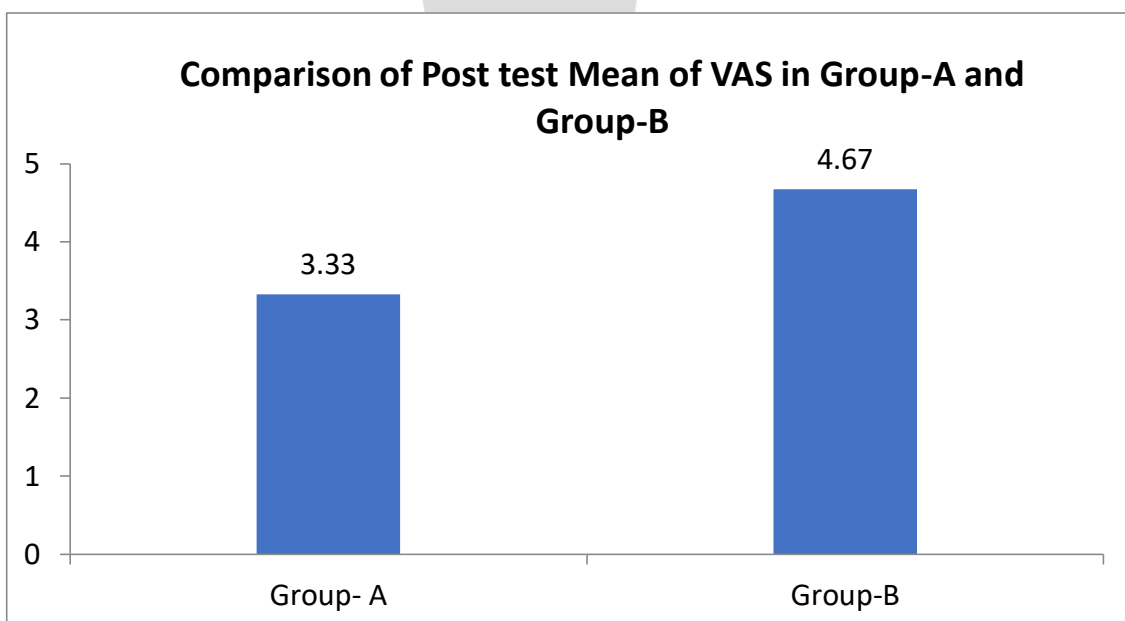


GRAPH 6: SHOWS PRE AND POST MEAN AND SD VALUES OF BCTQ SSS FSS SCALE IN GROUP B

TABLE - 7: MEAN AND STANDARD DEVIATION OF VISUAL ANALOGUE SCALE (VAS) SCORE POST VALUES DIFFERENCE BETWEEN GROUP-A AND GROUP-B

S.NO	GROUPS	VAS SCORE		't' value	P value	SIGNIFICANCE
		GROUP-A	GROUP-B			
1.	MEAN	3.33	4.67	4.0584	= 0.0004	SIGNIFICANT
2.	SD	0.90	0.90			

TABLE 7: Shows mean and standard deviation of Visual analogue scale in Post test of Group-A and Group-B. The mean of Post test in Group-A of Visual analogue scale is 3.33 and SD is 0.90 and post mean in Group-B is 4.67 and SD is 0.90. It shows increased mean t value is 4.0584 which is greater than 1% so that P value is equal to 0.0004 and is statistically significant.

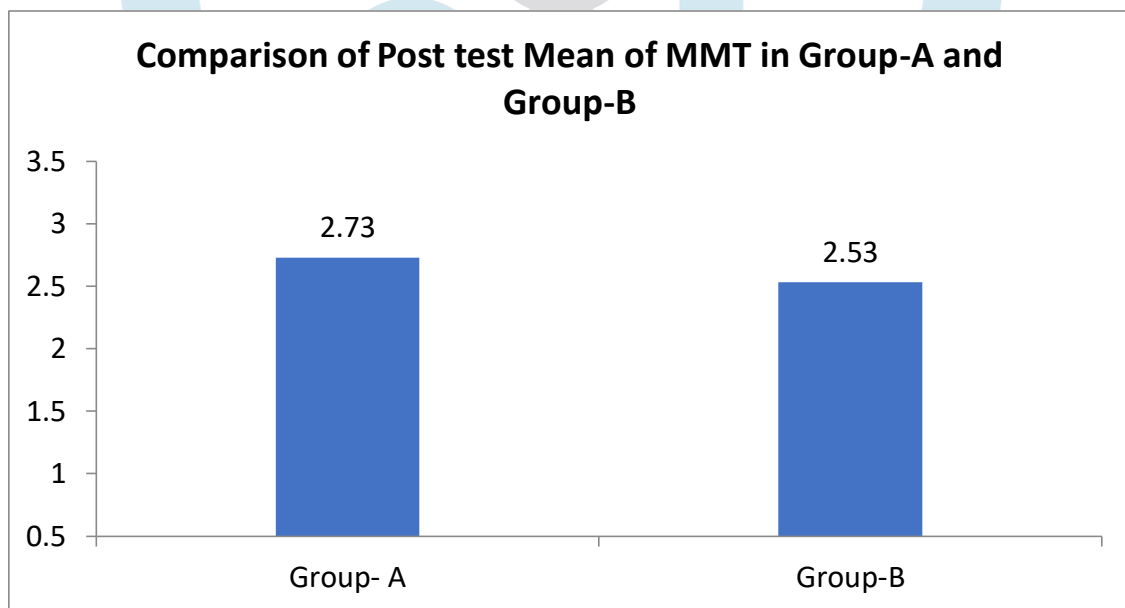


GRAPH 7:SHOWS COMPARISION OF POST MEAN VALUES OF VAS IN

GROUP A AND GROUP B**TABLE 8 -: MEAN AND STANDARD DEVIATION OF MMT SCORE POST VALUES DIFFERENCE BETWEEN GROUP-A AND GROUP-B**

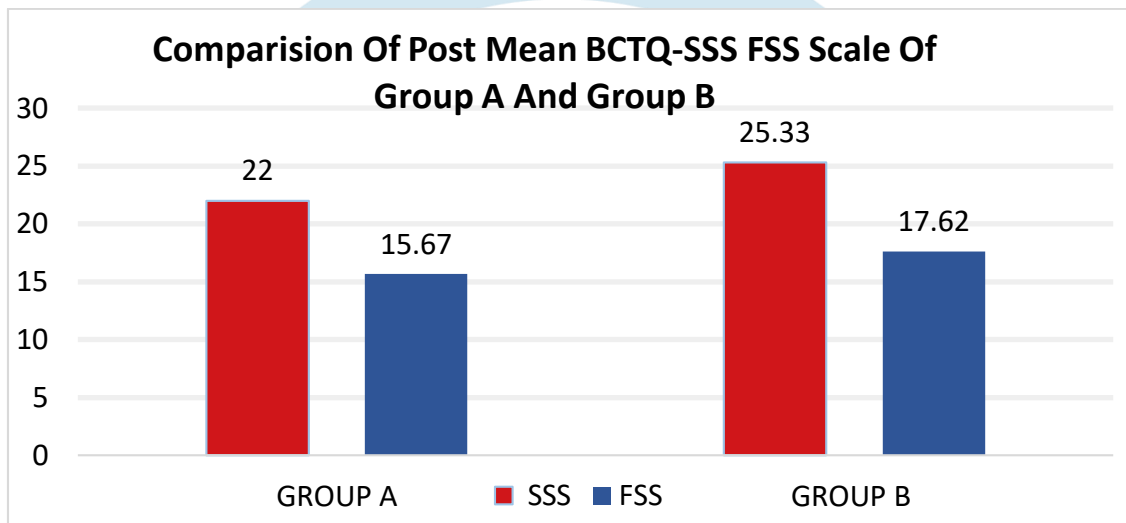
S.NO	GROUPS	MMT SCORE		't' value	P value	SIGNIFICANCE
		GROUP-A	GROUP-B			
1.	MEAN	2.73	2.53	1.1225	= 0.2712	SIGNIFICANT
2.	SD	0.46	0.52			

TABLE 8: Shows mean and standard deviation of MMT in Post test of Group-A and Group-B. The mean of post test in Group-A of MMT scale is 2.73 and SD is 0.46 and post mean in Group-B is 2.53 and SD is 0.52 It shows increased mean t value is 1.1225 which is greater than 1% so that P value is equal to 0.2712 and is statistically significant.

**GRAPH 8: SHOWS COMPARISON OF POST MEAN VALUES OF MMT IN GROUP A AND GROUP B****TABLE - 9: MEAN AND STANDARD DEVIATION OF BCTQ SCALE SCORE (SSS and FSS) POST VALUES DIFFERENCE BETWEEN GROUP-A AND GROUP-B**

S.NO	BCTQ	GROUPS				‘t’ value	P value	SIGNIFICANCE
		GROUP A		GROUP B				
		MEAN	SD	MEAN	SD			
1.	SSS	22.00	2.56	25.33	2.55	3.5675	=0.0013	SIGNIFICANT
2.	FSS	15.67	2.58	17.62	2.59	4.2592	=0.0080	SIGNIFICANT

TABLE 9: Shows mean and standard deviation of BCTQ scale (along with SSS and FSS) Post test values in Group A and Group B. The Post test means of Group A are mean for SSS scale is 22.00 and SD is 2.56 and for FSS Scale Mean is 15.67 and SD is 2.58. And post means of Group B for SSS is 25.33 and SD is 2.55 and for FSS Post test Mean is 17.62 and SD is 2.59. It shows the t value for SSS is 3.5675 which is greater than 1% so that P value is equal to 0.0013, so it is Statistically significant and for FSS the t value is equal to 4.2592 and P value is equal to 0.0080 which is significant.



GRAPH 9: SHOWS COMPARISON OF POST MEAN VALUES OF BCTQ SSS-FSS SCALE IN GROUP A AND GROUP B

DISCUSSION

The main objective of the study was to compare the effect of neuromobilization versus nerve flossing technique in subjects with mild to moderate carpal tunnel syndrome.

In this study the subjects with mild to moderate carpal tunnel syndrome were divided into two groups, group A with 15 subjects and group B with 15 subjects. Analysis from the results found there is statistical significant changes in mean of VAS, BCTQ Scale and MMT in both the groups when mean were analyzed from pre interventions within the groups

In group A, the pre score for the mean of total VAS score was 5.47 with SD of 0.92 and the post score for the total VAS score was 3.33 with SD of 0.90.

Similarly, the pre score for mean of total **BCTQ SCALE** which include 2 aspects – Symptom severity Scale with pre score was 28.93 with SD of 2.87 and the post score was 22.00 with SD of 2.56. Functional severity scale with pre score was 19.93 with SD of 3.06 and the post score was 15.67 with SD of 2.58. The pre score for the mean of total MMT was 2.00 with SD of 0.00 and the post score for the total MMT 2.73 with SD of 0.46. with the paired t-test and unpaired t-test was carried out to compare pre and post values and it showed significant improvement with p value < 0.0001.

In group B, the pre score for the mean of total VAS score was 5.89 with SD of 1.01 and the post score for the total VAS score was 4.67 with SD of 0.90.

Similarly, the pre score for mean of total BCTQ SCALE which include 2 aspects – Symptom severity scale with pre score was 28.93 with SD of 2.29 and the post score was 25.33 with SD of 2.55. Functional severity scale with pre score was 21.87 with SD of 3.005 and the post score was 17.62 with SD of 2.59

The pre score for the mean of total MMT was 2.13 with SD of 0.35 and the post score for the total MMT 2.53 with SD of 0.52. with the paired t-test and unpaired t-test was carried out to compare pre and post values and it showed significant improvement with p value < 0.0001.

Here both the group A and group B shows significant improvement in the VAS, BCTQ SCALE and MMT as compared on 1 week and 6th week. But when statistical analysis was done in between group A (Neuromobilization) and group B (Nerve flossing technique) group A has shown more significant improvement as compared to group B.

Muhammed Junaaid Ijaz, Hossein Karimi et al., (2022) conducted a study and concluded that addition of neuromobilization has better effect on treatment in mild to moderate carpal tunnel syndrome patients.

Kocjan, J.(2016-17) conducted a study on efficacy of neural mobilization and mid-carpal mobilization in the treatment of carpal tunnel syndrome on 36 subjects for 3 weeks and concluded that the combination of these two techniques may be effective in the treatment of CTS, especially in second degree of CTS.

Alam M, Khan M, Ahmed SI, Ali SS (2018) conducted a study on effectiveness of neural mobilization and ultrasound therapy on pain severity in carpal tunnel syndrome on 48 subjects for 4 weeks and concluded that neural mobilization for median nerve is more beneficial than ultrasound in reducing pain, intensity and functional limitations in CTS.

Hence the analysis of the result which was compared with unpaired test found statistically significant and was shown that the Neuromobilization is more significant than Nerve flossing technique in reducing pain (VAS), improvement of symptoms and functional severity and muscle power in mild to moderate carpal tunnel syndrome measured Boston Carpal Tunnel Syndrome Questionnaire in subjects with mild to moderate carpal tunnel syndrome.

CONCLUSION

The net result of the present study showed that there was statistically significant improvement in Group A when compared to Group B, so the alternative hypothesis was accepted there by rejecting the null hypothesis. Hence, we conclude that NEUROMOBILIZATION intervention (Group A) is more effective than the NERVE FLOSSING TECHNIQUE (Group – B) in subjects with mild to moderate carpal tunnel syndrome.

LIMITATIONS OF THE STUDY:

- The study was done with smaller sample and for a short duration which may result in low power.
- The sample for this study consists of 30 subjects only and included with only mild to moderate carpal tunnel syndrome.
- No long term follow up was done.

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