PREVENTION OF MEDIAN NERVE NEUROPATHY IN LONG-TERM COMPUTER USERS – A COMPARATIVE STUDY

DISSERTATION

Submitted for the partial fulfillment of the requirement for the degree of

MASTER OF PHYSIOTHERAPY (MPT)

(Elective –Advanced Physiotherapy in Neurology)

APRIL – 2018

By

Regn. No: 271620264

Submitted to:

THE TAMILNADU DR.M.G.R MEDICAL UNIVERSITY

CHENNAI – 60003

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This is to certify that the Dissertation entitled "**PREVENTION OF MEDIAN NERVE NEUROPATHY IN LONG-TERM COMPUTER USERS – A COMPARATIVE STUDY**" was done by Bearing Regn. No:**271620264.** This work has been done as a partial fulfillment for the degree of Master of Physiotherapy done at **Mohamed Sathak A.J College of Physiotherapy**, Chennai and submitted in the year April 2018 to **The Tamilnadu Dr. M.G.R Medical University, Chennai.**

Date:

Place: Chennai

Seal & Signature of Principal

……..…

Prof. R. Radhakrishnan, MPT., PGDHM.,

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CERTIFICATE

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Date:

Place: Chennai **…..…….**

Prof. S. PARVATHI, MPT (Neuro)., M.Sc (Psy)., M.I.A.P.

Mohamed Sathak A.J College of Physiotherapy

CERTIFICATE

MOHAMED SATHAK A.J COLLEGE OF PHYSIOTHERAPY

Nungambakkam, Chennai – 600034.

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The undersigned examiners has duly verified and examined the submitted Dissertation done by the above candidate.

…… ……

Internal Examiner **External Examiner**

Place:

Date:

DECLARATION BY THE CANDIDATE

I hereby declare that the Dissertation entitled "**PREVENTION OF MEDIAN NERVE NEUROPATHY IN LONG-TERM COMPUTER USERS – A COMPARATIVE STUDY"** was done by me for the partial fulfillment of the requirement of Master of Physiotherapy degree. The dissertation had been done under the direct supervision and guidance of my Guide **Prof. S. PARVATHI, MPT (Neuro)., M.Sc (Psy)., M.I.A.P.** at **Mohamed Sathak A.J college of Physiotherapy**, Chennai, and submitted the same during the year April 2018 to **The Tamilnadu Dr. M.G.R Medical University, Chennai.**

Date:

Place: Chennai

…..……

Signature of the Candidate

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I thank our **Management** for providing sufficient books, good faculties and facilitating us to gain a wide knowledge on our field.

My sincere thanks to our respectable **Correspondent Mr. Alhaj E.S.M.A. Basheer Ahmed** and our **Director Mr. Janab Mohamed Arshad,** Mohammed Sathak A.J College of Physiotherapy, Chennai.

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I extend my thanks to all who motivated and helped me in all aspects to complete the study

INDEX

1. ABSTRACT

TITLE:

Prevention Of Median Nerve Neuropathy In Long-Term Computer Users – A Comparative Study

INTRODUCTION:

Long term computer users who exhibited symptoms of median nerve neuropathy were observed for the effectiveness of neural muscular mobilization relaxation technique, isometric intrascapular strengthening of shoulder muscles and posture correction with some ergonomic modification.

MATERIALS AND METHODS OF STUDY:

Thirty long-term computer users between ages 30 to 45 years were identified and selected for the study. The inclusion criteria were the computer users having worked for more than 8 hours per day, 5-6 days per week on a regular basis for more than 10 years. Study duration 4 weeks. The sample should be positive in upper limb nerve tension test (ULNTT). The entire sample would be categorized per the symptoms they manifest, namely:

1. Pain
2. Numbness and/or tingling
3. Muscle weakness

Inclusion criteria:

Both gender.

Pain.

Numbness.

Paraesthesia.

Nerve entrapment.

Positivity to upper limb nerve tension testing

Exclusion criteria:

Any central or peripheral nervous system disease.

Systemic arthritis.

Tumors.

Sensory defects.

CONCLUSION:

Median nerve mobilization techniques significantly reduced intensity of pain and increased painless range of motion in subjects as compared to those that received conservative muscle strengthening exercises.

2. INTRODUCTION

Intensive computer work can increase the risk of developing neuromusculoskeletal symptoms and disorders in the upper extremities. There is a general consensus in the literature that computer use is often associated with an increased prevalence of hand and wrist disorders. Association between computer use and neuromusculoskeletal disorders of the wrist have been related to repetitive motions, non-neutral postures and consistent static muscle loading. Symptoms may be associated with specific clinical entities such as peripheral nerve entrapment. Certain postures or positions can place increased pressure either directly or by increasing tension on the nerves at different entrapment points.

The most commonly affected peripheral nerve in long term computer users are median and ulnar nerve. The accumulative amount of time spent on a keyboard may be substantial for many individuals resulting in an increase in concerns for upper extremity disorders related to “overuse.” The involvement of the peripheral nervous system in “non-specific“ upper limb dysfunction in computer operators has been suggested in previous reports and studies[1].

Numerous impairments such as increased threshold to vibratory stimulation, tension in the nerves, reduced nervous mobility, mechanical allodynia, pathological change in axonal flare reaction, and reduction in muscle strength have been reported in computer users who have experienced pain.

Peripheral nerves are susceptible to mechanical compression, friction, and repeated tension. If sufficient mechanical stimuli are exerted upon the nerve to cause damage; the damaged cells will release number of chemical agents, including bradykinin, histamine and prostaglandins[1]. These chemical agents are capable of directly stimulating the nociceptors found within the connective tissue layers of the nerve.

Compression can also result in structural damage, blockage of axoplasmic flow, and impairment of blood flow resulting in ischemia, all of which will result in altered function of the nerve. In addition, chemicals released from non-neural tissues are capable of mediating an inflammatory response, stimulating nociceptors within the connective tissue of nerves. Nerve tension testing, which causes mechanical tension on a nerve is expected to increase pain from the nerve. There is support for this concept immediately following neural tension, positioning in people without any pathology there is an increase in the threshold of sensory reception touch; and decreased threshold for pain. David Butler described nerve tension testing positions and mobilization techniques for the nerves of the upper extremity.

Techniques that restore the mobility of a nerve that has restricted longitudinal movement are often called “neural mobilization techniques”. When neural mobilization is used for treatment of adverse neural tension, the primary theoretical objective is to restore the dynamic balance between the relative movement of neural tissues and surrounding tissue interfaces. This will in turn reduce intrinsic pressure on neural tissues and promote optimum physiologic function. Based on his premise for this intervention one might expect improved mobility of the nerve and visceral structures following neural mobilization.

We have proposed that computer users have developed minor neural injury as a consequence of restricted gliding or compression of the median or ulnar nerves. Hence long term computer users diagnosed to have ulnar or median nerve neuropathy were observed for the effectiveness of neuromuscular mobilization relaxation technique, isometric intrascapular muscle strengthening, and posture correction with some ergonomic modification.

3. AIM OF THE STUDY

To compare the effectiveness of muscle strengthening exercises and neural mobilization techniques in prevention of median nerve neuropathy in long term computer users.

4. NEED OF THE STUDY

The purpose of the study is to analyse prevention strategies for median nerve neuropathy in long term computer users with posture and/or ergonomic modification.

5. HYPOTHESIS

NULL HYPOTHESIS (H_0):

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

ALTERNATE HYPOTHESIS (H_1):

There is a significant difference between Group A and Group B in improving median nerve neuropathy.

6. REVIEW OF LITERATURE

1. **Gayle Yaxley et al 1991**, on a study "A Modified upper limb tension test; an investigation of responses in normal subjects" concluded that area of sensory responses were different to those documented for the original UL TT suggesting that the modified UL TT does move or place tension on the neural tissue tract at different sites.

2. **J Byng et al 1997**, on a study "overuse syndromes of the upper limb and the upper limb tension test; A comparison between patients, asymptomatic keyboard workers and asymptomatic non-keyboard workers" concluded the need for intervention in an office environment to prevent further cases of Overuse syndromes of the upper limb from developing.

3. **Latko WA et al 1999**, on "cross-sectional study of the relationship between repetitive work and the prevalence of upper limb musculoskeletal disorders" repetitive work is related to upper limb discomfort, tendinitis, and carpal tunnel syndrome in workers.

4. **Gerr F, et al 2000**, on "work-related upper extremity musculoskeletal disorders" suggested adverse ergonomic exposures of force, repetition, vibration and certain postures are risk factors for development of many of upper extremity disorders and treatment can only be successful when exposure to adverse ergonomic risk factors is reduced or eliminated.

5. **Jørgen Riis Jepsen 2004**, on study "Upper limb neuropathy in computer operators? A clinical case study of 21 patients" concluded that there is limited success in the prevention and management of computer-related upper limb disorders and demands new approaches to practice and research in the field.

6. **Jepsen JR et al 2004**, on study "Upper limb neuropathy in computer operators. A clinical case study of 21 patients" concluded that there is limited success in the prevention and management of computer-related upper limb disorders and demands new approaches to practice and research in the field.

7. **Andrea Julius et al 2004**, on study "Shoulder posture and median nerve gliding" concluded that direct effects of slumped sitting on median nerve strain are not sufficient to alter nerve function. However, shoulder protraction does appear to restrict nerve sliding and prolonged protraction leads to pareasthesias.

8. **J Heinrich et al 2004**, on study "A comparison of methods for the assessment of postural load and duration of computer use" concluded the challenge to develop quick and inexpensive techniques for assessing exposure to postural load and duration of computer use is still open.

9. **Fred Gerr et al 2004**, "Epidemiology of musculoskeletal disorders among computer users: lesson learned from the role of posture and keyboard use" suggested lowering the height of the keyboard to or below the height of the elbow and resting the arms on the desk surface or chair arm`rests is associated with reduced risk of neck and shoulder MSDs.

10. **Heinrich J, et al 2004**, on a study "A comparison of methods for the assessment of postural load and duration of computer use" concluded challenge to develop quick and inexpensive techniques for assessing exposure to postural load and duration of computer use is still open.

11. **Jorgen R Jepsen et al 2006** on study "A Cross-sectional study of the relation between symptoms and physical findings in computer operators" concluded that cross-sectional study of computer operators has identified individual and patterns of neurological findings reflecting the upper limb peripheral nerves in three specific patterns with nerve involvement at explicit locations namely the brachial plexus at chord level, the posterior interosseous and median nerves at elbow level.

12. **Annina B Schmid et al 2009**, on study "Reliability of clinical tests to evaluate nerve function and mechanosensitivity of the upper limb peripheral nervous system" concluded clinical tests to evaluate increased nerve mechanosensitivity and afferent/efferent function have moderate to substantial reliability.

13. **Agneta Lindegard, et al 2012**, on study "Perceived exertion, comfort and working technique in professional computer users and associations with the incidence of neck and upper extremity symptoms" concluded strong association between perceived exertion and the development of neck, shoulder, and arm/hand symptoms.

14. **Colak et al 2013**, on study "Association between computer use and entrapment neuropathies in the wrist region" concluded that several studies showed that long term computer users are at increased risk for entrapment neuropathies in the wrist region and most of these studies include no measure of nerve conduction velocity and conclusions of these studies were based on self reported symptoms of entrapment neuropathies without conforming neurophysiological studies.

15. **Bamac et al 2014**, on a study " Influence of the long term use of a computer on median, ulnar and radial sensory nerves in the wrist region" concluded that computer users have a tendency to experience median and ulnar sensory nerve damage despite being neurologically asymptomatic. Sustained wrist extension and ulnar deviation may result in stretching of these nerves across the wrist during computer mouse use and typing and may represent presymptomatic or asymptomatic neuropathy similar to the type of subclinical entrapment neuropathy.

16. **Vanitha Arumugam et al 2014**, on study "Radial Nerve Mobilization Reduces Lateral Elbow Pain and Provides Short-Term Relief in Computer Users" concluded the mobilization of the radial nerve resulted in a significant short-term relief in the lateral elbow pain of computer users.

17. **Sarfraznawaz et al 2015**, on study "the effect of the upper limb tension test in the management of ROM Limitation and pain in cervical radiculopathy" concluded the upper limb tension test as

a method of neural mobilization in the treatment of cervical radiculopathy with respect to pain and cervical range of motion.

18. **Shahanawaz, et al 2016**, on study "Upper Limb Neural Tissue Extensibility in Apparently Asymptomatic Professional Computer users" concluded the susceptibility of the median nerve and ulnar nerve towards posture related reduced extensibility and abnormal posture leads to abnormal neural tissue mobility.

19. **Xiaoqi Chen et al 2017**, on study "Work place-based interventions for neck pain in office workers, Systematic review and meta-analysis" concluded workplace-based strengthening exercises were effective in reducing neck pain in office workers who were symptomatic, and the effect size was large when the exercises were targeted to the neck/shoulder.

20. **Bulter,DS**: The Sensitive Nervous System. Adelaide, Australia: Noigroup Publications, 2000.

21. **Susan Edwards**; Neurological physiotherapy, A problem-solving approach, second edition 2004.

22. Mobilization of the nervous system, **David S. Butler**.

23. Clinical Neurophysiology, Nerve Conduction, Electromyography, Evoked Potentials, third edition, **UK Misra, J Kalita**, 2014.

24. Therapeutic Exercise – Foundations and Techniques; **Carolyn Kisner, Lynn Allen Colby**; sixth edition, 2012

7. METHODOLOGY

RESEARCH DESIGN: Comparative study.

SAMPLING DESIGN: Convenient sampling.

SAMPLE SIZE: 30 subjects.

GROUP A: 15 Subjects.

GROUP B: 15 subjects.

CRITERIA FOR SELECTION

INCLUSION CRITERIA:

Both gender.

Pain.

Numbness.

Paraesthesia.

Nerve entrapment.

Positivity to upper limb nerve tension testing

EXCLUSION CRITERIA:

Any central or peripheral nervous system disease.

Systemic arthritis.

Tumours.

Sensory defects.

STUDY SETTINGS: Clinical and home-based.

STUDY DURATION: 4 weeks.

PROCEDURE

The patients consent was obtained by explaining the procedure to the individuals. The group of 30 patients were divided into two groups: Group A consisted of 15 patients who underwent conservative treatment. Group B consisted of 15 patients, who underwent conservative treatment and neural mobilization and relaxation technique.

Group A

Each patient in Group A was treated conservatively with muscle strengthening exercises.

Group B

Each patient in Group B was treated with muscle strengthening exercises and median nerve mobilization technique (Butler mobilization).

Butler Neural Mobilisation

a. Shoulder Girdle Depression and Shoulder Abduction

b. Forearm supination and elbow extension

c. Wrist and Finger Extension

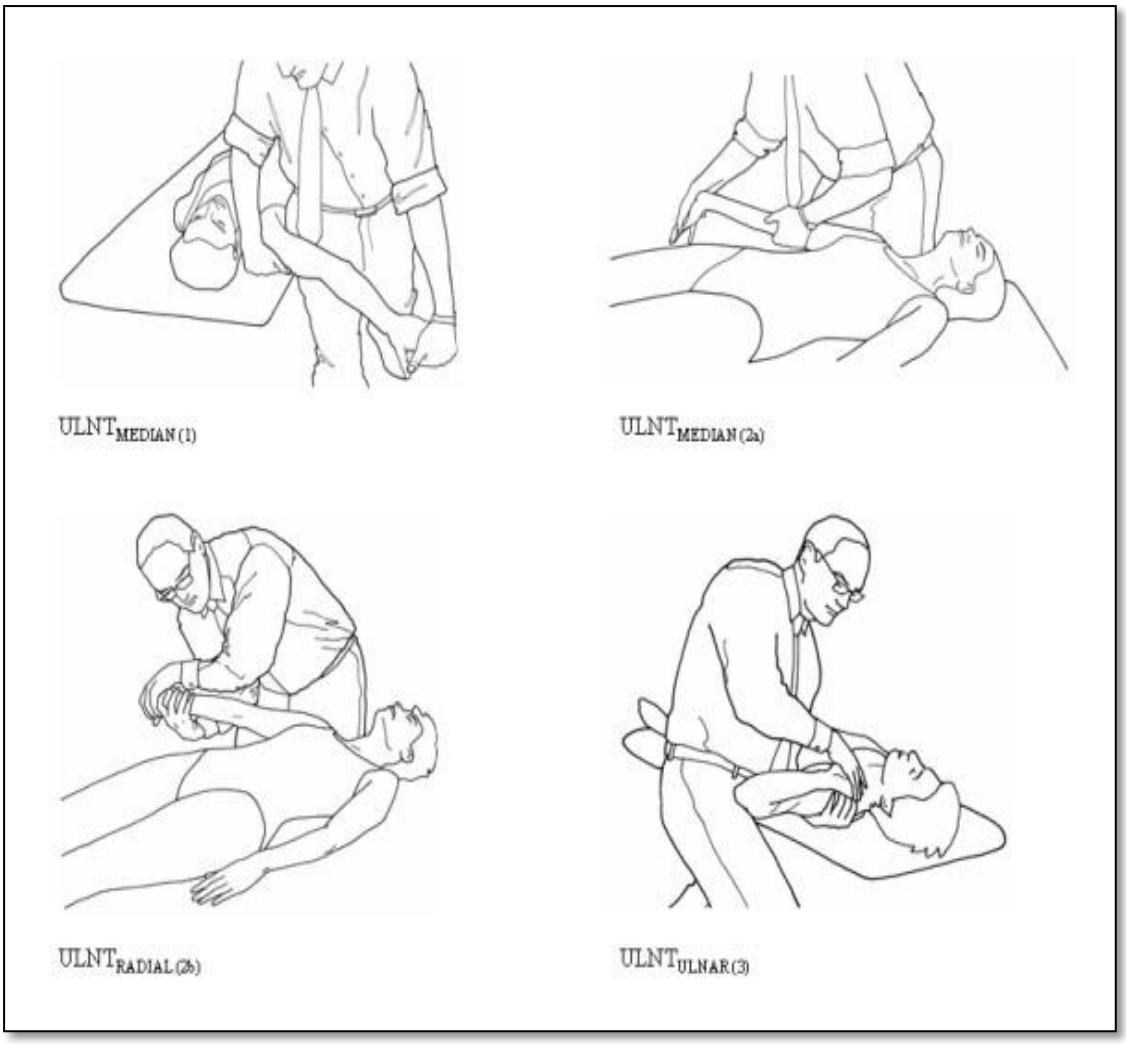
d. Butler Mobilisation done

The individuals were evaluated and the procedure was performed in the same sequence as described by Butler D.

Butler neural mobilization technique:

JOINT	MOVEMENT
Shoulder Girdle	Depression
Shoulder Joint	Abduction
Forearm	Supination
Wrist And Finger	Extension
Shoulder Joint	Lateral Rotation
Elbow	Extension

JOINT	MOVEMENT
Shoulder Girdle	Depression
Shoulder Joint	Abduction 10 degree
Elbow	Extension
Arm	Lateral Rotation
Forearm	Supination
Wrist and Finger and Thumb	Extension



Median nerve mobilization technique:

A. Wrist neutral with fingers and hand thumb flexed.

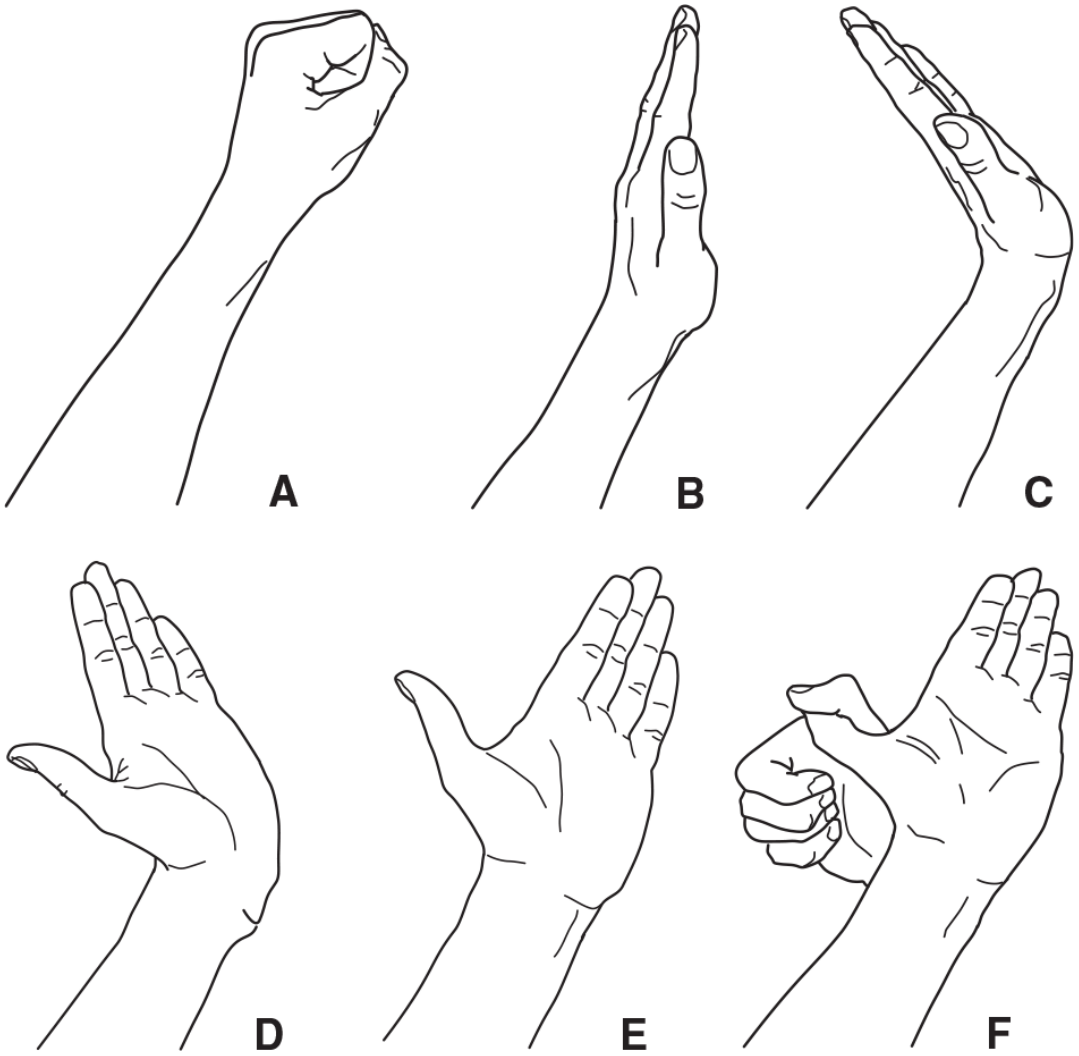
B. Wrist neutral with fingers and thumb extended.

C. Wrist and fingers extended, thumb neutral.

D. Wrist, fingers and thumb extended.

E. Wrist, fingers and thumb extended and forearm supinated.

F. Wrist fingers and thumb extended forearm supinated and thumb stretched into extension.



Each patient in Group B were given median nerve mobilization treatment following the above-mentioned protocol beginning with position A and gradually progressing to each succeeding position until the median nerve symptom was just provoked and sustained the position for 5 to 30 seconds without making the symptoms worse. Then the stretch position was alternated making sure the patient was symptom free. This mobilization routine was done three times a day without exacerbation of symptoms.

8. DATA ANALYSIS

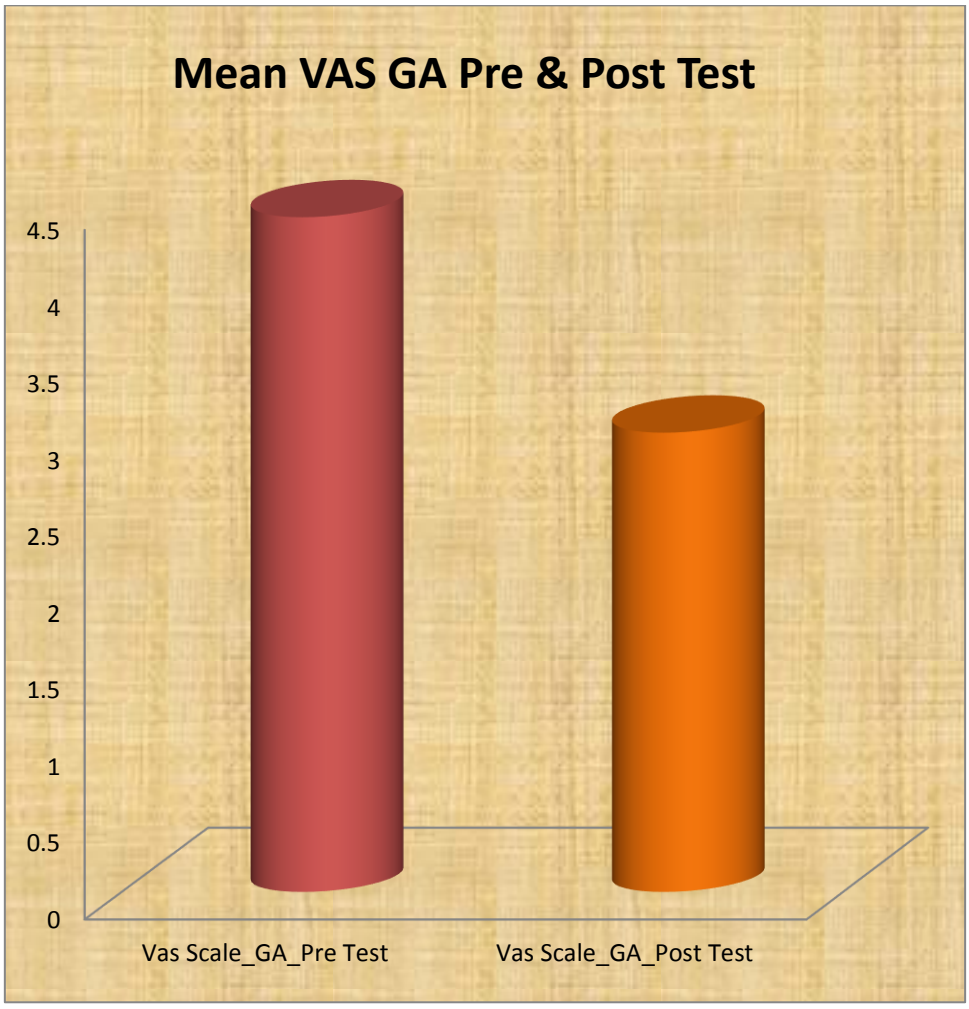
Paired t test

Visual Analog Scale (Group A)

Table: 1

Paired Samples Statistics					
variable	Mean	N	Std. Deviation	Std. Error Mean	**P-Value**
Vas Scale_GA_Pre Test	4.40	15	1.121	0.289	0.0001
Vas Scale_GA_Post Test	3.00	15	1.195	0.309	

Fig: 1

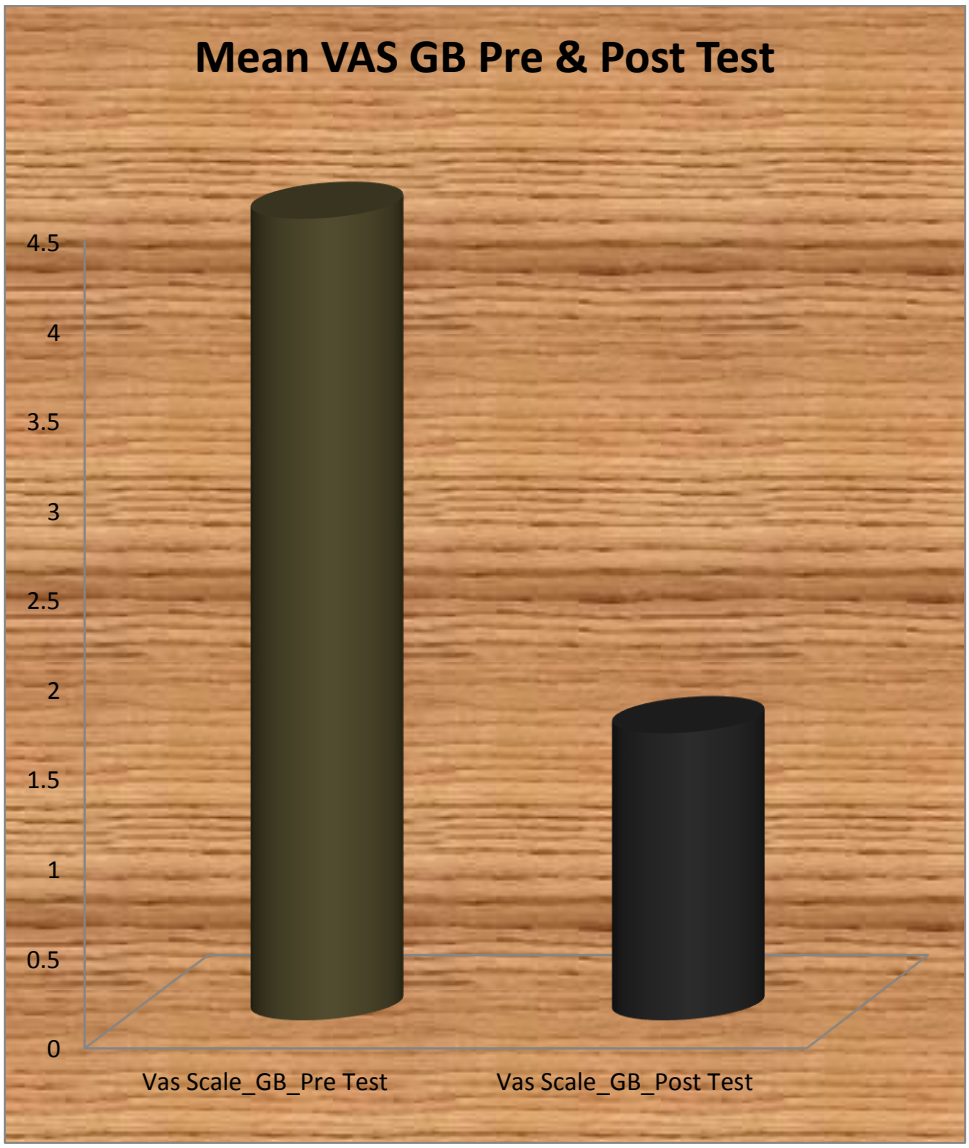

Mean VAS GA Pre & Post Test
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Vas Scale_GA_Pre Test
Vas Scale_GA_Post Test

Visual Analog Scale (Group B)

Table: 2

Paired Samples Statistics					
Variable	Mean	N	Std. Deviation	Std. Error Mean	**P-Value**
Vas Scale_GB_Pre Test	4.47	15	1.125	.291	0.0001
Vas Scale_GB_Post Test	1.60	15	.737	.190	

Fig: 2


Mean VAS GB Pre & Post Test
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Vas Scale_GB_Pre Test
Vas Scale_GB_Post Test

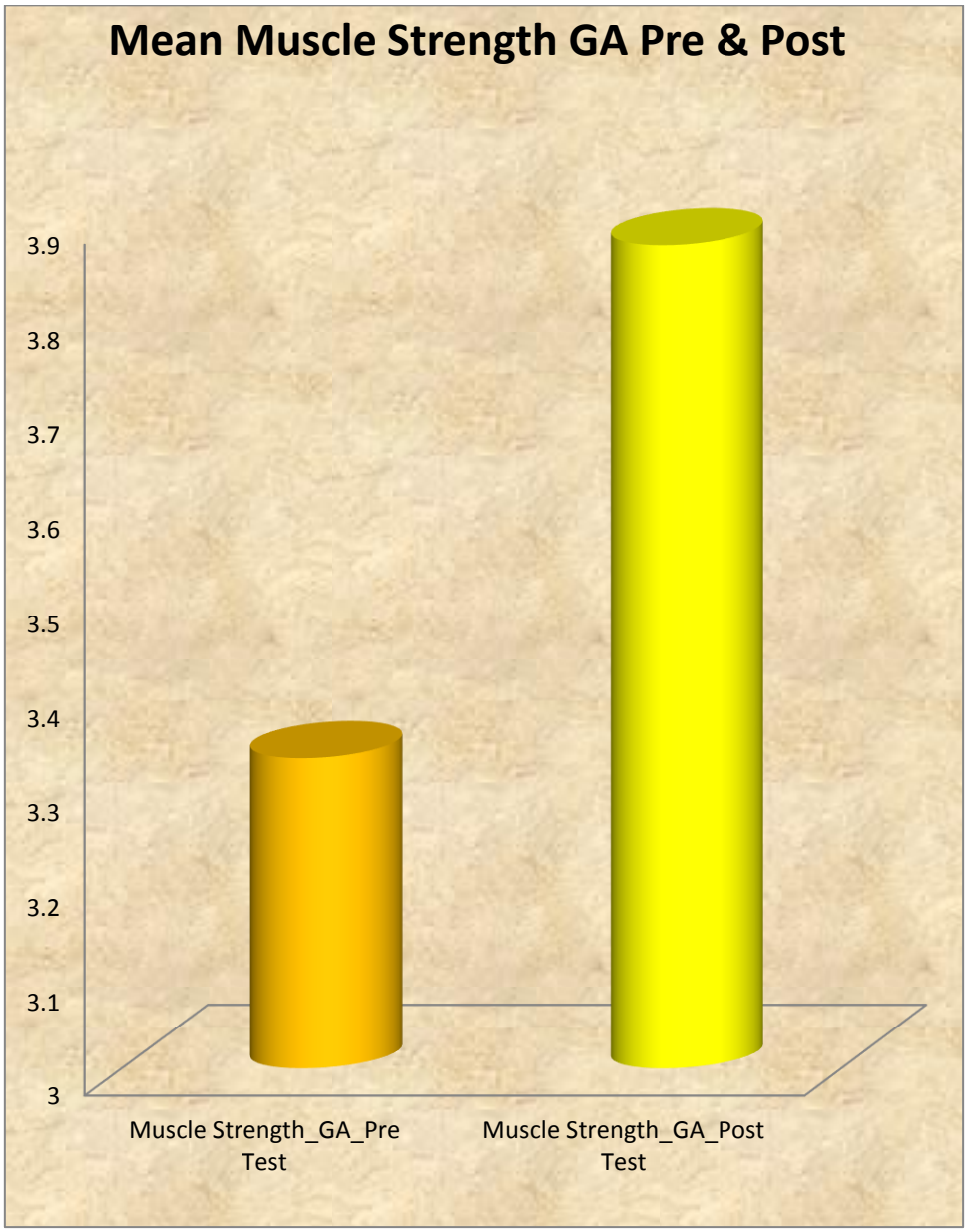
Paired t test

Muscle Strength (MRC) Grading (Group A)

Table:3

Paired Samples Statistics					
Variable	Mean	N	Std. Deviation	Std. Error	**P-Value**
Muscle Strength_GA_Pre Test	3.33	15	.617	.159	0. 001
Muscle Strength_GA_Post Test	3.87	15	.516	.133	

Fig: 3

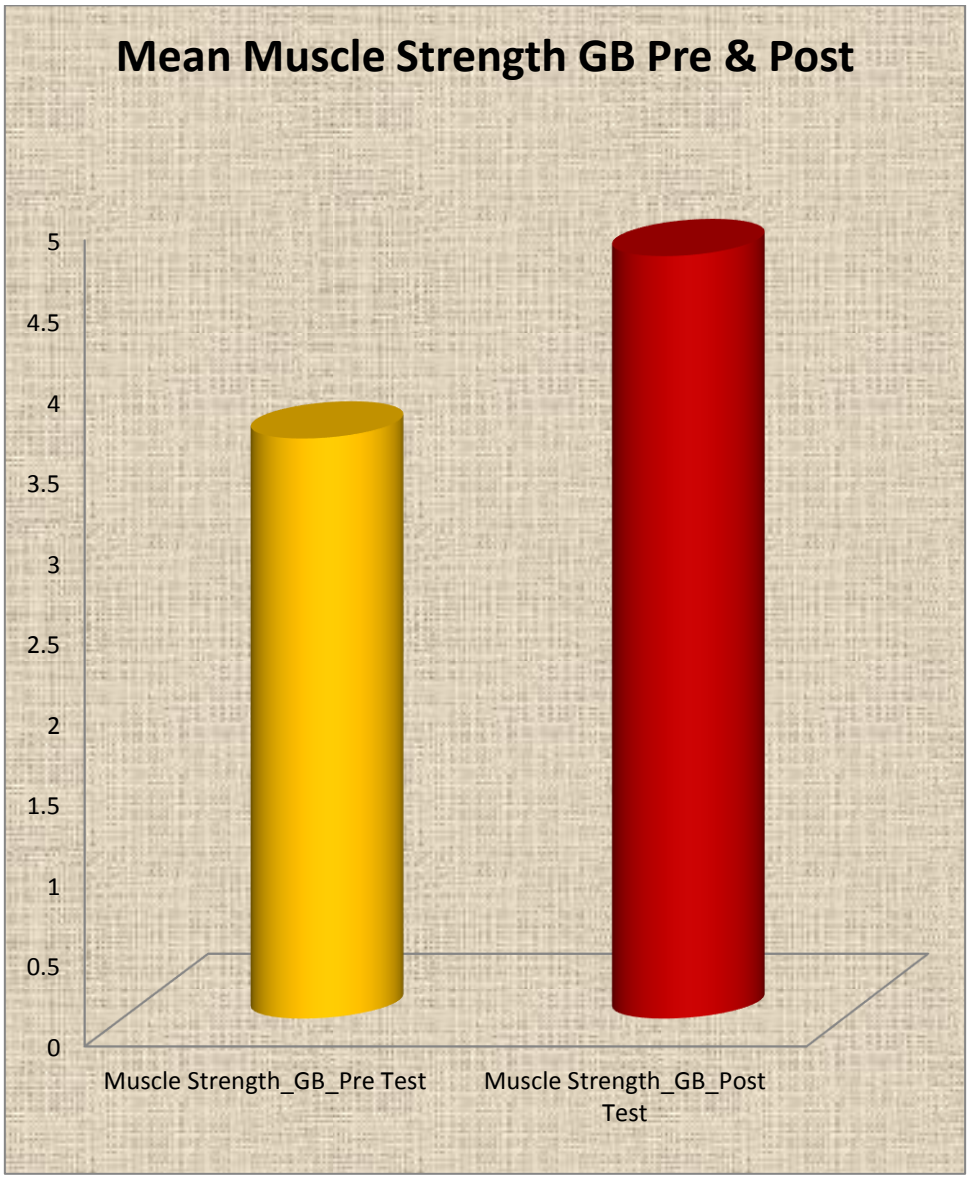

Mean Muscle Strength GA Pre & Post
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3
Muscle Strength_GA_Pre Test
Muscle Strength_GA_Post Test

Muscle Strength (MRC) Grading (Group B)

Table:4

Paired Samples Statistics					
Variable	Mean	N	Std. Deviation	Std. Error	**P-Value**
Muscle Strength_GB_Pre Test	3.60	15	.507	.131	0.0001
Muscle Strength_GB_Post Test	4.73	15	.458	.118	

Fig: 4


Mean Muscle Strength GB Pre & Post
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Muscle Strength_GB_Pre Test
Muscle Strength_GB_Post Test

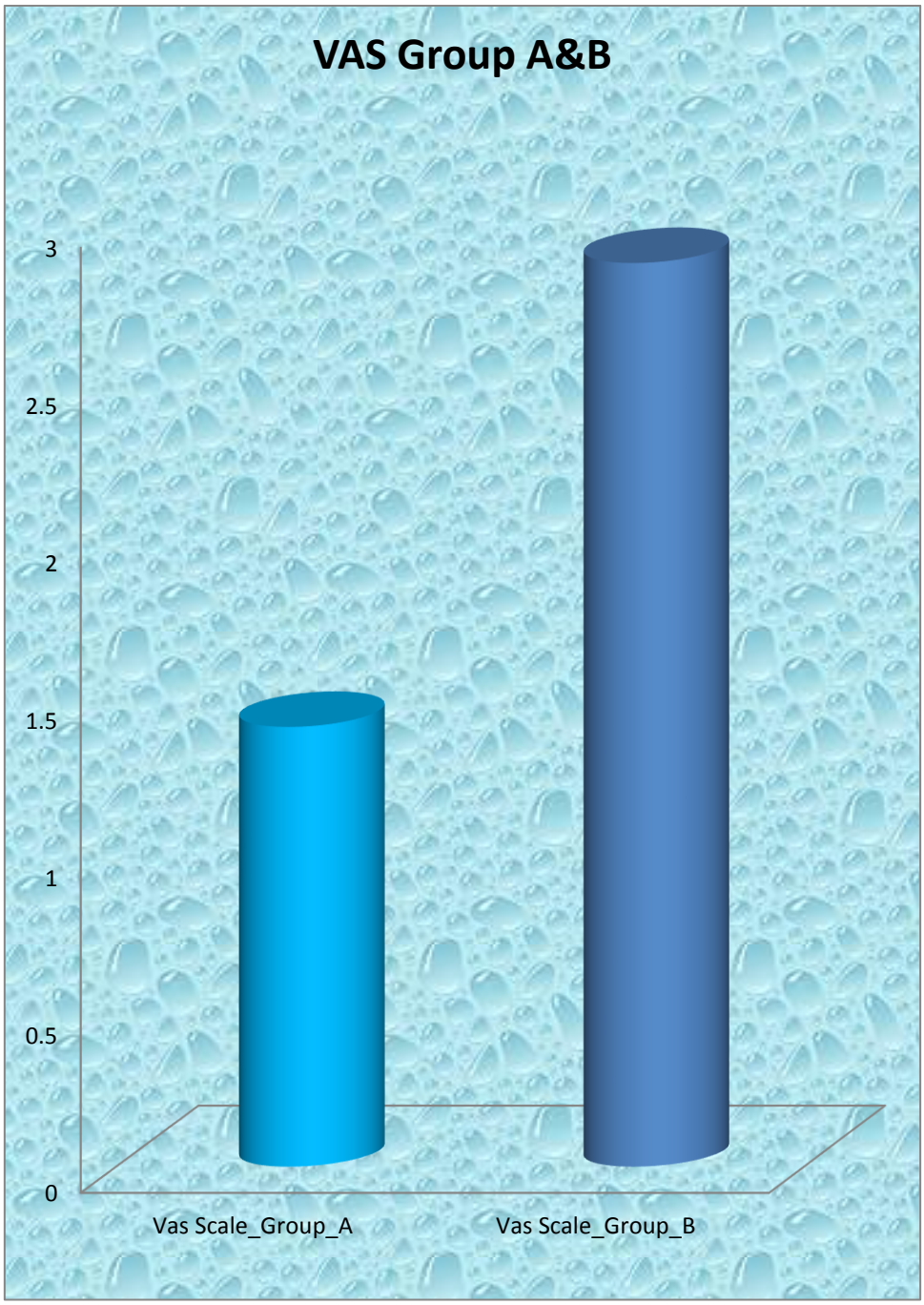
Independent t test:

Visual Analog Scale Group A&B

Table:5

	Mean	**SD**	**Std. Error**	**T-Value**	**P-Value**
Vas Scale_Group_A	1.400	0.507	0.131	10.693 df=14	0.0001
Vas Scale_Group_B	2.867	0.640	0.165	17.349 df =14	0.0001

Fig: 5

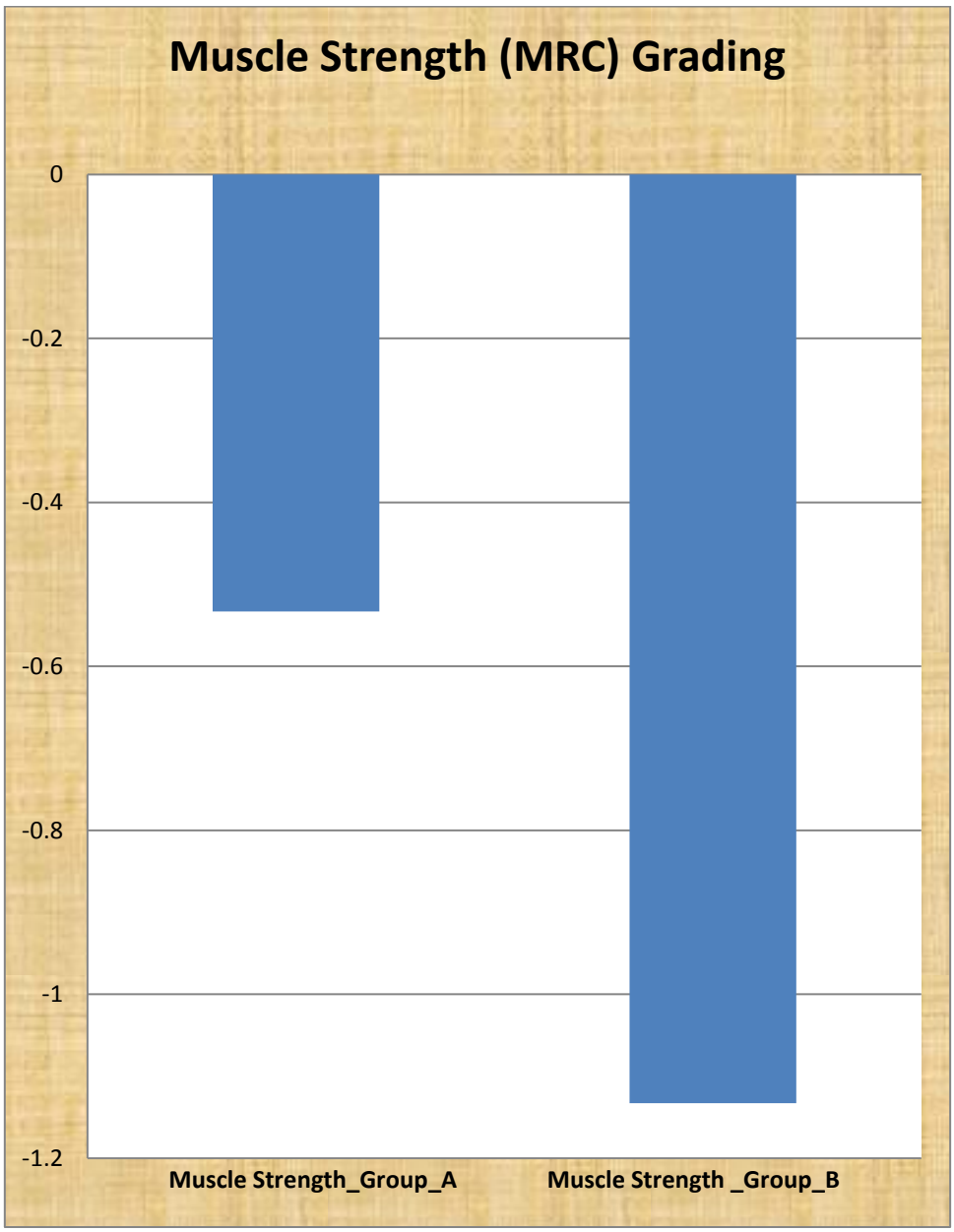


Muscle Strength (MRC) Grading

Table:6

	Mean	**SD**	**SE**	**T-Value**	**P-Value**
Muscle Strength_Group_A	-0.533	0.516	0.133	-4.000 df=14	0.001
Muscle Strength _Group_B	-1.133	0.352	0.091	-12.475 df =14	0.0001

Fig: 6


Muscle Strength (MRC) Grading
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
Muscle Strength_Group_A
Muscle Strength _Group_B

9. DISCUSSION

Wrist positions and forces employed by computer users have been evaluated in several studies. During typing, wrist and elbow postures are maintained for long periods, creating static loading in the antigravity muscles, namely, the wrist extensors **(Keir and Wells, 2002).**

The average position of the wrist for extension during typing has been reported as between 13° and 33° **(Simoneau et al., 1999; Simoneau et al., 2003)**. The average position of the wrist in ulnar deviation has been reported to be between 11° and 25° (Simoneau et al., 1999; Simoneau et al., 2003).

Descriptions of keyboard kinematics have documented that the wrist is often maintained in ulnar deviation **(Simoneau et al., 1999; Rose, 1991; Baker, 2007).** A hyperextended 5th MCP joint was noted in 50% of the right hands and 68% of the left hands of this sample and a hyperextended 4th MCP joint was noted in 23% of the right hands and 46% of the left hands. This hand position has been noted to cause a muscle contraction that exceeds 25% of the computer users maximum voluntary contraction in the extrinsic extensor muscles **(Rose, 1991)** putting the finger extensor tendons at risk for musculoskeletal disorders of the upper extremity.

Some keyboarders also abduct as well as hyperextend their 5th digits continuously during keyboarding **(Pascarelli and Kella, 1993)**, thereby maintaining tension on the 4th dorsal interosseous and abductor digiti minimi **(Baker, 2007)**. The musculoskeletal system presents the nervous system with a mechanical interface. A static muscle contraction such as those witnessed in keyboard users can cause compression of a nerve in various anatomical sites (Byng, 1997).

In this study a sample of 30 subjects fulfilling the inclusion criteria have randomized into two groups, 15 each in this study.

Group-A underwent muscle strengthening exercises for a period of 4 weeks.

Table 1 shows that the effectiveness of muscle strengthening exercise in prevention of median nerve neuropathy in long term computer users in terms of VAS, the paired t test shows the overall effectiveness in VAS, i.e., P value = 0.001<0.05. Hence the evidence is sufficient to conclude that on average, there is significant mean decrease in VAS due to the treatment of strengthening exercise.

Table 3 shows that the effectiveness of muscle strengthening exercise in prevention of median nerve neuropathy in terms of MRC grading, the paired t test shows the overall effectiveness in MRC Grading, i.e., P value = 0.001<0.05. Hence the evidence is sufficient to conclude that on average, there is significant mean increase in MRC grading.

Group-B underwent muscle strengthening exercises and median nerve mobilization for a period of 4 weeks.

Table 2 & 4 show that the effectiveness of muscle strengthening exercise in prevention of median nerve neuropathy in long term computer users in terms of VAS and MRC Grading shows the overall effectiveness on MRC Grading, i.e., P value = 0.001<0.05. Hence the evidence shows that it is sufficient to conclude that on an average, there is significant mean increase in the MRC Grading.

The study found that median nerve mobilization techniques drastically reduced the number and intensity of symptoms by Group B as compared to Group A.

While group A subjected to conservative treatment had only marginal reduction in number and intensity of symptoms, group B which was subjected to conservative treatment as well as median nerve mobilization techniques reported marked reduction in both number and intensity of symptoms as can be seen in the findings in table 5 and table 6. Mean value 4.26<1.66 shows that we can conclude that neural mobilisation technique gives more effectiveness on the median nerve neuropathy patients.

While both groups subjectively reported change in pain intensity on the visual analog scale, the study was limited by the fact that more objective measurements such as nerve conduction studies were not performed.

Pre and post treatment painless range of motion was measured objectively in both groups on a numeric scale of 1 to 10 and changes pre and post treatment were logged.

10. CONCLUSION

Median nerve mobilization techniques significantly reduced intensity of pain and increased painless range of motion in subjects as compared to those that received conservative muscle strengthening exercises. The difference in mean muscle strength was 0.6 in favour of Group B.

11. LIMITATIONS AND RECOMMENDATIONS

LIMITATIONS:

- Study has limited number of patients.
- The study is done in shorter duration.
- Study is done only on patients with symptoms.

RECOMMENDATIONS:

- Study size can be increased.
- Study duration can be increased.
- Further studies need to be done.

12. REFERENCES

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ANNEXURE

MEDICAL RESEARCH COUNCIL SCALE FOR MUSCLE STRENGTH

Power examination technique:

Power or strength is tested by comparing the patient's strength against your own.

Start proximally and move distally.

Compare one side to the other.

Grade strength using the MRC scale.

MRC Scale:

GRADE	DESCRIPTION
0	**No contraction**
1	**Flicker or trace of contraction**
2	**Active movement with gravity eliminated**
3	**Active movement against gravity**
4	**Active movement against gravity and resistance**
5	**Normal power**

The patient's effort is graded on a scale of 0-5:

- Grade 5: Muscle contracts normally against full resistance.
- Grade 4: Muscle strength is reduced but muscle contraction can still move joint against resistance.
- Grade 3: Muscle strength is further reduced such that the joint can be moved only against gravity with the examiner's resistance completely removed.
- Grade 2: Muscle can move only if the resistance of gravity is removed.
- Grade 1: Only a trace or flicker of movement is seen or felt in the muscle or fasciculations are observed in the muscle.
- Grade 0: No movement is observed.

CONSENT FORM

I, Mrs. / Ms …… voluntary consent to participate in the Dissertation study named **"PREVENTION OF MEDIAN NERVE NEUROPATHY IN LONG-TERM COMPUTER USERS".** The physical therapy student has explained me about the procedure in detail. Here I assure that I will adhere to the treatment programme prescribed to me and have been given the liberty to withdraw myself from programme at any time with knowledge of the physical therapy student.

Participant's signature :

Signature of witness :

Sign of physical therapy student :

Date :

Place :

MASTER CHART

VAS SCALE					
	GROUP A			GROUP B	
SUBJECT	PRE TEST	POST TEST		PRE TEST	POST TEST
1	5	3		6	3
2	6	4		5	2
3	4	2		4	1
4	3	2		5	1
5	6	5		6	3
6	3	1		3	1
7	5	4		5	2
8	4	3		3	1
9	6	5		4	1
10	3	2		6	2
11	5	3		3	1
12	4	3		5	2
13	3	2		4	1
14	5	4		3	1
15	4	2		5	2

MUSCLE STRENGTH					
	GROUP A			GROUP B	
SUBJECT	PRE TEST	POST TEST		PRE TEST	POST TEST
1	3	4		4	5
2	4	4		3	5
3	3	4		4	5
4	4	5		3	4
5	3	4		4	5
6	4	4		3	4
7	3	3		4	5
8	4	4		3	5
9	3	4		4	5
10	4	4		3	4
11	3	3		4	5
12	3	4		4	5
13	2	3		3	4
14	3	4		4	5
15	4	4		4	5