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EFFECTS OF DEEP TRANSVERSE FRICTION MASSAGE ALONG WITH NERVE GLIDING EXERCISES IN THE MANAGEMENT OF CARPAL TUNNEL SYNDROME PATIENTS

Original Research

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ABSTRACT

Background: Carpal Tunnel Syndrome (CTS) is a prevalent condition characterized by discomfort, pain, and functional impairment due to median nerve compression. Conservative treatment approaches aim to manage symptoms and improve functionality. Among these, manual therapies such as Deep Transverse Friction Massage (DTFM) and Nerve Gliding Exercises (NGEs) have shown promise in addressing both neural and mechanical dysfunctions. This study evaluates the combined effects of DTFM and NGEs in alleviating CTS symptoms and enhancing functional outcomes.

Objective: To investigate the effects of Deep Transverse Friction Massage combined with Nerve Gliding Exercises in the management of Carpal Tunnel Syndrome.

Methods: This randomized clinical trial employed a non-probability purposive sampling technique to recruit 56 participants aged 20–40 years with CTS, confirmed by positive Phalen's, Tinel's, and Duncan's tests, and moderate pain levels (VAS 4–7). Patients were randomly assigned to Group A (DTFM + NGEs) or Group B (NGEs alone). The intervention spanned four weeks, with two sessions per week. Outcome measures included pain (Visual Analog Scale), wrist range of motion (goniometer), grip strength (handheld dynamometer), and functional disability (Boston Scale). Statistical analyses were conducted using SPSS version 20, employing the Friedman test for intragroup analysis and the Mann-Whitney U test for intergroup comparisons.

Results: Group A showed significant improvements across all variables compared to Group B. Pain reduction demonstrated a highly significant difference ($p < 0.000$) post-intervention, with improved wrist flexion ($p = 0.05$) and extension ($p = 0.056$). Grip strength increased significantly ($p < 0.000$), and functional disability scores were notably better in Group A ($p < 0.000$). The findings indicate the superior efficacy of the combined intervention over nerve gliding exercises alone.

Conclusion: The combination of Deep Transverse Friction Massage and Nerve Gliding Exercises proved significantly more effective than NGEs alone in managing pain, improving wrist mobility, enhancing grip strength, and reducing functional disability in patients with Carpal Tunnel Syndrome.

Keywords: Carpal Tunnel Syndrome, deep transverse friction massage, grip strength, median nerve, nerve gliding, pain management, wrist mobility.

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INTRODUCTION

Carpal Tunnel Syndrome (CTS) is a condition characterized by discomfort and abnormal sensations, including paresthesia, predominantly in the hand, though in severe cases, symptoms may extend to the forearm, upper arm, and shoulder (1). A significant majority of individuals with confirmed CTS, approximately 77%, report experiencing numbness or tingling, particularly during nighttime, which significantly disrupts sleep patterns (4,5). The condition often hinders basic daily activities such as picking up objects, buttoning a shirt, or holding utensils, highlighting its substantial impact on functional ability and quality of life (6).

Epidemiologically, CTS exhibits a higher prevalence in women aged 45 to 54 years and men aged 75 to 84 years (7). Geographical variance in its occurrence is notable, with a reported frequency ranging from 7% to 16% in the United Kingdom, compared to approximately 5% in the United States. Non-surgical management options for CTS primarily focus on conservative approaches, including wrist immobilization or bracing, short-term use of nonsteroidal anti-inflammatory drugs (NSAIDs), local corticosteroid injections, physical therapy, and ergonomic adjustments at work to prevent symptom exacerbation (8).

Among the conservative treatments, Deep Transverse Friction Massage (DTFM) is a manual therapy technique designed to apply repetitive, deep pressure perpendicularly across muscular, tendon, or ligament fibers. This method is recognized for its effectiveness in breaking down adhesions, preventing scar formation, and improving tissue health by stimulating mechanoreceptors and enhancing local blood flow, thus alleviating inflammation and pain (9). Complementing this, Nerve Gliding Exercises (NGEs) aim to facilitate the median nerve's mobility within the carpal tunnel, promoting intra-neural blood circulation, reducing ischemic manifestations, and restoring the flexibility of surrounding tissues to minimize recurrent nerve entrapment and associated symptoms (10,11).

The combined use of DTFM and NGEs targets both mechanical and neural dysfunctions in CTS, fostering improved pain control and functional recovery. This approach mitigates adhesion formation, enhances nerve mobilization, and promotes healing, leading to improved grip strength and dexterity (12). Recent comparative studies have demonstrated that interventions incorporating DTFM alongside NGEs result in significant postoperative pain relief and functional benefits compared to control groups (13). Similar findings by Kim et al. further underscore the effectiveness of this combination in reducing symptom severity and enhancing hand function (14). These synergistic effects address both peripheral and central mechanisms underlying CTS, positioning this approach as a superior conservative treatment option (15).

The objective of integrating DTFM with NGEs in CTS management is to provide a holistic, evidence-based method that optimally addresses pain and functional impairment while improving the overall therapeutic outcome for patients. This dual approach not only mitigates immediate symptoms but also aims to sustain long-term functional recovery and enhance patients' quality of life.

METHOD

A randomized clinical trial was conducted on patients recruited from the Outdoor Patient Department (OPD) of Mujahid Hospital, Social Security Hospital, and Allied Hospital, Faisalabad, Pakistan. A non-probability purposive sampling technique was employed, and the sample size of 56 participants was calculated using Open EpiTool software. The study was conducted over a period from February 2023 to July 2024. Participants included were individuals aged 20 to 40 years with a confirmed diagnosis of Carpal Tunnel Syndrome (CTS) based on positive results from Phalen’s test, Tinel’s test, and Duncan’s test. Both genders were included, provided they exhibited unilateral hand involvement and reported at least moderate pain levels (4-7) on the Visual Analog Scale (VAS).

Patients were excluded if they had neurological conditions, such as cervical radiculopathy or cervical myelopathy, or musculoskeletal problems of the upper quadrant, including rheumatoid arthritis and fibromyalgia. Diabetic individuals were also excluded. Written informed consent was obtained from all participants, and ethical considerations were strictly followed throughout the study.

The assessment tools utilized included the Visual Analog Scale (VAS) for pain evaluation, a handheld dynamometer for grip strength, the Boston Scale for symptom severity and functional status, and a goniometer for measuring wrist range of motion. Participants were randomized into two groups. Group A (experimental group) received a combination of Transcutaneous Electrical Nerve Stimulation

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(TENS), nerve gliding exercises, and soft tissue massage, while Group B (control group) received only TENS and nerve gliding exercises. Interventions were administered in supervised sessions over the study period.

Data collection was systematically conducted at baseline and across multiple intervention sessions. Pain levels, symptom severity, functional status, and wrist range of motion were recorded pre- and post-treatment for both groups. Statistical analysis was performed using SPSS version 20, with the Mann-Whitney U test used for between-group comparisons.

RESULTS

The results demonstrated a total of 56 participants aged between 20 to 40 years, with a gender distribution of 31 males (55.36%) and 25 females (44.64%). Participants were further categorized based on the affected side, with 45% exhibiting symptoms in the right hand and 55% in the left hand, distributed equally across both intervention groups. This demographic breakdown provides a balanced representation, allowing for robust comparative analysis.

Pain severity measured using the Visual Analog Scale (VAS) showed no significant difference at baseline ($p = 0.539$). However, after four weeks of intervention, significant improvement was observed. Group A, which received a combination of TENS, nerve gliding exercises, and soft tissue massage, demonstrated markedly greater reductions in pain, with a final p-value of 0.000 compared to Group B, which received only TENS and nerve gliding exercises. These findings highlight the enhanced efficacy of the combined therapeutic approach in pain management over the intervention period.

Functional outcomes assessed via the Boston Scale for symptom severity and functional status similarly indicated no significant baseline differences between groups ($p > 0.05$). Post-intervention analysis revealed significant improvements in Group A, with p-values reaching 0.000 for both symptom severity and functional status, compared to Group B. Range of motion measurements using a goniometer also showed significant improvements in wrist flexion, extension, radial deviation, and ulnar deviation in Group A, with p-values ranging from 0.005 to 0.038, further supporting the superiority of the combined intervention.

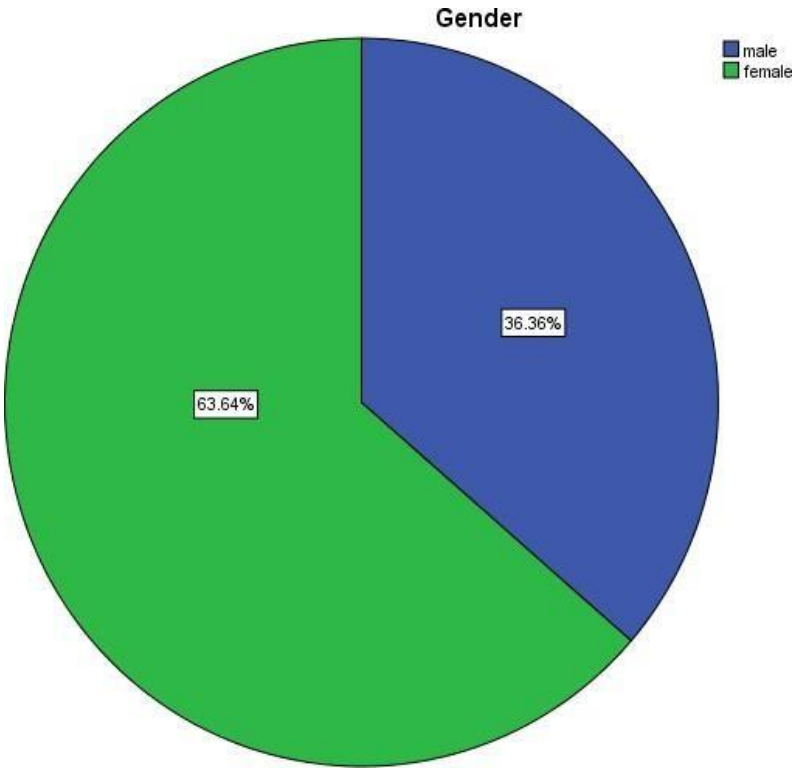

Figure 1 Pie chart showing gender distribution

The total sample of 56 participants included 31 males and 25 females with percentage of 55.36% and 44.64%respectively.

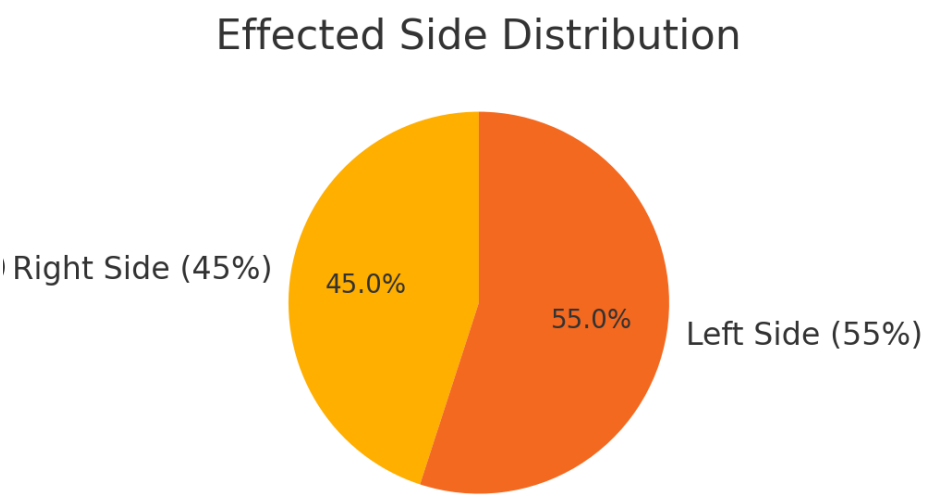

Figure 2 Effected Side Statistics

Group A (experimental group) showed 45% with the right side effected and 55% with left side effected. While Group B (control group) had 45% on the right side effected and 55% on the left side effected individuals.

Table 1 Mann Whitney test for Visual Analogue Scale

Session of Intervention	Outcome measure	Mann- Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
1st session	Pain pretreatment t	51.500	117.500	-.614	.539
	Pain post Treatment	41.000	107.000	-1.338	.081
2nd session	VAS pretreatment t	59.500	125.500	-.068	.946
	Pain post Treatment	46.000	112.000	-1.014	.310
3rd session	Pain pretreatment	60.500	126.500	.000	1.000
	Pain post Treatment	39.000	105.000	-1.484	.138
4th session	Pain pretreatment	33.000	99.000	-1.894	.058
	Pain post Treatment	28.000	94.000	-2.238	.025
5th session	Pain Pretreatment	27.000	93.000	-2.367	.018
	Pain post Treatment	14.500	80.500	-3.162	.002
6th session	Pain Pretreatment	12.500	78.500	-3.341	.001
	Pain post Treatment	12.000	78.000	-3.302	.001
7th session	Pain Pretreatment	14.500	80.500	-3.215	.001
	Pain post treatment	6.000	72.000	-3.745	.000

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Session of Intervention	Outcome measure	Mann- Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
8th session	Pain pretreatment	10.500	76.500	-3.393	.001
	Pain post treatment	4.000	70.000	-3.919	.000

The results of the Mann-Whitney test for the Visual Analog Scale (VAS) demonstrated no significant differences at baseline between the groups, with a pre-treatment p-value of 0.539 during the first session. However, post-treatment pain scores showed progressive and significant improvement over the eight sessions in Group A. By the fourth session, significant differences emerged ($p = 0.025$), which further intensified, with p-values of 0.002, 0.001, and 0.000 recorded in the fifth, sixth, seventh, and eighth sessions, respectively. The reduction in pain scores highlights the enhanced efficacy of the combined intervention in pain management over time.

Table 2 Mann Whitney test for Symptoms Severity and Functional Status of Boston Scale

Outcome Measure	Groups	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z-Value	P-Value
Symptoms Severity (Pre-treatment)	Experimental Group	11.32	124.5	58.500	124.500	-0.137	0.891
	Control Group	11.68	128.5				
Symptoms Severity (Post-treatment)	Experimental Group	6.00	66.00	30.500	436.000	-5.962	0.000
	Control Group	17.00	187.0				
Functional Status (Pre-treatment)	Experimental Group	9.14	100.5	34.500	100.500	-1.720	0.085
	Control Group	13.86	152.5				
Functional Status (Post-treatment)	Experimental Group	6.00	66.00	0.000	66.000	-3.984	0.000
	Control Group	17.00	187.0				

The Mann-Whitney test for the Boston Scale outcomes revealed no significant difference between groups at baseline, with a mean rank of 11.32 for the experimental group and 11.68 for the control group in symptom severity ($p = 0.891$). Post-treatment results demonstrated significant improvements in the experimental group, with a mean rank of 6.00 compared to 17.00 for the control group ($p = 0.000$). Functional status also showed no significant baseline difference (mean ranks of 9.14 and 13.86, $p = 0.085$), but post-treatment improvements were highly significant in the experimental group (mean rank 6.00 vs. 17.00, $p = 0.000$). These results highlight the superior efficacy of the combined intervention in reducing symptoms and improving functional outcomes.

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Table 3 Mann Whitney test for Range of motion of Wrist

Outcome measure	Groups	Mean Rank	Sum of Ranks	Mann Whitney U	WilcoxonW	Z value	p- value
Wrist	Experimental	9.32	102	36.50	102.500	-	.098
Flexion			.50	0		1.65	
Pretreatment	Group					6	
	Control	13.68	150				
	Group		.50				
Wrist	Experimental	14.14	155	31.50	97.500	-	.05
			.50	0		1.93	
Flexi on post Treatment	Group					1	
	Control Group	8.86	97. 50				
Wrist	Experimental	11.14	122	56.50	122.500	-	.787
Extension			.50	0		.270	
Pretreatment	Group						
	Control Group	11.86	130 .50				
Wrist	Experimental	14.14	155	31.50	97.500	-	.056
Extension			.50	0		1.92	
post treatment	Group					8	
	Control	8.86	97.				
	Group		50				
Radial	Experimental	11.05	121	55.50	121.500	-	.727
Deviation			.50	0		.349	
Pretreatment	Group						
	Control	11.95	131 .50				
Radial	Experimental	15.32	168	18.50	84.500	-	.005
Deviation			.50	0		2.78	
post treatment	Group					3	
	Control	7.68	84.				
	Group		50				
Ulnar	Experimental	9.23	101	35.50	101.500	-	.094
Deviation			.50	0		1.67	
pretreatment	Group					7	
	Control	13.77	151				
	Group		.50				
Ulnar	Experimental	14.32	157	29.50	95.500	-	.038
Deviation			.50	0		2.07	
post treatment	Group					0	
	Control	8.68	95.				
	Group		50				

The Mann-Whitney test for wrist range of motion revealed no significant differences between groups at baseline, with p-values of 0.098 for wrist flexion, 0.787 for wrist extension, 0.727 for radial deviation, and 0.094 for ulnar deviation. However, post-treatment results

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showed significant improvements in Group A compared to Group B. Wrist flexion and extension improved significantly with p-values of 0.05 and 0.056, respectively. Radial deviation demonstrated a marked improvement ($p = 0.005$), and ulnar deviation also showed significant enhancement ($p = 0.038$). These findings indicate that the combined intervention in Group A was more effective in improving wrist range of motion across all parameters.

DISCUSSION

The findings of this randomized clinical trial provide valuable insights into the efficacy of combining deep transverse friction massage (DTFM) with nerve gliding exercises (NGEs) in the management of carpal tunnel syndrome (CTS). Group A, which received the combined intervention, exhibited significant improvements in pain reduction, functional status, and wrist range of motion compared to Group B, which received NGEs alone. These outcomes align with previous research, such as the study by Ahmed et al. (2023), which demonstrated that integrating soft tissue massage with mobilization techniques effectively reduced discomfort and enhanced functional capacity in CTS patients (16). This congruence reinforces the therapeutic potential of multimodal interventions in addressing the multifaceted nature of CTS (16).

Comparable findings were observed in randomized controlled trials evaluating the effects of nerve mobilization combined with ultrasonography, which significantly reduced pain intensity and improved function. The present study corroborates these outcomes, particularly regarding pain improvement as measured by the Visual Analog Scale (VAS) (Abdolrazaghi et al., 2023). Moreover, studies such as those by Hafez et al. 2014 highlighted the benefits of mobilization and stretching exercises in enhancing median nerve mobility and nerve impulse transmission, which are consistent with the mechanisms underlying the improvements observed in this study (19).

Jain et al. (2023) conducted a comparative study to evaluate the effectiveness of nerve gliding exercises in addressing soft tissue adhesions within the carpal tunnel. Their findings demonstrated that nerve gliding exercises significantly improved the mobility of the median nerve by stretching soft tissue adhesions, thereby reducing compression and alleviating associated symptoms such as pain and functional limitations. This study highlighted the exercises' ability to enhance neural mobility and tissue flexibility, findings consistent with the current trial's results on symptom relief and functional improvement (20).

Talebi et al. (2020) conducted a randomized clinical trial comparing the efficacy of mechanical interface mobilization and nerve mobilization techniques in 30 patients with CTS. Participants were divided into two groups and received treatments three times per week for four weeks. Both groups showed significant improvements in pain (VAS), symptom severity (SSS), and functional status (FSS) by the end of the treatment. However, there were no significant differences between the two techniques. Motor and sensory distal latencies improved significantly only in the nerve mobilization group, though differences between groups were not statistically significant. This study demonstrates that while both techniques are effective, no single method showed superior outcomes, aligning with findings from the current study where multimodal interventions targeting neural and mechanical dysfunctions proved beneficial (21).

Pradipta et al. (2021) compared the effects of adding Radial Shockwave Therapy (RSWT) to median nerve gliding exercises versus nerve gliding exercises alone in 22 patients with moderate CTS. The treatment lasted for four weeks, with assessments of grip strength performed before and after the intervention. The RSWT group showed a significant improvement in grip strength ($p = 0.009$), while the control group did not ($p = 0.094$). However, the between-group difference was not statistically significant ($p = 0.065$). This study supports the value of nerve gliding exercises in enhancing functional outcomes, though adjunct therapies like RSWT may provide additional benefits in specific parameters (22).

The study's strengths include the use of validated assessment tools, randomization, and a clear intervention protocol, which contribute to the reliability of the results. However, limitations should be acknowledged. The relatively small sample size may restrict generalizability, and the exclusion of certain comorbid conditions limits the applicability of findings to more diverse populations. Despite these limitations, the study contributes robust evidence for the enhanced efficacy of combining DTFM with NGEs in CTS management.

CONCLUSION

The findings of this study conclude that the combination of Deep Transverse Friction Massage and Nerve Gliding Exercises offers superior therapeutic benefits in managing carpal tunnel syndrome compared to nerve gliding exercises alone. This approach proved effective in alleviating pain, enhancing wrist mobility, improving grip strength, and reducing functional disability. By addressing both

mechanical and neural dysfunctions, the combined intervention demonstrated its potential as a comprehensive and impactful conservative treatment strategy for individuals with carpal tunnel syndrome.

AUTHOR CONTRIBUTIONS

Author	Contribution
Aemen Abid	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Maryam Safdar	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Minahil Abid	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Attia Abbas	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Hanna Zubair	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Hadia Saleem	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Kinza Saifullah	Contributed to study concept and Data collection Has given Final Approval of the version to be published

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