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A Study to Compare the Effectiveness of Selective Lower Trapezius Strengthening and Conventional Scapular Stabilization Exercises on Pain, Range of Motion, and Disability among Patients with Chronic Neck Pain

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ABSTRACT

Background- Chronic neck pain is a common musculoskeletal disorder associated with impaired scapular stability and weakness of the scapular muscles. Scapular stabilization exercises and selective lower trapezius strengthening have both demonstrated effective in reducing neck pain and improving functional outcomes. However, limited evidence is available comparing these two exercise approaches.

Objective- This study aimed to compare the effectiveness of selective lower trapezius strengthening and conventional scapular stabilization exercises on pain, cervical range of motion, and disability among patients with chronic neck pain.

Methods- A total of 132 patients were screened, of whom 68 both male and female met the eligibility criteria. Participants were allocated into three groups conveniently : Group A received conventional treatment (hot pack, TENS, and neck isometric exercises) Group B received conventional treatment selective lower trapezius strengthening and Group C received conventional treatment conventional scapular stabilization exercises. Twenty-three participants dropped out from the study leaving 45 participants (15 per group) for final analysis. Outcomes were assessed using NPRS for pain, cervical range of motion measured with a universal goniometer, and NDI on pre treatment on Day 1 and post- treatment 7th and 15th day. Treatment was administered five days per week for three weeks.

Results- Within-group analysis demonstrated significant improvements in NPRS, cervical range of motion and NDI scores in all three groups. Between-group analysis demonstrated greater improvement in pain and cervical range of motion in both experimental groups compared with the control group and no significant differences were observed between the two experimental groups. Disability was improved similarly in all the groups.

Conclusion- The addition of selective lower trapezius strengthening and conventional scapular stabilization exercises to conventional physiotherapy was more effective than conventional physiotherapy alone in reducing pain and improving cervical range of motion among patients with chronic neck pain. However, no significant difference was observed between the two experimental interventions indicating comparable effectiveness. Disability was improved similarly in all the groups

Keywords Chronic Neck Pain; Lower Trapezius Strengthening; Scapular Stabilization Exercises; Neck Isometric Exercises; Cervical Range of Motion; Neck Disability Index; Pain; Physiotherapy

INTRODUCTION

Chronic neck pain is a common musculoskeletal disorder characterized by pain and discomfort in the posterior cervical region persisting for more than three months.[1,2] It is a major contributor to disability worldwide, affecting functional activities, quality of life, and work performance.[3,4] Epidemiological studies report a high prevalence of neck pain among office workers and individuals exposed to prolonged postural stress, particularly due to excessive computer and mobile phone use.[5,6] Poor posture, muscular imbalance, repetitive strain, and altered cervical biomechanics are considered major contributing factors in the development of chronic neck pain.[7,8]

The cervical spine functions in close association with the scapular region through the kinetic chain proper scapular stability depends on the coordinated activation of the trapezius and serratus anterior muscles.[9,10] In individuals with chronic neck pain, weakness of the lower trapezius and serratus anterior along with overactivity of the upper trapezius and levator scapulae, may disturb scapular mechanics and increase stress on the cervical spine.[8,11,12] Such muscular imbalance may lead to altered scapular positioning, reduced cervical range of motion, pain, and functional disability.[8,11,13]

Conservative management remains the primary treatment like TENS, thermotherapy and with exercise therapy demonstrating significant benefits.[14,15] Studies have demonstrated that scapular stabilization exercises improve neuromuscular control by decreasing load on joints[17], reduce pain [16,17,18] disability [16,18], and enhance cervical range of motion[16,17,18]. Selective strengthening of the lower trapezius has also been found to improve scapular stability, reduce pain, and enhance functional outcomes in individuals with chronic neck pain.[19,20]

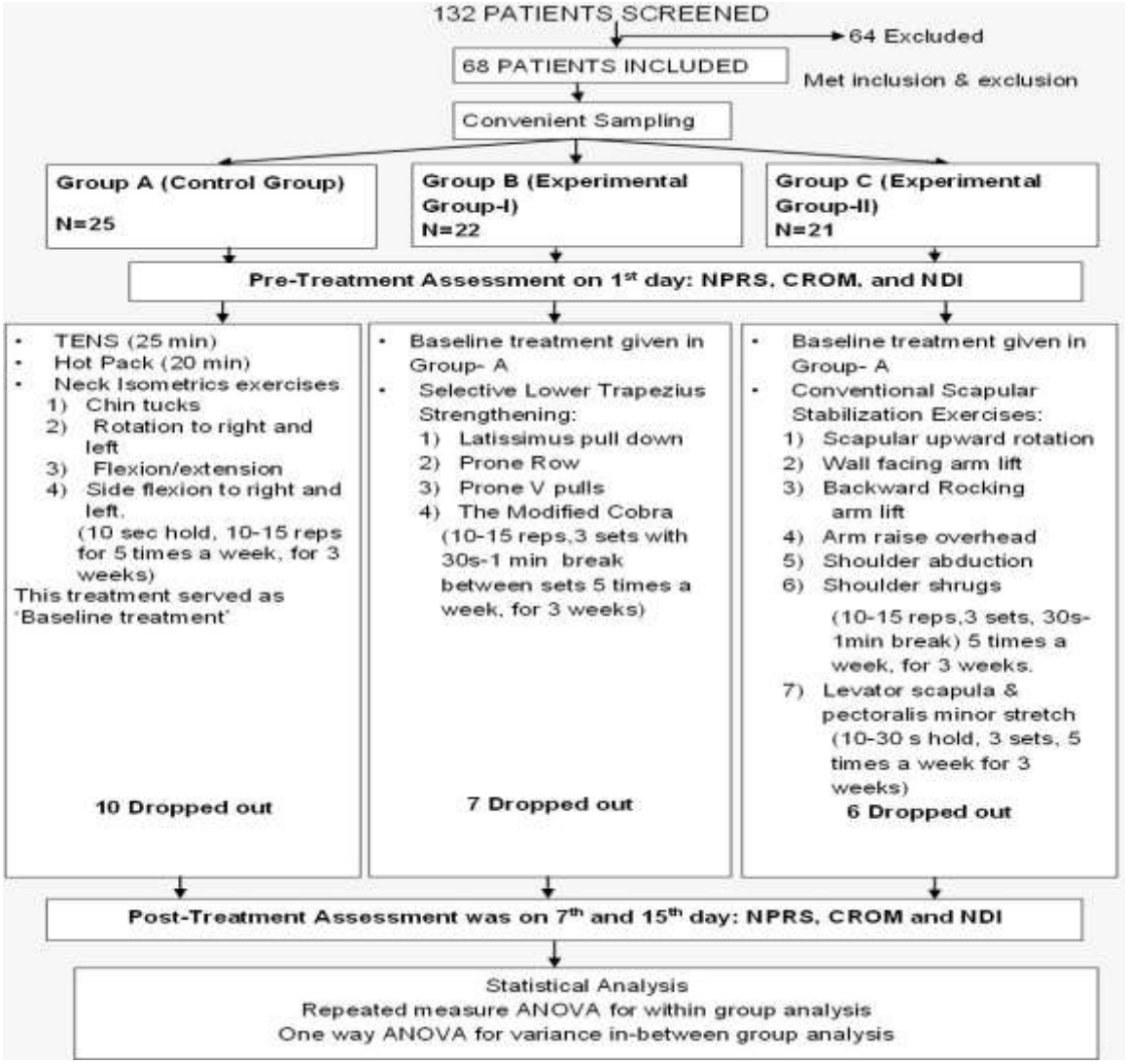
Since both interventions target scapular muscle dysfunction, comparing their effectiveness may help identify an appropriate rehabilitation approach for patients with chronic neck pain. Therefore, the present study was conducted to compare the effectiveness of selective lower trapezius strengthening and conventional scapular stabilization exercises on pain, cervical range of motion, and disability among patients with chronic neck pain.

Methodology

Participant- Both male and female patient between the age 20–50 years with chronic neck pain lasting more than 3 months with moderate pain intensity (NPRS 3–8), who provided written informed consent and were willing to cooperative & participate in the study were included. Patients with a history of cervical spine surgery, pre- diagnosed malignancy, upper-limb radiculopathy, vascular involvement, skin infections or lesions on the neck/upper back, neurological disorders causing impaired sensation or diminished upper-limb reflexes were excluded.

Procedure- A total of 132 patients presenting with neck pain were screened as per inclusion & exclusion criteria out of which 68 patients were allocated into three groups. Group A (control group) received baseline treatment comprising transcutaneous electrical nerve stimulation (TENS), hot pack and neck isometric exercises. Group B received selective lower trapezius strengthening exercises in addition to the baseline treatment and Group C received conventional scapular stabilization exercises in addition to the baseline treatment. During the study period, 23 participants dropped -out from the study and only 45 participants completed the study with 15 participants in each group. Data was recorded on pre- treatment

1st day, post- treatment 7th day and 15th day using NPRS for pain, cervical range of motion (CROM) and neck disability by NDI.



Protocol

All participants received conventional physiotherapy treatment consisting of TENS, hot pack application, and neck isometric exercises. TENS was administered at a frequency of 80 Hz for 25 minutes and a moist hot pack was applied to the cervical region for 20 minutes. Neck isometric exercises included chin tucks and isometric exercises for cervical flexors, extensors, bilateral rotators and lateral flexors, 3 sets of 10 repetitions with 10 second hold for each muscle group.

Participants in Group B performed four selective lower trapezius strengthening exercises, in addition to baseline treatment including i.e latissimus pull-downs (fig.A), prone rows (fig.B), prone V-raises (fig.C), and modified prone cobra (fig.D) exercises. The exercises were performed for 3 sets of 10– 15 repetitions, with progressive resistance using therabands during the second and third weeks of intervention. Participants in Group C in addition to baseline treatment performed 3 sets of 10–15 repetitions of six conventional scapular stabilization exercises, including scapular upward rotation(fig.A), wall-facing arm lifts (fig.B), backward arm lifts (fig.C), overhead arm raises(fig.D), shoulder abduction

in the scapular plane (fig.E) and shoulder shrugs (fig.F). Exercises were performed with progressive resistance according to the participant's 1-repetition maximum (1RM)-based strength. In group-C three repetitions of stretching of muscle levator scapulae(fig.G) and pectoralis minor(fig.H) maintained for 15–30 seconds .

FIGURES

Figure 1- Selective lower trapezius exercises
A. Latissimus pull-downs B. Prone rows C. Prone V-raises D. Modified prone cobra

Figure 2 - Scapular stabilization exercises
A. scapular upward rotation **B.** wall-facing arm lifts **C.** backward arm lifts **D.** overhead arm raises **E.** shoulder abduction in the scapular plane **F.** shoulder shrugs **G.** levator scapulae **H**. pectoralis minor

RESULTS

Data was analyzed using repeated measure ANOVA for within group analysis and one-way ANOVA for between group analysis for NPRS, CROM and NDI. Within-group analysis demonstrated significant improvements in NPRS, cervical range of motion and NDI scores in all Groups over a period of 3 weeks. (Table - 1).

One way ANOVA analysis demonstrated significant difference between groups for NPRS postintervention. Further post-hoc analysis showed between Group B (NPRS) was more improved than Group A significantly pain (p-value-0.021 and mean change-1.00), in between Group A& C , Group C showed better improvement (p-value- 0.033 and mean change -0.933) and no difference were observed between group B & C. Similarly for CROM significant difference between groups. Further analysis between A& B showed significant improvement in Group B in regards with flexion (p-value 0.002 and mean change-7.480), right rotation (p-value 0.012 and mean change- 6.82) left rotation (pvalue 0.006 and mean change-7.360) in comparison with Group A. While no significant differences were found between Groups B & C and between Group A& C. And there was no significant difference between groups in NDI.

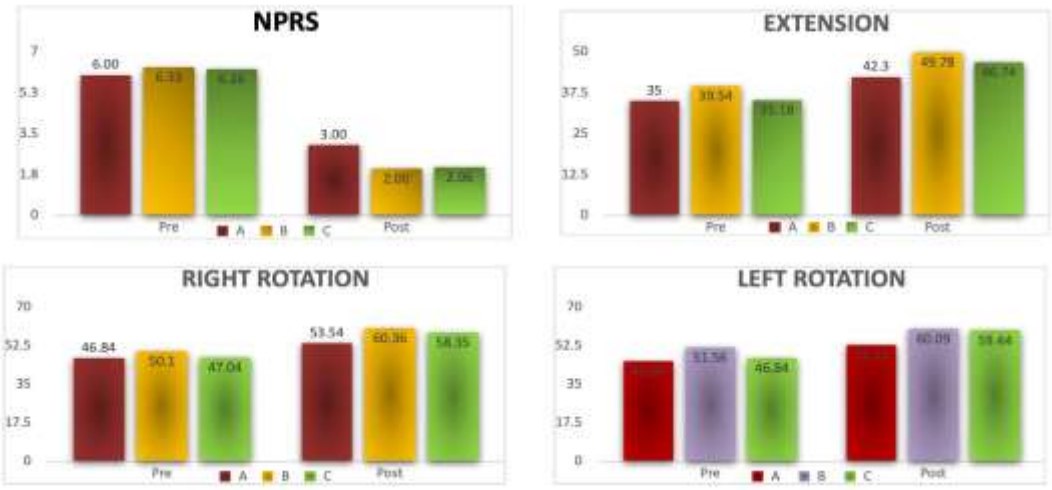


Figure 3. Graphs of pre and post treatment between groups of significant parameters.

Table 1. Mean ±SD, F-values, and p-values for NPRS, cervical range of motion, and NDI at Day 1, Day 7, and Day 15

	Group A	Group B	Group C	F-value between group	p-value between group	F-value/p-value within group		
						Group A	Group B	Group C
NPRS								
Day 1	6±1.06	6.33±0.89	6.26±1.16	0.424	0.657	90.11/0.00	202.712/0.0	153.537/0.0
Day 7	4.46±0.99	4.06+0.88	4.00±0.92	1.095	0.344			
Day 15	3±0.75	2.00+0.84	2.06±1.16	5.332	0.009			
CROM F								

	Group A	Group B	Group C	F-value between group	p-value between group	F-value/p-value within group		
						Group A	Group B	Group C
Day 1	31.40±7.26	31.36±4.08	29.80±3.70	0.448	0.642	20.31/0.00	52.87/0.00	57.82/0.00
Day 7	33.84±6.56	36.40+5.25	35.05±5.24	0.755	0.476			
Day 15	36.64±6.66	41.90+5.33	39.54±5.38	3.072	0.057			
CROME								
Day 1	35.00±5.22	39.54±9.14	35.18±6.24	1.982	0.151	27.28/0.00	34.72/0.00	49.296/0.00
Day 7	38.22±4.20	44.46+8.08	40.88±6.62	3.482	0.040			
Day 15	42.30±3.57	49.78+5.48	46.74±6.38	7.618	0.002			
CROMRR								
Day 1	46.84±4.89	50.10±6.89	47.04±7.20	1.220	0.305	39.33/0.00	33.65/0.00	60.26 /0.00
Day 7	50.08±5.41	54.59+7.47	52.58±8.17	1.515	0.232			
Day 15	53.54±5.99	60.36+4.85	58.35±6.81	5.214	0.009			
CROMRL								
Day 1	45.35±5.59	51.56+6.85	46.84±8.72	3.067	0.057	17.94/0.00	37.91/0.00	25.41/0.00
Day 7	48.78±5.98	55.60+5.81	52.79±5.36	5.356	0.008			
Day 15	52.73±7.10	60.09+3.60	59.44±6.53	7.031	0.002			
NDI								
Day 1	28.62±12.33	26.54±8.66	34.46±10.94	2.182	0.125	86.27/0.00	99.55/0.00	111.86 /0.00
Day 7	19.16±9.20	14.40+6.93	20.33±6.70	2.499	0.094			
Day 15	13.38±7.65	8.40+5.71	12.29±6.00	2.426	0.101			

DISCUSSION

All three groups demonstrated a significant reduction in neck pain following the intervention. Group A demonstrated a 50% improvement in pain with baseline treatment (hot pack, TENS, and neck isometric exercises). Similar findings have been reported in studies by Gulseen[22] (62%) and Shin HJ[23] (39%) using TENS, thermotherapy, and neck stabilization exercises.[21,22,23] The reduction in pain observed in the present study may be attributed to increased circulation and muscle relaxation associated with hot pack application, pain modulation through the gate-control mechanism of TENS, and improved neuromuscular control achieved through isometric exercises.[24,25,26]

Group B also demonstrated 68.41% improvement in pain significantly with baseline treatment with selective lower trapezius execises. These findings are consistent with previous studies by Cho IK[19] (63%) investigating selective lower trapezius strengthening exercises. The improvement may be associated with enhanced scapulothoracic stability, correction of muscular imbalance, reduction in upper trapezius overactivity, and improved neuromuscular coordination as described by previous studies[27,28,29] Strengthening exercises performed using therabands could have also stimulate proprioceptive mechanisms and contribute to pain reduction.[30] Group C also demonstrated a marked reduction in pain with a 67.01% reduction in pain significantly with baseline treatment and conventional scapular stabilization exercises which is inconsistent with previous studies Ozdemier et.al (62%)[31] , a higher improvement (79%) was observed by Javdaneh N et.al[17] and Celenay S et.al reported only 40% reduction[32] with scapular stabilization exercises. The reduction in pain could be associated with improved scapular alignment, enhanced muscular control, and decreased abnormal mechanical stress on the cervical spine.[33]

Significant differences were observed in NPRS on Day 15 for between group analysis using One-way ANOVA demonstrating significantly greater improvement in both the experimental groups (Groups B & C) compared with control group (Group A), whereas no significant difference was observed between experimental groups (Groups B & C). Similar findings have been reported by Cho et al. and Parmar et al., who observed greater pain reduction following lower trapezius strengthening and scapular stabilization exercises when combined with conventional physiotherapy.[19,35] the additive effect of exercises in the experimental groups could have contributed reduction in pain in comparison to control group.

All three groups demonstrated significant improvement cervical ranges. Improvement in the control group in cervical flexion 16.68%, extension 20.85%, right rotation 14.3%, and left rotation 16.27% following treatment in similar way like Chung S[41] showed 16.22% in flexion-extension and 24.6% in cervical rotation. This may be attributed to reduced pain, improved tissue extensibility, decreased muscle spasm, and enhanced muscular performance following conventional physiotherapy. Heat therapy may improve soft-tissue extensibility and circulation, while isometric exercises could have improve muscle strength, coordination, and cervical stability.[36,37] Group B demonstrated greater improvement in cervical range of motion compared with the control group, particularly in extension 25.91% and rotational movements right rotation 20.47% and left rotation 16.53% . These findings are supported by previous studies Kim K et.al[20] upto 10.07% increased flexion ROM, 14.16% extension, 14.16% right rotation and 14.74% and 12%, 4.8%, 16.4% and 15.4% in flexion, extension, right rotation and left rotation by Song M et.al[27] investigating lower trapezius strengthening exercises. Improvement in cervical mobility may be associated with restoration of normal scapular biomechanics, reduction in upper trapezius overactivity, improved scapular positioning, and enhanced scapulothoracic stability.[20,27] along with the beneficial effect of baseline treatment. Group C also demonstrated significant improvement in cervical range of motion like flexion 32.67%, extension 32.87%, right rotation 24.04% and left rotation by 26.88% consistent with

Celenay ST et al.[32] investigating scapular stabilization exercises 14.72% in flexion, 15.58% in extension, 12.67% in right rotation, and 8.33% in left rotation. Improved scapular control and neuromuscular coordination could have reduced cervical strain and facilitated improved movement patterns around the cervical and scapular regions.18,32,33,38

Between-group analysis demonstrated no significant differences in cervical flexion among the three groups. However, significant differences were observed for extension, right rotation, and left rotation on Day 15, with Groups B and C demonstrating greater improvement than Group A. No significant differences were observed between Groups B and C, indicating comparable effectiveness of the two experimental interventions in improving cervical mobility. Similar improvements in cervical range of motion following lower trapezius strengthening and scapular stabilization exercises have been reported by Song et al. and other authors.[27,38]

All three groups demonstrated a significant reduction in disability scores following 3 weeks of intervention. Improvement in Group A 15.24% could have associated with reduced pain, increased cervical range of motion, improved muscular strength, and enhanced cervical stability achieved through conventional physiotherapy.[15,21,25,39] similar studies of Gulsen reported 17.21% reduced disability with similar treatment comprising Hotpack, TENS, US, and neck isometrics exercises.[22] Group B demonstrated greater reduction in disability by 18.14% which is consistent with previous studies investigating lower trapezius strengthening exercises demonstrating 12.54% by Kim KY[20] and 10.73% reduction in disability by Song MJ.[27] Improvement in disability may be associated with reduced pain, improved cervical mobility, and enhanced scapular muscle function along with the beneficial effect of baseline treatment. Group C also demonstrated a significant reduction in disability scores by 22.16% consistent with previous studies in which they use TENS, superficial heat, ultrasound and scapular stabilization exercises and reported 15.8% reduction in disability.[31] a lower percentage of 9% was reported by Olofin O[40] Reduction in disability may have occurred due to improved cervical function and decreased pain following scapular stabilization training[18,39] along with the beneficial effect of baseline treatment.

However, between-group analysis demonstrated no significant differences in NDI scores throughout the study period, indicating that all three interventions were similarly effective in improving disability associated with chronic neck pain. Similar findings were reported by Parmar et al., who observed no significant additional improvement in disability when scapular stabilization exercises were combined with conventional treatment.[35]

CLINICAL IMPLICATIONS-

The findings of the present study suggest that incorporating scapularfocused strengthening exercises into conventional physiotherapy may provide additional benefits in the management of chronic neck pain. Both selective lower trapezius strengthening and conventional scapular stabilization exercises may be considered as adjunctive exercise approaches for improving pain and selected aspects of cervical mobility.

CONCLUSION

All three interventions demonstrated significant improvements in neck pain, cervical range of motion, and disability following the intervention period.Experimental groups which received selective lower trapezius strengthening and conventional scapular stabilization exercises respectively, demonstrated greater reductions in pain compared with control group which received baseline treatment physiotherapy consisting of hot pack, TENS, and neck isometric exercises. Both the experimental group were equally

benefitted in terms of pain.In regard to cervical extension, bilateral rotation ROM experimental group which received selective trapezius exercises showed better improvement than control group. No significant differences were observed between Groups B & C and group A& C for cervical range of motion. For cervical flexion and NDI no significant differences in between-group were observed suggesting that all three interventions were similarly effective for these outcomes.

Therefore, the authors suggests for addition of selective lower trapezius strengthening and conventional scapular stabilization exercises to conventional physiotherapy for more beneficial effect than conventional physiotherapy alone for reducing pain and improving selected components of cervical range of motion in patients with chronic neck pain.

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