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LONG TERM EFFECT OF RADIAL NERVE MOBILIZATION ON RANGE OF MOTION AND FUNCTION IN COMPUTER USERS WITH LATERAL ELBOW PAIN

[1]Dr. Trilok Chand Mahajan, [2]Dr. Dhruv Taneja and [3]Dr. Manoj Kumar Mathur

[1]MPT(Musculoskeletal & Sports), Chief Physiotherapist Spine care and Ortho Care Hospital, Bangalore, Karnataka, India 560023
[2]MPT(Musculoskeletal & Sports), Assist Professor, Department of Physiotherapy, Maharaj Vinayak Global University, Jaipur, India
[3]MPT(Musculoskeletal Disorders). Assist professor, Dept of Physiotherapy, Maharaja Vinayak Global University, Jaipur Physiotherapy College, Jaipur Rajasthan, India

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ABSTRACT

Background: Lateral elbow pain is a frequently reported condition in computer professionals. There is little known about the effect of radial nerve mobilization which is used to treat lateral elbow pain and its effect on the functional activities. The purpose of this study was to investigate the long term effect of radial nerve mobilization on functional activities and ROM in computer users with lateral elbow pain.
Objective: To determine the long term effect of radial nerve mobilization on range of motion and functions in computer professionals with lateral elbow pain.
Method: This study was carried out with 30 subjects, who had lateral elbow pain. Group A (n =15) had received radial nerve mobilization along with conventional therapy. Group B (n =15) was treated with conventional therapy alone. Outcome measures were used Goniometer for ROM and PSFS for functions. All patients received ten treatment sessions initially. After that they were advised to do unsupervised home exercises for six months with a follow up in every two weeks.
Result: In group A the ROM score improved which was statistically significant ($p < 0.05$). In group B the ROM score improved but it was statistically not significant ($p > 0.05$). In group A and group B the PSFS score improved which was statistically significant ($p < 0.05$). But while comparing the scores in between groups there was no significant difference ($p > 0.05$).
Conclusion: There was no significant difference in between the groups in improvement in ROM and PSFS score. Hence according to this study radial nerve mobilization and conventional therapy both are having similar effects on ROM and PSFS score in management of lateral elbow pain in computer professionals.

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INTRODUCTION

Computers have become an indispensible part of modern life, being used in every aspect of life. Technological advancement has ushered in a new genre of occupational health problem, The occupational health problems is slowly awakening to this group of modern occupational diseases, which are slowly taking its roots among the information technology (IT) professionals.

***Corresponding author: Dr. Trilok Chand Mahajan,**
MPT(Musculoskeletal & Sports), Chief Physiotherapist Spine care and Ortho Care Hospital, Bangalore, Karnataka, India 560023

These problems if ignored can prove debilitating and can cause crippling injuries. It can also influence the performance of a student and hence in all the society also has to bear the cost. Upper limb pain and dysfunction are frequent complaints associated with computer work. Physical findings in computer operators suggest3 that at specific anatomic locations with narrow passages nerve trunks may be compressed, tethered or fixed by surrounding structures. Accordingly, a rational preventive approach would aim to maintain nerve-mobility at these locations. This may be accomplished by influencing gradients of tissue pressure in order to improve capillary blood

flow and venous return in nerves4,5 and by re-establishing muscle balance. Lateral elbow pain is one of the most common musculoskeletal problems reported by computer professionals and has been attributed to several causes8-13. For example, in a detailed examination of injured workers who were predominantly computer users, 33% were identified as having lateral epicondylosis7. The patho-anatomic mechanisms behind symptoms of lateral elbow pain are unknown, but local vascular abnormalities14, thermographic changes15 and minor nerve entrapment16-18 have been investigated. Nerves move in relation to their surrounding connective tissues19-20. Entrapment of a nerve can restrict nerve movement and can cause ischemia, pain, inflammation, axonal degeneration, vascular compromise, leading abnormal tension in the nerve called "adverse mechanical tension"21-23. Injured or inflamed peripheral nerves usually have increased sensitivity to mechanical loading24 Peripheral nerves are susceptible to mechanical compression, friction, and repeated tension25. 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. These chemical agents are capable of directly stimulating the nociceptors found within the connective tissue layers of the nerve26. 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 nerve27-31. In addition, chemicals released from non-neural tissues are capable of mediating an inflammatory response, stimulating nociceptors within the connective tissue of nerves28.

Lateral elbow pain in some cases is related to compression of the radial nerve at the radial tunnel[32-33]. Nerve tension testing, which causes mechanical tension on a nerve is expected to increase pain from the nerve34. 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 pain35. David Butler described nerve tension testing positions and mobilization techniques for the nerves of the upper extremity36. Lateral elbow pain is also related to lateral epicondylitis or tennis elbow. The recent studies have demonstrated the presence of neuropeptides, substance P and calcitonin related gene peptide (CRG) in sensory nerve fibers supplying ECRB which could imply the possibility of neurogenic sensitization as an additional source of pain. Injury can also occur in those who carry out repetitive one sided movement in their job eg.- electrician, carpenters, knitting, gardening, needle work etc. Any activity that requires repetitive wrist movement, excessive constant gripping or squeezing can cause lateral elbow pain. Lateral epicondylitis is largely self limiting and symptoms seem to resolve between 6 and 24 months in most of the patients. The treatment outcomes for most lateral epicondylitis cases is favourable and numerous authorities have indicated that lateral epicondylitis will normally respond to conservative treatment modalities. Techniques that restore the mobility of a nerve that has restricted longitudinal movement are often called "neural mobilization techniques"22-23. 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 function37. Based on this premise for this intervention one might expect improved mobility of the nerve and visceral structures following neural mobilization.

MATERIALS AND METHODS

This experimental study was conducted on total of 30 subjects who were having lateral elbow pain from bangalore based on the inclusion and exclusion criteria and they were divided into 2 group randomly by chit method after informed consent was obtained. GROUP A – Experimental group (n=15), GROUP B – Control group (n= 15). Experimental group (Group A) was treated by radial nerve mobilization along with conventional therapy (elbow brace, stretching and ROM exercises). Treatment was continued for up to 10 days. Reassessment of outcome measure was done after the treatment session and a comparison was made. Subjects were advised to do active radial nerve mobilization in between the working hours at least once. After finishing the 10 days session of treatment, follow up examinations were taken every 2 weeks interval for up to 6 months. Mobilization technique- The participants were positioned in a supine lying position. The physiotherapist assumed a standing position. The shoulder girdle was depressed, elbow extended, arm internally rotated, wrist, thumb and fingers were flexed. These movements stressed the radial nerve, and then shoulder depression was maintained with elbow flexion and wrist extension. The wrist and fingers were fixed prior to the elbow extension test that was performed gently, extending the elbow for approximately 2 seconds just into the range where the participant felt only the tension but no pain and then flexing the elbow. Three sets of 6 to 8 oscillations were performed for a single session. ROM was re-assessed to ascertain change.

Control Group (Group B) was treated by conventional therapy alone (elbow brace, stretching and ROM exercises). Treatment was continued for up to 10 days. Reassessment of outcome measure was done after the treatment session and a comparison was made. Subjects were advised to do simple stretching exercises. After finishing the 10 days session of treatment, follow up examinations were taken every 2 weeks interval for up to 6 months. Outcome measures were used Goniometer for ROM and PSFS(Patient specific functional scale) for functions. All patients received ten treatment sessions initially. After that they were advised to do unsupervised home exercises for six months with a follow up in every two weeks.

Data Analysis

- Data analysis performed by SPSS (version 17) for windows. α value will be set as 0.05.
- Descriptive statistics performed to find out mean, range, standard deviation for demographic variable and outcome variable.
- Chi-square test performed to find out the gender difference among both groups.Unpaired t-test used to find out the significant difference among demographic variables such as age.
- Mann Whitney U test used to find out significant differences in between groups and to compare for PSFS.
- Wilcoxon test used to find out significant difference within groups for PSFS.
- Paired t-test is used to find out significant difference within groups for ROM.

RESULTS

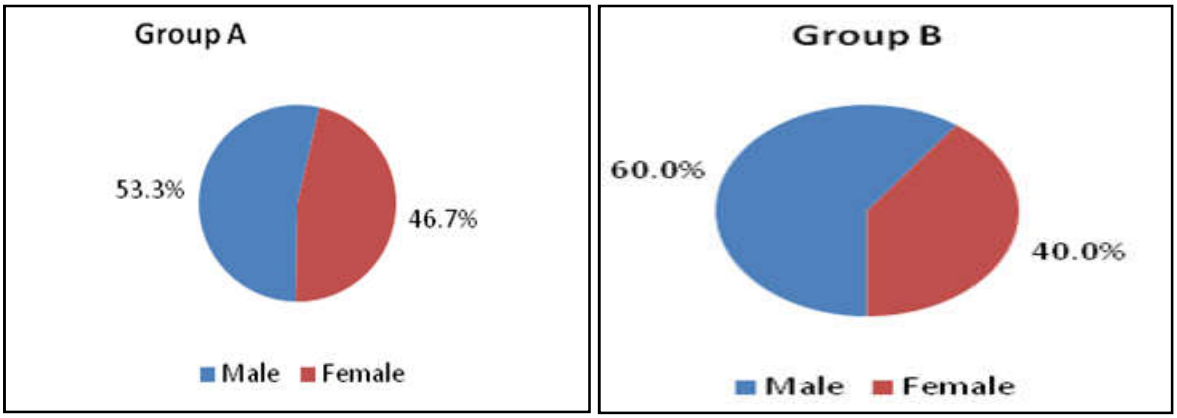
The table shows the proportion of computer professionals with lateral elbow pain according to gender. In group -A, the computer users administered with radial nerve mobilization and conventional therapy 8 (53.3%) of them were males and 7 (46.7%) of them were females. In group-B, the computer users administered with conventional therapy, 9 (60.0%) were males and 6 (40.0%) were females. There is no variation in between the groups according to gender and it was not significant (χ^2=0.136, df=1) at 5% level ie., p > 0.05. It evidenced the baseline characteristic of gender is homogeneous in both the groups.

The above table-3 shows the outcomes of ROM and patient specific functional scale (PSFS) among the computer users with lateral elbow pain in group-A. In pre test, the restricted elbow extension ROM was ranging within 0 – 15 with mean 4.00 with SD 4.71. But in post test, the restricted elbow extension ROM was ranging within 0-10 degrees with mean 1.00 with SD 2.80. The parametric test for comparison of dependent outcomes, the paired t-test was carried out and it was found to be significant at p=0.023 (p<0.05). Regarding the outcome measure of patient specific functional scale (PSFS) was ranging within 2.4 -7.2 with mean 4.87 with SD 1.36 in pre test. But, in post test it was ranged within 4.5 – 9.4 with mean 7.13 with SD 1.60.

Table 1. Distribution of computer professionals with lateral elbow pain according to gender in both groups

Sno	Gender	Group	
		Group-A Experimental	Group-B Control
1	Male	8 (53.3%)	9 (60.0 %)
2	Female	7 (46.7%)	6 (40.0%)
		Chi-Square value=0.136, df=1, p=0.713,NS	

NS-Not significant. ie.,p>0.05.



In Group 'A'. **In Group 'B'.**

Graph 1. Gender Distribution

Table 2. Range, mean and SD of age among computer users with lateral elbow pain in both the groups

Sno	Variable	Experimental		Control		Unpaired t-test
		Range	Mean ± SD	Range	Mean ± SD	
1	Age in years	24-44	32.60±6.76	28-43	34.13±5.12	t=1.04, p=0.307, NS

NS-Not significant. ie.,p>0.05.

Table 3. Range, mean and SD of elbow ROM(extension) and patient specific functional scale(PSFS) in group-A

Sno	Outcome measures	Radial nerve mobilization with conventional therapy				Test value	p-value
		Pre test Range	Mean ±SD	Post test Range	Mean ±SD		
1	Extension ROM	0-15 (15)	4.00 ± 4.71	0-10 (10)	1.00 ± 2.80	Paired t-test=2.55*	P=0.023
2	Patient specific functional scale	2.4-7.2 (4.8)	4.87±1.36	4.5 – 9.4 (4.9)	7.13±1.60	Wilcoxon Test Z = -2.86*	p=0.004*

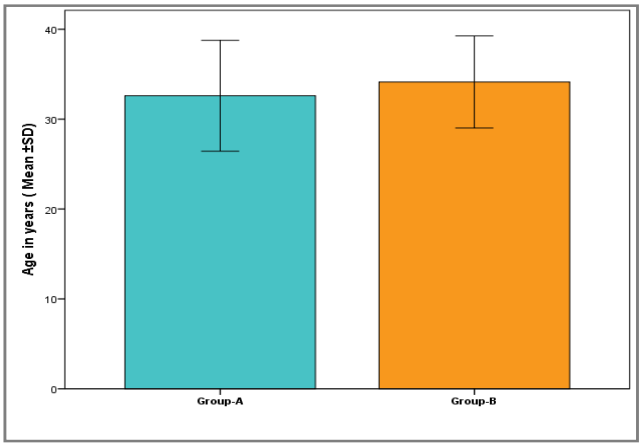
Note; * denotes –Significant (p<0.05).

The table 2 presents the outcomes of age in years of the computer users with lateral elbow pain in both the groups. In group-A the subjects were ranging within the age of 24-44 with mean 32.60 and SD of 6.76. In group-B the subjects were ranging within the age of 28-43with mean 34.13 and SD of 5.12. The unpaired t-test was carried to compare the means, which was found to be not significant at 5% level (ie., p>0.05). It revealed that the baselinecharacteristic of age was similar in both the groups.

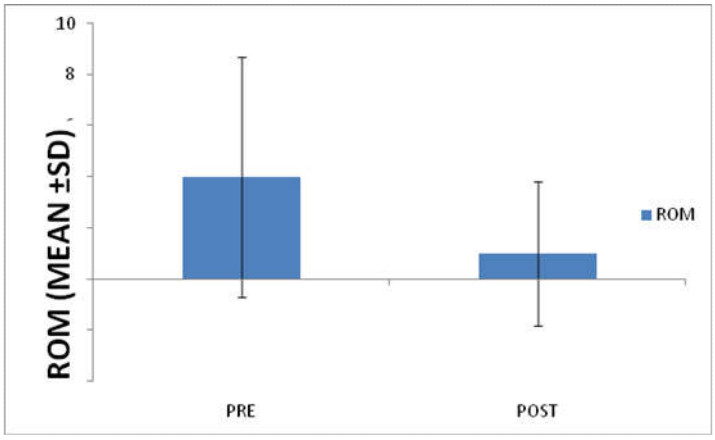
The non -parametric test for comparison of dependent outcomes, the Wilcoxon test was carried out and it was found to be significant at p=0.004 (p<0.05). It evidenced the significant improvement in extension ROM and patient specific functional scale scores and hence the radial nerve mobilization with conventional therapy was effective in improving the range of motion and functions of computer professionals with lateral elbow pain.

The above table-3 shows the outcomes of improvement in elbow extension ROM and patient specific functional scale (PSFS) among the computer users with lateral elbow pain in group-B. In pre test, the restricted elbow extension ROM was ranging within 0 – 10 degrees with mean 3.33 with SD 4.08. But in post test, the extension ROM was also ranging within 0 – 10 with mean 2.00 with SD 3.16. The parametric test for comparison of dependent outcomes, the paired t-test was carried out and it was not found to be significant at p=0.104 (p>0.05). Regarding the outcome measure of patient specific functional scale (PSFS) was ranging within 3.8 – 7.1 with mean 5.24 with SD 1.20 in pre test. But, in post test it was ranged within 4-9 with mean 6.13 with SD 1.44. The non - parametric test for comparison of dependent outcomes, the Wilcoxon test was carried out and it was found to be significant at p=0.038 (p<0.05). It evidenced that there was no significant improvement in elbow extension ROM but there was significant improvement in patient specific functional scale scores and hence the conventional therapy was effective in improving functions in computer users with lateral elbow pain but conventional therapy was ineffective to improve ROM in computer users with lateral elbow pain.

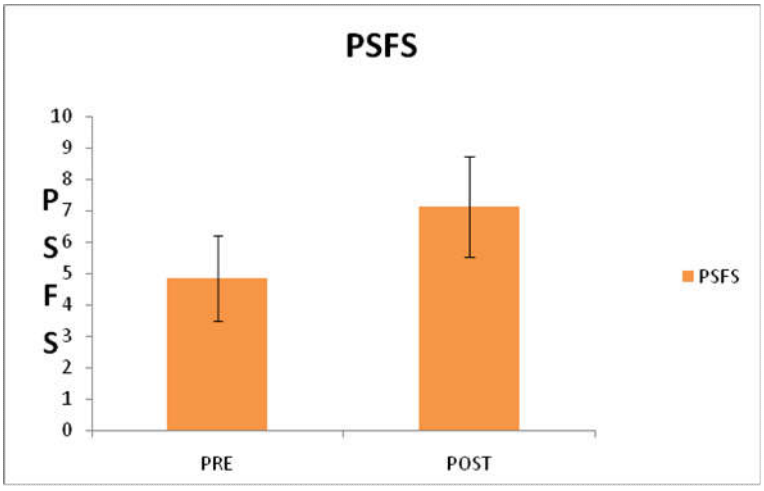
The above table-3 shows the outcomes of improvement in elbow extension ROM and patient specific functional scale (PSFS) among the computer users with lateral elbow pain in group-B. In pre test, the restricted elbow extension ROM was ranging within 0 – 10 degrees with mean 3.33 with SD 4.08. But in post test, the extension ROM was also ranging within 0 – 10 with mean 2.00 with SD 3.16. The parametric test for comparison of dependent outcomes, the paired t-test was carried out and it was not found to be significant at p=0.104 (p>0.05). Regarding the outcome measure of patient specific functional scale (PSFS) was ranging within 3.8 – 7.1 with mean 5.24 with SD 1.20 in pre test. But, in post test it was ranged within 4-9 with mean 6.13 with SD 1.44. The non - parametric test for comparison of dependent outcomes, the Wilcoxon test was carried out and it was found to be significant at p=0.038 (p<0.05). It evidenced that there was no significant improvement in elbow extension ROM but there was significant improvement in patient specific functional scale scores and hence the conventional therapy was effective in improving functions in computer users with lateral elbow pain but conventional therapy was ineffective to improve ROM in computer users with lateral elbow pain.



Graph 3. Age Distribution in Group 'A' and Group 'B'



Graph-4 – Pre and Post Interventional ROM in Group 'A'.

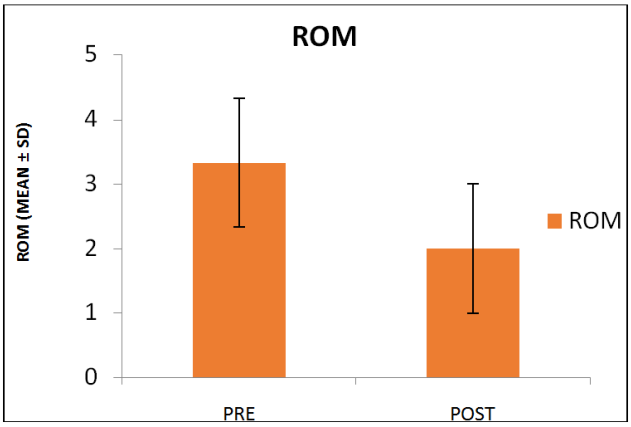


Graph – 5 – Pre and Post Interventional PSFS Score (Mean ± SD) In Group 'A'.

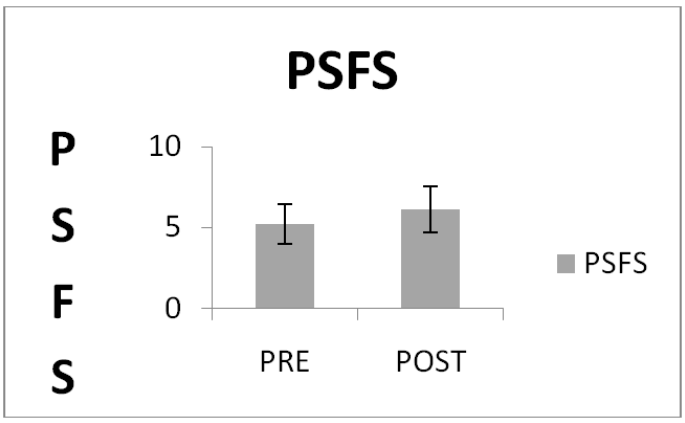
Table 4. Range, mean and SD of elbow ROM (extension) and patient specific functional scale (PSFS) in group-B

Sno	Outcome measures	Conventional therapy				Test value	p-value
		Pre test		Post test			
		Range	Mean ±SD	Range	Mean ±SD		
1	Extension ROM	0-10 (10)	3.33 ± 4.08	0-10 (10)	2.00 ± 3.16	Paired t-test=1.739	p= 0.104
2	Patient specific functional scale	3.8 – 7.1 (3.3)	5.24 ±1.20	4 – 9 (5)	6.13 ± 1.44	Wilcoxon Test Z = -2.07	p = 0.038*

Note; * denotes –Significant (p<0.05).



Graph. 6. Pre and Post Interventional ROM in Group 'B'

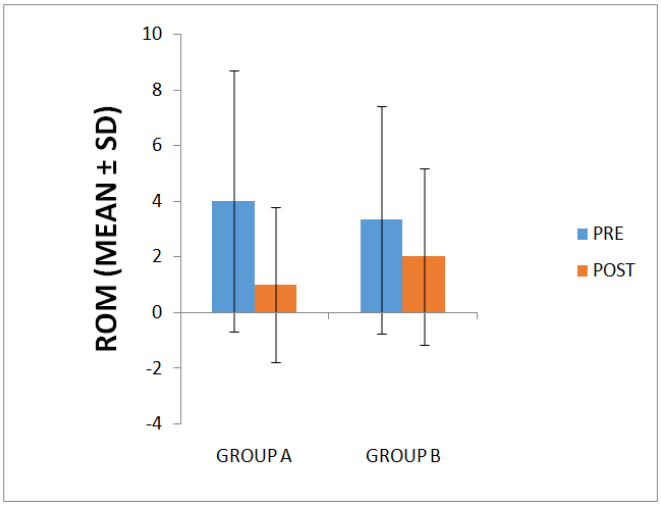


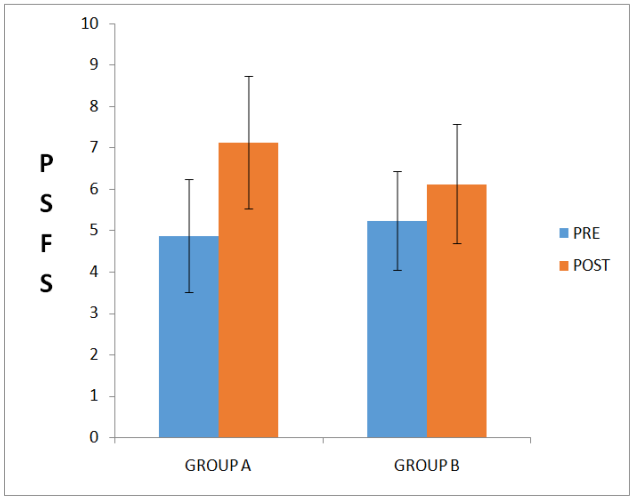
Graph 7. Pre and Post Interventional PSFS Score (Mean ± SD) in Group 'B'.

Table 5. Comparison of pre and post test extension ROM and PSFS among the computer users with elbow pain in between the two groups

Sno	Outcome measures	Pre test		Post test	
		Group-A Mean ±SD	Group-B Mean ±SD	Group-A Mean ±SD	Group-B Mean ±SD
1	Extension ROM	4.00 ± 4.70	3.33 ± 4.08	1.00± 2.80	2.00 ± 3.16
2	PSFS	4.87±1.36	5.24 ±1.20	7.13±1.60	6.13 ± 1.44
Between group comparison		➢ ROM: t=0.4169, p=0.6799, NS ➢ PSFS :z= -0.539 p=0.5892, NS		➢ ROM: t=0.917, p=0.367, NS ➢ PSFS z=1.617, p=0.105, NS	

S-denotes significant (p<0.05); t-unpaired t-test, z-Mann-Whitney U test , NS – not significant (p>0.05)





Graph- 8 & Graph 9 – Comparison of ROM & PSFSA Between Group 'A' and Group 'B'

The above table-5 presents the outcomes of between group comparison of improved elbow extension ROM and PSFS among the computer user with lateral elbow pain in between the two groups. The pre test scores of extension ROM was 4.00 ± 4.70 in group-A and 3.33 ± 4.08 in group-B were more or less same and it was not significant at p = 0.6799 (p>0.05) . Similarly the PSFS 4.87 ± 1.36 in group-A and 5.24 ±1.20 in group B were not statistically significant (p>0.05). It evidenced that initially before the intervention the computer user with lateral elbow pain in both the groups were similar range of motion and function. While comparison of post test scores of improved extension ROM 1.00 ± 2.80 in group-A is also more or less similar to improved extension ROM 2.00 ± 3.16 in group-B and it was also statistically not significant. Similarly, while comparison of post test PSFS 7.13±1.60 in group-A, more or less same to the PSFS 6.13 ± 1.44 in group-B and it was statistically not significant. It evidenced that there was no significant difference in outcomes of both the treatment strategies in improving the ROM and functions in computer users with lateral elbow pain.

Interpretation of Result

In group A the mean ROM score improved significantly ($p < 0.05$). In group B the mean ROM score improved but it was statistically not significant ($p > 0.05$). In group A and B the mean PSFS score improved significantly ($p < 0.05$). But while comparison between the groups the difference in improvement in ROM and PSFS score was not significant ($p > 0.05$). although, radial nerve mobilization and conventional therapy are having more or less same effects in improvement in ROM and functional outcomes in computer professionals with lateral elbow pain but radial nerve mobilization is more effective for improving ROM and functional status of patients and can be

used in management of lateral elbow pain in computer professionals.

DISCUSSION

Computer users may be at risk of lateral elbow pain. It is theorized that adverse mechanical tension can arise in the radial nerve with sustained keyboarding due to sustained static work of the elbow extensor muscles. Neural mobilization has been suggested as a potential treatment. Objective of this study was to find out the long term effect of radial nerve mobilization on elbow ROM and functions in computer professionals with lateral elbow pain. The baseline demographic variables were homogeneous in nature in both the groups. In group A there were 8 male subjects and 7 female subjects. Similarly, in group B there were 9 male subjects and 6 female subjects. The mean age in group A, was 32.60 with SD of 6.76 and in group B the mean age was 34.13 with SD of 5.12. All the patients in both the groups were able to complete the study. According to result of study, in group A the mean ROM improved significantly ($p < 0.05$). Possible explanation for the improved ROM for the subject in group A could be because of longitudinal elongation of the nerve bed[55]. According to another study done by Sharma. S, Balthillaya.G, Rao.R, Mani.R, neural slider and tensioners are both effective in increasing hamstring flexibility as an adjunct to static hamstring stretching when compared to static stretching alone by decreasing neural mechanosensitivity due to neural mobilization[56]. Neural mobilization also improve muscle flexibility by "Sensory theory" proposed by Weppler and Magnusson suggested that muscle flexibility and its response to sudden stretch have more to do with perceptions of stretch and pain than the biomechanical effects of muscle tissue itself[57].Thus improving the ROM. This proposal was supported in a study by Aparicio and colleagues which demonstrated that a suboccipital muscle inhibition technique altered hamstring flexibility when compared to a placebo intervention.

The fact that such a distant technique (suboccipital region) could have an immediate effect on the flexibility in the hamstrings may tend support to the "Sensory theory" limiting flexibility of the posterior thigh structures. It seems reasonable to attribute the observed increase in hamstring tissue flexibility following the suboccipital muscle inhibition technique to changes in the subject"s perception of stretch or pain[58]. In group A, the mean PSFS score have showed significant improvement. This is accordance to the study by Jason M. Beneciuk, Mark D. Bishop, Steven Z.Goerge neural mobilization (tensioning technique) had an immediate hypoalgesic effect on C-fiber mediated pain perception (temporal summation). Enhanced temporal summation of C fiber mediated pain has been identified in patients with painful conditions. Therefore, inhibition of temporal summation is believed to have therapeutic value. Inhibition of temporal summation with neural mobilization, suggesting a hypoalgesic mechanism for neuromobilization tensioning techniques which is associated with improvement in functional status of subjects[59]. According to Cleland, Hunt and Palmer, if the etiology of symptoms originates from the intra-neural edema, the changes in intra-neural pressure that accompany the neural mobilization may be sufficient to disperse the edema, thus alleviating the hypoxia and reducing the associated symptoms.. In addition, there is the hypothesis that nerve movement within pain-free variations can help to reduce nerve compression, friction and tension, therefore decreasing its mechano-sensitivity.[60] In the group B the mean pre ROM improved but it was not statistically significant ($p > 0.05$). Improvement in ROM was because of the analgesic effect of stretching exercises. Muscle stretching increases the pain threshold.[61] Increased ROM following stretching may be due to analgesic effects. In a study, subjects stretched until they reached their pain threshold.[62] On a second stretch, more force was needed to reach the pain threshold and there was increased pain-free ROM. But the result was not statistically significant , because, however the physiological effects of stretches may contribute to reducing discomfort and pain but , if other measures are not in place to remediate their causes, stretches may suppress awareness of risks, resulting in more debilitating injuries. If inadequately performed, stretches may also cause or aggravate injuries. Careful analysis and stretching program design are required before implementing stretches.[63] Similarly in group B the mean PSFS score increased which was statistically significant ($p < 0.05$). This is because of elbow orthosis produces a counter force effect to reduce the load on common extensor tendon and thereby reducing pain. According to another study done by Stonecipher and Catlin, the armband (tenis elbow brace) disperses stresses generated by muscle contraction, thereby reducing painful inhibition and allowing the subject to contract more forcefully. The arm band may also facilitate muscle contraction by sensory skin stimulation and/or muscle belly pressure.[64]This would explain improvement in functional status of subjects with lateral elbow pain.While comparing the both the groups there was no statistically significant difference in ROM and PSFS score ($p > 0.05$). Both groups were showing improvement in ROM by different mechanism. In the group A mean ROM was 1.00 ± 2.80 and group B mean ROM was 2.00 ± 3.16, which was not statistically significant ($p > 0.05$). Improvement in ROM in group A was because of decreased neural mechanosensitivity[60] and elongation of nerve bed[55]. In group B improvement in ROM is because of increased pain threshold[61,62]. However improvement in ROM with radial nerve mobilization was noted better than conventional therapy alone. Similarly, in group A mean PSFS score was 7.13 ± 1.60 and in group B mean PSFS was 6.13 ± 1.44, which were not statistically significant ($p > 0.05$). This was showing that both the groups were having improvement in functional status because radial nerve mobilization and stretching exercises with elbow brace both were producing analgesic effects[59,,60,64] which results in better functional outcomes.

Conclusion

This study is aimed to find out the long term effects of radial nerve mobilization on ROM and functional outcomes in computer users with lateral elbow pain. Group A showed improvement in both ROM and functional status of patients (PSFS) However Group B showed improvement in functional status of patients (PSFS) and not much difference in ROM. There is no significant difference in between the groups in ROM and PSFS scores.

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