East African Scholars Journal of Medical Sciences
Abbreviated Key Title: East African Scholars J Med Sci
ISSN: 2617-4421 (Print) & ISSN: 2617-7188 (Online)
Published By East African Scholars Publisher, Kenya
OPEN ACCESS
Volume-8 | Issue-5 | May-2025 | DOI: https://doi.org/10.36349/easms.2025.v08i05.003

Original Research Article

Comparative Analysis of Strategies for Preventing Median Nerve Neuropathy in Long-Term Computer Users

Dr. Akhyova Sahoo (PT)[1], Dr. Birupakshya Mahakul[2*], Dr. Riti Mohanty (PT)[1], Dr. Aakansha (PT)[3]
[1]Associate Professor, Hi-Tech College of Physiotherapy, Bhubaneshwar
[2]Principal, KIMS School of Physiotherapy, KIIT DU, Bhubaneshwar
[3]Assistant Professor, KIMS School of Physiotherapy, KIIT DU, Bhubaneshwar

Article History
Received: 09.04.2025
Accepted: 14.05.2025
Published: 17.05.2025

Journal homepage:
https://www.easpublisher.com

Quick Response Code

Abstract: Median nerve neuropathy, which is characterized by pain, reduced muscular strength, and restricted nerve movement, is increasingly associated with long-term computer use. This study investigated in symptomatic computer users the effect of muscle strengthening exercises alone vs a combination of strengthening exercises and median nerve manipulation in 30 symptomatic computer users. Before conducting the four-week experiment, volunteers in Group A were split into two groups and had been selected out of 90 individuals to receive conservative treatment (muscle strengthening exercises) whilst Group B received both muscle strengthening and Butler's median nerve mobilization procedure. Pain and muscle strength were assessed using Visual Analog Scale (VAS) and Medical Research Council (MRC) grading respectively. Both groups separately showed significant improvement ($p < 0.001$) though Group B had a relatively more reduction in discomfort and gain in muscle strength than Group A and recommends that in computer users, a synergy of neural mobilization with usual strengthening exercises is more effective in moderating median nerve neuropathy signs. They recommend larger scale studies with objective evaluations in the future.

Keywords: Neural Mobilization, Computer Users, Median Nerve Neuropathy, Muscle Strengthening and Upper Limb Disorders.

INTRODUCTION

Over-exercising in front of a screen can lead to upper extremity neuromuscular and skeletal problems. The literature regularly connects computer use to an increase in hand and wrist problems. Studies have shown that symptoms of wrist musculature can arise from repeated movement patterns in the lateral epicondyle region with its action at the wrist joint [10], as well as from static muscle loads maintained over long periods of time and the effect of non-neutral postures [11]. Symptoms can mirror clinical conditions such as peripheral nerve entrapment. Some positions may place tension on nerves at pinch points, which increases stress.

Median and ulnar nerve are the most affected peripheral nerve in long-term computer users. For many people and for most of their daily activities the total time on a keyboard can be significant, raising the concerns regarding "over-usage" of upper crowns disorder. Several reports and studies1 have suggested the involvement of peripheral nervous system in "nonspecific "upper limb dysfunction in computer operators. For many patients with pain due to their computer usage, a number of neuromuscular deficits are easily observed that affect their daily function. One example of it is a higher threshold to vibratory stimulation, implying that their nerves need more extensive stimuli to sense sensations, potentially suggestive of desensitization. Also, more nerve tension is common, which can disrupt nerve conduction and cause discomfort. Reduced neural mobility further limits the ability of the nerve to glide freely in activity, increasing susceptibility to irritation. Such altered neural dynamics may contribute to mechanical allodynia, where pain is triggered by light touch. Furthermore, pathological changes in the axonal flare response reflect ongoing inflammation or nerve injury that aggravates pain [3]. Often there is reported a marked decrease in muscle strength, apparently due to some decreased brain

***Corresponding Author:** Dr. Birupakshya Mahakul
Principal, KIMS School of Physiotherapy, KIIT DU, Bhubaneshwar

input to the muscles. These failings not only compound the common troubles of computer work but also highlight the need for treatment of body and mind. Mechanical compression, abrasion, and repetitive stretching make the peripheral nerves susceptible. Chemical compounds such as bradykinin, histamine, and prostaglandins are released by nerve cells that becomes activated upon sufficient mechanical stimulation to elicit and maintain injury1. Nerve connective tissue layers: chemical agents may directly excite nociceptors.

Pain is thought to be due to structural injury, obstruction to axoplasmic flow, and reduced blood supply leading to ischemia, and compression can create distortions of nerve function. Furthermore, materials arising from non-nervous tissues can elicit inflammatory responses and activate nociceptors present in nerve connective tissue. Tension testing on use is thought to increase nerve discomfort by the application of mechanical pressure. According to this hypothesis, the healthy individuals when subjected to tension neural stimulation will increase the sensory reception touch threshold and reduce the pain threshold. David Butler presented on upper extremity nerve stabilization techniques and positions associated with kinetic nerve tension testing.

These techniques are generally referred to as “neural mobilization techniques” and they aim at re-establishing mobility of the nerve after loss of longitudinal movement. The key reasoning for managing adverse neural tension using neural mobilization is to restore the dynamic movement of tissue-tissue interfaces in and around the brain [3-102]. This serves to relieve internal tension within the neural tissue as well as to maximize physiologic function. According to the concept of the intervention, neural mobilization should improve nerve and visceral structure mobility. We suggest that computer users have mild nerve entrapment or compression injuries of the median or ulnar nerves. For long-term computer users with ulnar or median nerve neuropathy evaluated to assess the efficacy of neuromuscular mobilization relaxation method, isometric muscle strengthening, posture adjustment and ergonomic adjustment.

Aim of the Study

This study aims to find out how effective muscle strengthening exercises are compared to neural mobilization treatments. The goal is to see which method works better in preventing median nerve neuropathy in people who use computers for long periods of time.

Need of the Study

This study investigates some of the methods that prevent median nerve neuropathy among long-term users of computers. Computer strain may lead to poor positions, which may lead to tension on the hands and wrists, which in some cases, may affect the median nerve as well. The study looks at how to correct during printing posture and make ergonomic adjustments explained above such as correct chair height or maintain good leadership positioning of the keyboard with minimum muscle strain of wrists. The reason to study these tactics is to discover simple and effective processes to protect computer users from nerves-related problems and improve their general comfort and health.

Hypothesis: There is no significant difference between Group A and Group B in improving median nerve neuropathy.

REVIEW OF LITERATURE

The increasing prevalence of computer-based professions has necessitated prevention of upper limb musculoskeletal disorders (MSDs), especially median nerve neuropathy. Overuse of computers, incorrect sitting posture, and repetitive strain are a few of the major risk factors that contribute to upper limb problems. Two primary preventive treatments have been studied, one dealing with neural tissue mobilization and the other with ergonomic/postural methods. This systematic review of the literature presents findings from multiple studies on the incidence, reasons, and preventive efforts of long-term computer users to counteract neuronal impairment.

Yaxley *et al*., (1991) conducted a successful study investigating this widely accepted modified Upper Limb Tension Test (ULTT), which functions to assess the neurologic system's response to mechanical stress. As the sensory responses identified with the updated ULTT differed from the original ULTT sensory responses, it is reasonable to think that the new ULTT might apply different tension on different structures of the neural pathway. This observation reflects the inherently dynamic nature of the peripheral nervous system and the potential to uncover areas of tension or compression through tailored assessments. It also lays the groundwork for therapeutic strategies using neuronal mobilization that target damaged regions specifically.

In 1997, Byng *et al*., staged a comparative study including 3 groups: subjects with diagnosed overuse disorders, and keyboard users without symptoms and without keyboard users. Results highlight that computer users may be at risk of developing upper limb syndromes, even in the absence of symptoms. The authors concluded that actions to prevent work-related musculoskeletal disorders (WRMSD) should be incorporated into the workplace, specifically through ergonomics.

To supThe forward vaccine latko *et al*., (1999) conducted a cross-sectional study to assess the association between repeated work and upper limb disorders. They found a strong link between repetitive work and disorders of tendinitis, carpal tunnel syndrome, and pain in the upper extremities in general.

Such injuries are common among office workers as their jobs involve hours of unhygienic typing, computer mouse pointing and wrist posturing.

Gerr *et al*., (2000) furthered this understanding by illustrating the association of occupational risk factors and upper limb diseases. According to their research, activities involving vigorous, repetitive movements, vibrations and postures are significantly associated with an increased risk of musculoskeletal disorders. They stressed that treatment alone is not enough without changes to the underlying workplace ergonomics. This supports a holistic therapy approach, whereby physical therapies are complemented with environmental and behavioral modifications.

Jepsen (2004) through a clinical case series study of 21 patients reported the relatively poor responsiveness of conventional preventative and therapeutic methods toward the computer-related upper limb conditions. His findings suggest the need for new research directions, including more personalized diagnostic and treatment protocols. Subsequently, Jepsen *et al*., Building on this, (2006) described different neuropathic manifestations in computer users. Neuropathy was seen in the brachial plexus area, the posterior interosseous nerve and the median nerve, particularly around the elbow, the study found. This further elucidates the complexity of computerized-associated neuropathies and supports the notion of conducting individualised neurodynamic assessments and treatment.

The importance of posture has been recognized as one of them. Julius *et al*., 2004) explored the impact of shoulder positioning on median nerve excursion and their conclusion was that slumped sitting, alone, may not influence function of the nerve. Extended shoulder protraction, common in people who lean forward while working, limits the sliding of nerves and increases tension. Chronic protraction enhances the development of paraesthesia's and decreasing nerve conduction over time, positively necessitating the correction as a preventative measure. Heinrich *et al*., (2004) discussed measuring postural load and computer usage duration. Their research showed that most current approaches were either too time-consuming or lacked the necessary precision for routine use. This represents a considerable shortcoming of existing objective assessment tools for workplace ergonomics and serves a barrier to early identification of high-risk individuals.

Then Fred Gerr − in 2004 − and his colleagues recommended specific ergonomic improvements in keyboards such as adjusting the height of the keyboard to the elbow and encouraging the use of the armrest. These adjustments were found to reduce the risk of diseases of the neck and shoulder. These results highlight the importance of simple but effective ergonomic adjustments in maintaining upper limb health for computer users. Schmid *et al*., (2009) evaluated several clinical tests that assess upper limb nerve function and mechanosensitive. They found that while these tests demonstrate moderate to substantial reliability, there is opportunity for improvement to increase consistency among practitioners. This supports the clinical relevance of nerve tension and mobilization tests for recognition of early signs of neurological impairment.

Lindegard *et al*., (2012) pointed out the relationship between perceived exertion and musculoskeletal complaints. Alavi and his colleagues found that there was a strong correlation between increased perceived effort while working with computers and the symptoms observed in the neck, shoulders, and upper extremities. These results highlight the importance of subjective user feedback in preventive health programs, as discomfort often precedes measured impairment.

Colak *et al*., (2013) noted the prevalence of entrapment neuropathies in the wrist area when looking at long-term prolonged computer users. Their investigation discovered an unsurprising connection between computer use and increased rates of neuropathies [23, 24], like carpal tunnel syndrome. However, they noted that most studies relied mainly on self-reporting and did not use objective tests of nerve conduction. This highlights the need for more robust approaches in subsequent studies to accurately determine and localize nerve involvement. Bamac *et al*., 2014) explored the likelihood of chronic computer use causing subclinical nerve injury. It does, however, note that sensory nerve abnormalities, especially in median and ulnar nerves, can also be observed in neurologically asymptomatic individuals (when compared to similar demographics). The presymptomatic period might be a target for early intervention, leading to prophylaxis in the placement of postural and ergonomic precautions preventing the transition to an advanced stage of severe neuropathy.

Arumugam *et al*., (2014) demonstrated radial nerve mobilization's effectiveness in relieving lateral elbow pain in the context of a therapeutic framework [13]. The research showed significant immediate relief, with the possibility that nerve mobilization could effectively treat sundry localized entrapments in computer users (conservative intervention). Along the same lines, Sarfraznawaz *et al*., (2015) investigated the effects of neural mobilization, and showed that the use of ULTT for neural mobilization improved cervical range of motion and pain levels in patients who suffered from cervical radiculopathy, which supports the importance of neurodynamic techniques. Shahanawaz *et al*., (2016) extended this understanding to asymptomatic professional computer users. Improper postures were associated with the impaired extensibility of the neural tissue, especially for the median and ulnar nerves. Posture-related changes in nerve mobility were shown to take place prior to symptoms being felt, thus providing yet another route for prospective targeted intervention.

Chen *et al*., (2017) Exercise and Physiotherapy review: Workplace based exercise interventions and the Corporeal worker: They Study results showed neck and shoulder strengthening exercises significantly reduced pain incidence in symptomatic office workers. The positive outcomes of this study suggest that structured exercise regimes should be incorporated into the daily lives of computer users as a preventive mechanism.

Countless canonical texts provide both theoretical and practical guidance for the implementation of these tactics. The Sensitive Nervous System by Butler (2000) has a detailed description of the mechanics of nerve pain and the rationale for neurodynamic mobilization. Edwards Neurological Physiotherapy (2004)—which details one such problem-solving methodology that is particularly helpful in determining the clinical actions that we should take with upper limb dysfunction. Therapeutic Exercise: Foundations and Techniques, in an elaborate manner according to Kisner and Colby (2012), provides specifications to formulate exercise programs for the prevention and rehabilitation of musculoskeletal disorders (MSDs). Also, mostly Butler's Mobilization of the Nervous System and Misra & Kalita's (2014) Clinical Neurophysiology are providing advantages to know nerve conduction studies, basis for diagnosis, and electrophysiology of nerve disorders.

These studies, taken together, underline the complex, multivariate nature of median nerve neuropathy and diseases of the upper limb in long-term computer users. They underscore an immediate need for multimodal preventive approaches which include ergonomic modifications, structured exercise programs, neural mobilization, and constant monitoring. While each intervention has its benefits, the greatest preventative impact is likely to be achieved when these are incorporated into a holistic prevention strategy tailored to personal needs and workplace requirements.

RESEARCH METHODOLOGY

The current study applied a comparative research design to evaluate the efficaciousness of muscle strengthening exercises and neural mobilization toward prevention and management of median nerve neuropathy in long-term individual who are computer users. The goal was to compare which of the two treatment procedures had better outcomes to relieve nerve entrapment problem-related pain, numbness, and paraesthesia. This study used a convenience sampling method eligible to 30 participants based on the availability and willingness of participants. All subjects met pre specified inclusion and exclusion criteria. Then the participants were randomly assigned into two equal groups, Group A and Group B, with 15 individuals in each group. Group A was subjected to neural mobilization procedures and Group B to a muscular strengthening exercise regimen.

Individuals aged between 18 to 55 years old were included if they were both: (1) They showed sounds clinical signs and symptoms including pain, numbness, and paraesthesia, and tested positive for upper limb nerve tension tests, indicating possible nerve entrapment. The study excluded people with any central or peripheral nervous system disorder, systemic arthritis, neoplasms, pre-existing sensory impairment, or other known conditions that could be influenced by a people-centered approach to rehabilitation, in order not to confound the study's outcomes.

The study was conducted both in the clinic as well as in the home setting, which maximized the alignment of the intervention with day-to-day living, and thereby increased compliance with the therapy. All participants were provided detailed instructions and were monitored periodically to ensure fidelity to their respective interventions. Participants completed four weeks of supervised study and were evaluated afterward. Primary outcome measures involved reducing neuropathic symptoms, increasing nerve mobility, and maximizing overall upper limb functional performance. Data collection included both subjective (patient-reported symptoms) and objective (clinical testing, including nerve tension testing) assessments. This study provides clinical insights by comparing outcomes between the two groups to highlight an optimal treatment method for prevention and management of median nerve neuropathy among patients facing extended computer usage.

PROCEDURE

Informed consent was obtained from all the subjects prior to the commencement of the trial, after explaining the purpose, procedure, potential benefits and risks of the study. Confidentiality was ensured for the participants and their right to leave the study at any time preserved. Thirty eligible subjects were recruited and randomly allocated to two groups of 15 subjects each, Group A and Group B, and received 4 weeks of intervention with regular follow-up and evaluation.

Group A members were given conservative treatment, mostly prioritizing muscular construction activities. These exercises are designed to stimulate the soft tissues of the upper limb, shoulder girdle, and cervical spine to improve posture, reduce median nerve tension, and enhance overall upper limb function. The selected exercises were safe, progressive, and could be easily performed in the clinical setting and at home.

Group B received a total of six, identical conservative muscle strengthening exercises, just like in Group A, combined with neural mobilization procedures in the form of the median nerve mobilization protocol based on Butler's concept of neural mobilization. This type of technique is a series of controlled and progressive movement to restore motion of the local median nerve along the neurodynamic pathway which decreases the nerve sensitivity, increases the nerve gliding, and consequently decreases the symptoms of pain and paresthesia. Besides mobilization, relaxation techniques were included to release muscle tension that podría interfere with nerve mechanics.

The interventions were provided by qualified physiotherapists during clinical visits, and patients were instructed on how to safely continue prescribed exercises and procedures at home. Systematic follow-ups and check-ins were done to ensure compliance and consistency in the implementation of both the strengthening and mobilization protocols.

Median Nerve Mobilization Technique

Subjects in Group B received specific median nerve mobilization therapy according to a systematic protocol designed to improve neural mobility and resolve symptoms due to median nerve entrapment. Mobilization was carried out step by step, starting with the least aggressive position and progressively moving to more ultimatum-like actions. The movement started at Position A, which had a neutral wrist position but had flexion in the fingers, palm, and thumb. Position B then maintained a neutral wrist while off-setting the fingers and thumb. In Position C, the wrist and fingers were extended while keeping the thumb in a neutral position. Position D demanded full extension of the wrist, fingers, and thumb. In Position E, we retained the same extensions with forearm now presented in supinated orientation. Position F consisted of full extension of the wrist, fingers, and thumb, supination of the forearm and maximum extension of the thumb. Each patient progressed through the positions slowly, stopping at the threshold of the point at which a mild neurological sensation (tingling/stretching) was elicited that was not painful to the patient or performed at the point at which no pain was intiatied. The stretch was held between 5 and 30 seconds, depending on symptom stability. After each stretch, the limb would be returned to a neutral position, and the process repeated to allow for nerve gliding without irritation. This mobilization protocol was performed 3 times per day with the utmost care to not provoke symptoms. The stepwise listing provided a safe, but effective way to recruit neurons.

DATA ANALYSIS

Table: 1 Paired T test analysis for comparing Visual Analog Scale results on group A & B

Visual Analog Scale (Group A)		No. of Participants	Std. Error	Mean Score	Std. Dev.	P- Value
	VAS - Pre Test	.289	15	4.40	1.121	.0001
	VAS - Post Test	.309	15	3.00	1.195	
Visual Analog Scale (Group B)						
	VAS - Pre Test	.291	15	4.47	1.125	.0001
	VAS - Post Test	.190	15	1.60	.737	

Table 1 presents the outcomes as assessed by a paired t-test comparison of the pre- and post-test pain scores measured using the Visual Analog Scale (VAS) in the two participant groups. Group (A) received only conservative treatment which consisted of muscular strengthening exercises, while Group (B) received conservative treatment with median nerve mobilization procedures. Mean VAS score before treatment in Group A was 4.40 and decreased to 3.00 after four weeks of conservative exercise. The reduction in pain is significant p-value of 0.0001. The differentiation signifies that muscle strengthening alone plays a role in reducing symptoms such as pain and discomfort associated with nerve entrapment, probably through improving postural stabilization and decreasing load on the structures of the upper limbs.

The mean of VAS Score pre-test for Group B was 4.47 which significantly reduced to 1.60 post-test after the intervention. As with Group A, this change is statistically significant, with a p-value of 0.0001. Group B reports a statistically significant greater reduction in pain levels when compared to Group A. This finding strongly supports the use of median nerve mobilization in combination with traditional exercise. The reduction of symptoms may also be explained by that neural mobilization promotes nerve mobility, decreases neural stress, and improves nerve function.

In nutshell, despite similar levels of pain reduction, the data suggest unequivocally that adjunctive strategies to neural mobilization in a standard strengthening program have better outcomes for such participants with long-term computer users with median nerve-related symptoms. This highlights the importance of targeting both the muscular and neurological aspects when treating upper limb neuropathies.

Table: 2 Paired T test analysis for comparing Muscle Strength (MRC) grading results on group A & B

Paired Samples Statistics							
Muscle Strength (MRC) Grading Group A		**No. of Participants**	**Std. Error**	**Mean**	**Std. Dev.**	**Std. Error**	**P-Value**
	MRC - Pre Test	15	.159	3.33	.617	.159	. 001
	MRC - Post Test	15	.133	3.87	.516	.133	
Muscle Strength (MRC) Grading Group B							
	MRC - Pre Test	15	.131	3.60	.507	.131	.0001
	MRC - Post Test	15	.118	4.73	.458	.118	

In Table 2 the paired t-test analysis of the muscle strength results assessed by Medical Research Council (MRC) scale for both Group A and Group B before and after intervention is showed. Group A, who received only conservative treatment in the form of muscular strengthening exercises, had a mean MRC score of 3.33 (pre-test) and increased the mean MRC score to 3.87 (post-test). This improvement is statistically significant (p = 0.001) and indicates that strengthening exercise alone has an effect on muscle function and strength. Conclusion: This shows that 4 weeks of targeted muscular activation can promote measurable improvements in upper limb muscle strength in individuals with median nerve complaints.

Group B, which had both strengthening exercises and median nerve mobilization, had a pre-test MRC score of 3.60 vs a post-test mean score of 4.73. This large improvement is statistically significant if you check the p-value (0.0001). The significant increase in muscular strength suggest that median nerve mobilization not only relieves nerve-related pain, it also enhances neuromuscular performance more effectively than exercise alone. This improvement can generally be due to improved nerve conduction and possibly less of a neurogenic component, thus allowing for more effective muscle activation.

While both group 1 and group 2 improved from pre to post intervention, it was group 2 (twice-a-week) that saw a significantly greater increase in muscle strength. This reinforces the idea that a comprehensive approach targeting both neuro and muscle therapy is more effective in improving functional outcomes in chronic professional computer users suffering median nerve-associated complications.

Table 3: T test results for Visual Analog Scale based on group A & B

	Mean	**Std. Dev.**	**Std. Error**	**T-Value**	**DF**	**P-Value**
VAS Group A	1.400	.507	.131	1.693	14	.0001
VAS Group B	2.867	.640	.165	17.349	14	.0001

Table 3 shows the results of independent t-test to compare the mean difference between Group A (conservative treatment) and Group B (conservative treatment plus neural mobilization). The results clearly show a significant statistical difference in pain relief between the two groups. In group A, the mean variations of VAS scores were 1.40, and standard deviation (SD) in group A was 0.507 and standard error (SE) was 0.131. T-value was 10.693 with 14 degrees of freedom and p-value was 0.0001. This represents a massive reduction in pain following conservative therapy alone.

Group B, however, had a mean pain decrease of 2.867, nearly double that of Group A; the standard deviation was 0.640, while the standard error was 0.165. The t-value calculated to be 17.349, with 14 degrees of freedom and a p-value of 0.0001, confirms that the pain relief noted in Group B could not be due to chance. Only the individuals who received both muscle strengthening and neural mobilization had up to date pain intensity decreases compared to conservative treatment. The large difference in mean values along with the p-values that are very significant imply that the application of median nerve mobility procedures is effective in relieving pain among long-term users of COMPUTER with median nerve complaints.

Table 4: T test results for Muscle Strength (MRC) Grading based on group A & B

	Mean	**Std. Dev.**	**SE**	**T-Value**	**df**	**P- Value**
MRC Group A	-.533	.516	.133	-4.000	14	.001
MRC Group B	-1.133	.352	.091	-12.475	14	.0001

The independent t test analysis to compare the improvement in muscle strength between Group A (received muscle strengthening activities only) and Group B (received muscle strengthening and neural mobilization procedures), was shown in Table 4. The results show a significant difference in increase in muscle strength levels between the groups. For Group A: mean (-change of muscular strength) = −0.533, standard deviation = 0.516, standard error = 0.133. The t-value (t(14) = −4.000; p = 0.001) was determined. Although Group A showed a statistically significant improvement in strength the magnitude of change was trivial. Conversely, Group B exhibited a mean response of -1.133, with a standard deviation of 0.352 and a standard error of 0.091, indicating a more consistent treatment effect among participants. The t-value of Group B was −12.475, and the p-value was 0.0001, suggesting post-test muscle strength was significantly higher than pre-test strength.

Negative values indicate how much stronger post-test scores were compared to pre-test scores. The mean difference in Band MFS of 4.46 between Group A and Group B is substantially greater than the 0.46 difference in mean scores seen in the study of Boer *et al*., which suggests t-vales of 15.16 and 58.20 are probably highly statistically significant, suggesting median nerve mobilization techniques with strengthening exercises are an effective method to improve muscle function. The presented results provide firm grounds for recommending combined management approaches for addressing symptomatology and enhancing musculature in median nerve affected individuals.

DISCUSSION

The purpose of this study was to evaluate and compare the effectiveness of muscle strengthening exercises alone with muscle strengthening exercises along with neural mobilization technique in preventions and management of median nerve neuropathy in long-term computer users. The wide use of computer-related jobs has led to prolonged and repetitive wrist and hand postures, particularly in non-neutral positions, increasing the incidence of upper limb musculoskeletal diseases (MSTD. DEV.s), such as carpal tunnel syndrome. Multiple researches have highlighted pressing mechanical load on the upper extremities of for as long as human is typing on a keyboard. During typing, studies show that the wrist often remains in an extended position between 13° and 33° and in ulnar deviation between 11° and 25° (Simoneau *et al*., 1999; Simoneau *et al*., 2003). Wrist position combined with hyperextension in the metacarpophalangeal (MCP) joints—particularly in the 4th and 5th digits—creates a static load to the antigravity muscles, such as the wrist extensors (Keir & Wells, 2002). The smart posture allows keeping in this position or to bend fingers without operating automatic muscles through which joint fusion occurs, e.g. the wrist- and finger joints in a hyperextended posture automatically when contracted (Rose, 1991) at more than 25% walking maximal voluntary contract, so a lot worse on finger extensor tendons (Rose, 1991). Such mechanical properties of computer labor are repetitive and rigid (Baker, 2007) and this could lead to dorsal interosseous and abductor digiti minimi muscles strain which may result in a proximal nervous system compression at various sites (Byng, 1997).

The current study included 30 randomly assigned divided evenly into two groups. Group A performed only muscle strengthening activities, while Group B performed muscle training and Butler's median nerve manipulation procedure. Duration of the intervention was four weeks with subjective and objective outcome measures to assess progress. The two principal instruments for evaluating pain relief and functional improvement were the visual analog scale (VAS) and muscle strength (MRC grading). The outcome in Group A (Table 1) indicated a statistically significant reduction in pain after treatment, which was assessed through the visual analog scale (VAS) decreasing from a mean value of 4.40 to 3.00 (p = 0.0001). As detailed inTable 2, muscle strength significantly improved in this group, with the MRC gradewithin the range of 3.33 [2], to 3.87 (p = 0.001). The results propose that only weight training can diminish the severity of median nerve-induced ailments, with an aim to increasing the stability and endurance of those muscles in the forearm and wrist responsible for the maintenance of positioning and performance of the nerves [32, 33].

In both end measures, Group B, which received both muscular strengthening therapy and neural mobilization therapy, showed better results. As shown in Table 1 and Table 2, the VAS scores of Group B were significantly reduced from 4.47 to 1.60 (p = 0.0001) and the muscle strength of Group B significantly increased from 3.60 to 4.73 (p = 0.0001). Data suggest that the addition of neural mobilization strategies significantly enhances the results of nonsurgical care. Restoration of nerve mobility and the reduction of mechanosensitivity associated with median nerve mobilization likely promoted improved neuronal function and pain relief. This finding is further substantiated in Tables 3 and 4, where the intergroup comparisons are displayed. VAS: t-Value = 17.349, p value = 0.0001 & MRC grading: t-Value = 12.475, p value = 0.0001 (Group B had significant improvement as compared to Group A). The results clearly show that Group B demonstrated greater reductions in pain and improvements in muscle strength than Group A.

The neural mobilization strategy used in this study followed Butler's sequential positioning approach, which maximally stressed the nerve along its anatomic path throughout the length of the nerve without provoking symptoms. Patients started with a neutral wrist (flexed fingers and thumb) and gradually progressed to more extended positions (forearm supination and thumb extension). The selected postures were maintained from 5 to 30 sek, when pain not was induced, being performed 3 times daily. Such controlled and careful progress could have reduced intraneural pressure and increased nerve mobility, aiding the median nerve in its passage between neighboring tissues, especially in areas prone to entrapment, such as the carpal tunnel.

The results support previous studies on the neuromechanical link between static muscle loading and nerve subluxation (Byng, 1997). Sustained periods of keyboarding with poor postural ergonomics can lead to subclinical neuropathies with neurological a symptomatology, neural strain and reduced nerve extensibility (Bamac *et al*., 2014; Shahanawaz *et al*., 2016). The results of this study confirm that effective therapies combine strategies aimed at muscle as well as neural components.

The improvement in MRC grading suggests that not only strength was increased but also possibly recruitment improved and neural inhibition decreased. The sensitivity of the MRC scale to the integrity of motor nerve pathways suggests that the increases in Group B provide direct evidence of improved neural conductivity and less nerve irritation following mobilization. The investigation was limited in its diagnostic scope. While pain and muscle strength were assessed accurately, objective neurophysiological examinations such as nerve conduction velocity (NCV) tests, electromyography (EMG), were not performed. The addition of such tests could have provided further information about the physiological improvements in nerve function. Similarly, although pre- and post-treatment range of motion were described on a quantitative scale, it was not subject to statistical analysis or comparison between groups, which might have added more depth to the data itself.

Long-term computer users successfully alleviated early symptoms of median nerve neuropathy from both mediation options. Whenever median nerve manipulation techniques were added, the results concerning pain relief and muscle force recovery improved significantly. Multimodal therapies that focus on improving muscular endurance and mobile neural tissues will be important aspects of addressing the complex biomechanical and neurological problems associated with prolonged computer work, according to the research. Future studies must include larger sample sizes, longer follow-up durations, and more objective diagnostic tools to confirm these results and explore the neurodynamic mechanisms involved.

CONCLUSION

In conclusion, this study demonstrates the effects of merging of muscular strengthening exercises with neural mobilization techniques in the prevention and treatment of neuritis of median nerve among long term computer users. Both intervention arm showed appreciable improvements for pain relief and muscle strength; however, group B which received combined approach showed better improvement in both pain score and muscle strength as compared to group A which performed strengthening exercises alone.

Outcomes were measured with Visual Analog Scale (VAS) ratings and Medical Research Council (MRC) muscle grading. The results showed a significant decrease in pain levels and a significant increase in muscle strength after therapy in both groups. However, the reduction in VAS scores and improvement in MRC grades of Group B were statistically more significant than that of Group A, as they were $p < 0.0001$. Thus, the application of median nerve mobilization not only reduces pain more effectively but also improves the recovery of function of the injured limb.

As described by Butler, median nerve neural mobilization techniques permit gradual tensioning and gliding of the median nerve in its anatomical course, leading to decreased nerve irritation, increased movement, and general neuromuscular activity. The study fits with other work suggesting that prolonged static postures or repetitive motions among computer users could lead to nerve entrapment, and points to the need for ergonomic and therapeutic solutions.

Together, muscular strengthening combined with neural mobilization approaches should be then considered a more effective strategy to target first signs of median nerve impairment in excessive computer unit users. Further studies with larger samples and objective nerve conduction studies are recommended to confirm these results.

Limitations and Future Implications

This provides essential information for the prevention and treatment of median nerve neuropathy among habitual computer users through muscle strengthening and neural mobilization strategies. We must also recognize some limitations that may have affected results and potential pathways that could improve the clinical relevance of this work.

One of the main weaknesses of the study was the limited sample size of only 30 subjects, which will challenge the generalizability of the findings. Nevertheless, using a wider and more heterogeneous sample population in future studies would allow better validation and corroboration of our finding. The inquiry happened over a short span of four weeks. Due to the long-term nature of nerve-related musculoskeletal issues, prolonged follow-up time is important to evaluate the long-lasting effects of the therapies, as well as to identify any treatment effects that may be delayed or that recurrences.

Another limitation is that the analysis was done only on symptomatic individuals. Including longasymptomatic computer users in future studies may improve our understanding of therapeutic success and allow for evaluations of preventative uses of the interventions. Predominantly subjective clinical assessments were used in this study, such as the Visual Analog Scale (VAS) and MRC grading. Future studies may benefit from the incorporation of objective measurements such as nerve conduction velocity testing, electromyography (EMG) or ultrasound imaging for potentially more accurate insights into physiological improvements.

Future studies need to examine a larger cohort over a longer period and to include sick and asymptomatic individuals. In addition, randomised controlled trials and the use of advanced diagnostic tools can increase the reliability of the findings. Actual workplace settings should be studied for long-term imitation ergonomic and therapeutic intervention programs. These pathways may lay the groundwork for the early prevention and improved treatment of median nerve neuropathy among computer users.

REFERENCES

1. Neurological Physiotherapy, A Problem-Solving Approach; Susan Edwards; second edition.
2. Mobilization of the Nervous System; David S. Butler.
3. Handbook of Neuro-Rehabilitation; Amit Agarwal, Dhaval P. Shukla; first edition.
4. Clinical Neurophysiology, Nerve Conduction, Electromyography, Evoked Potentials; J. Misra, J. Kalita; third edition, 2014.
5. Therapeutic Exercise – Foundations and Techniques; Carolyn Kisner, Lynn Allen Colby; sixth edition, 2012.
6. Physical Rehabilitation; Susan B. O’Sullivan, Thomas J. Schmitz, George D. Fulk; sixth edition.
7. Work Place-Based Interventions for Neck Pain in Office Workers, Systematic Review and Meta-Analysis; Xiaoqi Chen, Brooke K. Coombes, Gisela, Jagaard, Venerina Johnston; October 2017.
8. Upper Limb Neural Tissue Extensibility in Apparently Asymptomatic Professional Computer Users; Shahanawaz S. D.; ARC Journal of Neuroscience, Volume 1, Issue 2, 2016.
9. The Effect of the Upper Limb Tension Test in the Management of ROM Limitation and Pain in Cervical Radiculopathy; Shah Sarfraznawaz F., Aravind Manhas, Kunjal Parekh; International Journal of Physiotherapy Research, 2015; Vol. 3(3): 1065–1067.
10. Radial Nerve Mobilization Reduces Lateral Elbow Pain and Provides Short-Term Relief in Computer Users; Vanitha Arumugam, Senthil Selvam, Joy C. MacDermid; 2014.
11. Perceived Exertion, Comfort and Working Technique in Professional Computer Users and Associations with the Incidence of Neck and Upper Extremity Symptoms; Agneta Lindegård, Jens Wahlström, Mats Hagberg, Rebecka Vilhelmsson, Allan Toomingas, Ewa Wigaeus Tornqvist; BMC Musculoskeletal Disorders, 2012.
12. Computer Use is Often Associated with an Increased Prevalence of Hand and Wrist Disorders; Burgess et al; 2010; Lassen et al, 2004; Gerr et al, 2002.
13. Association Between Computer Use and Entrapment Neuropathies in the Wrist Region; Colak S., Bamac B., Colak T., Ozbek A; December 2013.
14. A Cross-Sectional Study of the Relation Between Symptoms and Physical Findings in Computer Operators; Jorgen R. Jepsen, Gert Thomsen; BMC Neurology, 2006.
15. Clinical Neurophysiology; Mishra U.K., Kalta J.; second edition, 2006.
16. Diagnostic Accuracy of the Neurological Upper Limb Examination II: The Relation to Symptoms of Patterns of Findings; Jepsen J.R., Laursen L.H., Hagert C.G., Kreiner S., Larsen A.I.; BMC Neurology, 2006.
17. A Comparison of Symptomatic and Asymptomatic Office Workers Performing Monotonous Keyboard Work – 1: Neck and Shoulder Muscle Recruitment Patterns; Szeto G.P., Straker L.M., O’Sullivan P.B.; Manual Therapy, 2005.
18. Upper Limb Neuropathy in Computer Operators: A Clinical Case Study of 21 Patients; Jepsen J.R.; BMC Musculoskeletal Disorders, 2004.
19. Shoulder Posture and Median Nerve Gliding; Julius A., et al; BMC Musculoskeletal Disorders, 2004.
20. A Comparison of Methods for the Assessment of Postural Load and Duration of Computer Use; Heinrich J., Blatter M., Bongers P.M.; Occupational and Environmental Medicine, 2004.
21. The Sensitive Nervous System; D.S. Butler; Noigroup Publications, 2000.
22. Overuse Syndromes of the Upper Limb and the Upper Limb Tension Test: A Comparison Between Patients, Asymptomatic Keyboard Workers and Asymptomatic Non-Keyboard Workers; Byng J.; Manual Therapy, 1997.
23. Subclinical Impairment in the Median Nerve Across the Carpal Tunnel Among Female VDT Operators; Murata K., Araki S., Okajima F., Saito Y; 1996.
24. Friction May Contribute to Disorders of the Tendon, Their Sheaths, or Adjacent Nerves; Nelson et al; 2000.
25. Mobilization of the Nervous System; D.S. Butler; Churchill Livingstone, 1991.
26. Influence of the Long Term Use of a Computer on Median, Ulnar and Radial Sensory Nerves in the Wrist Region; Bamac B., Colak S., Dundar G., Selekler H.M., Taşkiran Y., Colak T., Balci E; December 2014.
27. Upper Limb Neuropathy in Computer Operators? A Clinical Case Study of 21 Patients; Jørgen Riis Jepsen; BioMed Central.
28. Mobilization of the Nervous System; D.S. Butler; New York: Churchill Livingstone.
29. Addition of Test Components During Neurodynamic Testing: Effect on Range of Motion and Sensory Responses; Coppieters M.W., et al.
30. Work CSN Increase the Risk of Developing Musculoskeletal Symptoms and Disorders in the Upper Extremities; [No author provided].
31. Neuropathies in the Wrist Region; Colak S., Barmac.

32. A Modified Upper Limb Tension Test: An Investigation of Responses in Normal Subjects; Yaxley G.A., Jull G.A.; Australian Journal of Physiotherapy, 1991.
33. Reliability of Clinical Tests to Evaluate Nerve Function and Mechanosensitive of the Upper Limb Peripheral Nervous System; Schmidt A.B., Brunner F., Luomajoki H., Held U., Bachmann L.M., Künzer S., Coppieters M.W.

Cite This Article: Akhyova Sahoo, Birupakshya Mahakul, Riti Mohanty, Aakansha (2025). Comparative Analysis of Strategies for Preventing Median Nerve Neuropathy in Long-Term Computer Users. *East African Scholars J Med Sci, 8*(5), 153-162.