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Effectiveness of Deep Cervical Flexor Strengthening on Balance and Postural Stability in Elderly Individuals with Cervical Proprioceptive Decline: A Quasi

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Abstract

Background: Neck pain is a common health problem that negatively affects quality of life across age groups, and most people experience it at some point in their lives. Neck pain significantly impacts family life, community participation, healthcare costs, and occupational performance, making it an increasingly prevalent health concern.

Objective: To assess the effectiveness of deep cervical flexor strengthening on balance and postural stability in elderly individuals with cervical proprioceptive decline.

Design: Pretest and post-test two group experimental study design.

Participants: Thirty subjects aged 55 – 65 years with cervical proprioceptive decline were selected using a purposive sampling technique. The sampling technique was assigned. One group with 30 subjects received conventional physiotherapy with deep cervical flexor strengthening for balance and postural stability in the elderly.

Intervention: Strengthening and stretching exercises were given to the deep cervical flexor patient for 60 minutes per session, three times a week.

Outcome Measure: Time up and Go test was used to measure balance before and after treatment. The craniocervical flexion test was used to measure postural stability before and after treatment.

Result: Patients showed significant improvement with deep cervical flexor strengthening exercises.

Conclusion: It can be concluded that deep cervical flexor strengthening exercises are a promising intervention for improving balance and posture in older adults with cervical proprioceptive decline.

key words: Cervical proprioceptive decline, Deep cervical flexor strengthening exercises, Balance. Posture.

INTRODUCTION

Neck pain is one of the most common musculoskeletal disorders worldwide, affecting approximately 67% of individuals during their lifetime and becoming increasingly prevalent with advancing age [1]. Age-related degenerative changes in the cervical spine, along with impaired proprioception and muscle weakness, contribute to postural abnormalities such as forward head posture (FHP), reduced balance, and

functional limitations [3,8,14,17]. Deep cervical flexor (DCF) muscles, including the longus colli and longus capitis, play a crucial role in maintaining cervical posture and segmental stability [11,12]. Dysfunction or reduced activation of these muscles has been associated with neck pain, impaired neuromuscular control, and decreased postural stability [2,7,13].

Targeted DCF strengthening exercises have been shown to improve cervical muscle activation, reduce pain, enhance postural alignment, and improve balance [4,5,6,9,10,16]. Functional assessment tools such as the Craniovertebral Angle (CVA) and the Timed Up and Go (TUG) test are reliable measures for evaluating cervical posture, mobility, and balance in elderly individuals [8,14]. However, evidence regarding the effectiveness of DCF strengthening on balance and postural stability in elderly individuals with cervical proprioceptive decline remains limited. Therefore, this study aimed to evaluate the effectiveness of DCF strengthening exercises on balance and postural stability in this population.

METHODOLOGY

The study was approved by the institute ethics committee, IEC- RIPT/DT/21/4536. An experimental study was conducted over six months at the Outpatient Department of Revathi Medical Center, Tirupur. Thirty participants (55–65 years) were recruited using purposive sampling. Eligible participants underwent Deep Cervical Flexor (DCF) strengthening exercises for 30 minutes per session over four weeks. Posture and balance were assessed before and after the intervention using the Craniovertebral Angle (CVA) and Timed Up and Go (TUG) test. Individuals with severe cervical trauma, major postural deformities, temporomandibular disorders, systemic muscular diseases, or other exclusion criteria were not included. Written informed consent was obtained from all participants before enrollment.

INTERVENTION

Participants received Deep Cervical Flexor (DCF) strengthening exercises and scapular retraction exercises for 30 minutes per session over four weeks. DCF strengthening was performed in the supine position using the cranio-cervical chin tuck maneuver, followed by a slight head lift while maintaining cervical alignment. Each contraction was held for 2–8 seconds. with adequate rest between repetitions. Scapular retraction exercises were performed in standing using a Thera Band anchored at chest height. Participants pulled the band backward with the elbows close to the body while squeezing the shoulder blades together and avoiding shoulder elevation. All exercises were supervised by a physiotherapist and progressed according to participant tolerance.

OUTCOME MEASURES

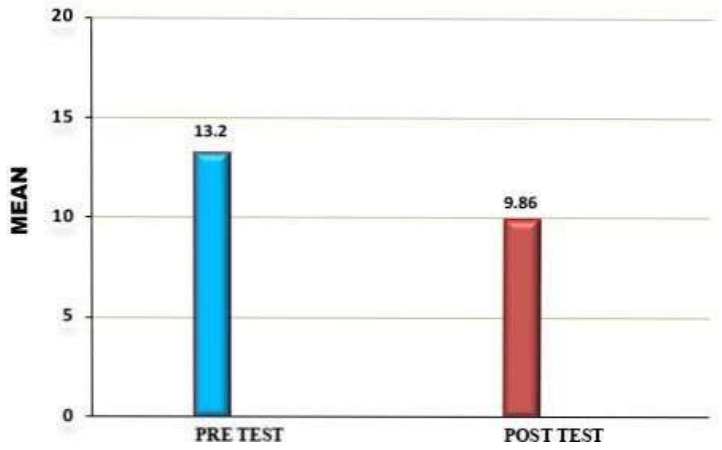
Outcome measures were assessed at baseline and after four weeks of intervention. Cervical posture was evaluated using the Craniovertebral Angle (CVA), a valid and reliable measure of Forward Head Posture (FHP), determined from lateral photographs by measuring the angle between a horizontal line through the C7 vertebra and a line connecting C7 to the tragus of the ear. Balance and functional mobility were assessed using the Timed Up and Go (TUG) test, a simple and reliable clinical tool used to evaluate mobility, dynamic balance, gait performance, and fall risk.

STATISTICAL ANALYSIS

The collected data were tabulated and analyzed using both descriptive and inferential statistics. All the parameters were assessed using the Statistical Package for Social Sciences (SPSS) version 24, with a significance level of p-value less than 0.05 and a 95% confidence interval set for all analyses. The Shapiro-Wilk test was used to determine the normality of the data. In this study, the Shapiro-Wilk test showed that the data were normally distributed for the dependent variable at P >0.05. Hence, a parametric test was adopted. Paired t–test was adopted to find the statistical difference within the groups.

Table 1: Comparison Of Timed Up and Go Test Score within Group (Pre-test and Post-test Values).

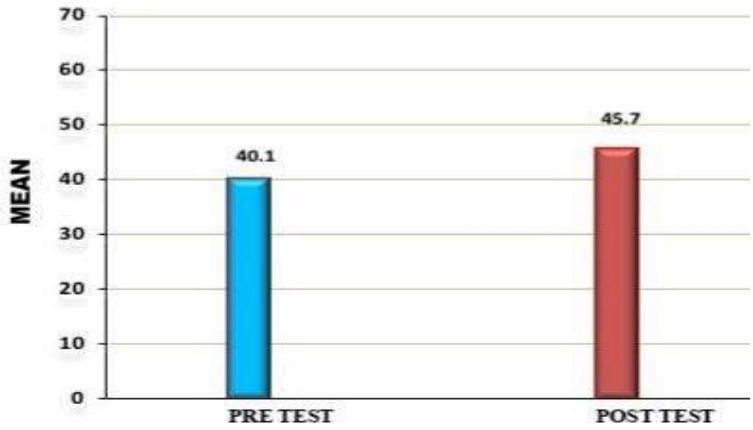
TEST	PRE TEST		POST TEST		t - test	df	Sig
	MEAN	S.D	MEAN	S.D			
TUGT	13.20	1.82	9.86	1.65	13.54	29	.001***



Graph 1: Comparison Of Timed Up and Go Test Score within Group (Pre-test and Post-test Values).

Table 2: Comparison of Craniovertebral Angle within Group (Pre-test and Post-test Values).

TEST	PRE TEST		POST TEST		t - test	df	Sig
	MEAN	S.D	MEAN	S.D			
CVA	45.51	1.56	47.19	1.51	-12.74	29	.001***



Graph 2: Comparison of Craniovertebral Angle within Group (Pre-test and Post-test Values).

RESULTS:

On comparing mean values of Timed Up and Go Test Score between Pretest 13.20 ± 1.82 and Posttest 9.86 ± 1.65 within Experimental Group, it shows there is a highly significant difference between Pretest and Posttest mean values, with a t value of 13.54 at $P \leq 0.001$. The post-test values have shown improvement when compared with the pre-test. Hence, the null hypothesis is rejected. On comparing mean values of Craniovertebral Angle Score between pre-test 45.51 ± 1.56 and post-test 47.19 ± 1.51 within the Experimental Group, it shows there is a highly significant difference between pre-test and post-test mean values, with a t value shows 12.74 at $P \leq 0.001$. The post-test values have shown improvement when compared with the pre-test; hence, the null hypothesis is rejected.

DISCUSSION

The present study demonstrated that Deep Cervical Flexor (DCF) strengthening exercises significantly improved posture and balance in elderly individuals with cervical proprioceptive decline. The deep cervical flexors, particularly the longus capitis and longus colli, play a key role in cervical stability, postural control, and proprioceptive function. Age-related degeneration and forward head posture reduce the efficiency of these muscles, leading to impaired balance and functional mobility. The observed improvements in Craniovertebral Angle (CVA) and Timed Up and Go (TUG) scores suggest that DCF strengthening enhanced cervical sensorimotor control and postural stability. The addition of scapular retraction exercises may have further improved cervical alignment by strengthening the scapular stabilizers

and promoting optimal posture. These findings are consistent with previous studies by Treleaven, Kibler et al., and Ruhe et al., which reported that cervical muscle training improves proprioception, balance, and postural control in older adults. Overall, the combined intervention appears to be an effective approach for improving functional balance and postural stability in elderly individuals with cervical proprioceptive decline.

CONCLUSION

The findings of this study demonstrate that Deep Cervical Flexor (DCF) strengthening exercises significantly improved posture and balance in elderly individuals with cervical proprioceptive decline. Following four weeks of intervention, participants showed significant improvements in Craniovertebral Angle (CVA) and Timed Up and Go (TUG) test scores. Therefore, DCF strengthening exercises can be considered an effective and safe intervention for enhancing postural stability and functional balance in this population.

LIMITATIONS AND RECOMMENDATIONS

This study was limited by its small sample size, single-center setting, quasi-experimental design, and short intervention period, which may restrict the generalizability and long- term interpretation of the findings. In addition, participant adherence outside supervised sessions and potential confounding factors were not objectively monitored. Future studies should employ randomized controlled trials with larger, multicenter samples and longer follow-up periods to confirm the long-term effectiveness of Deep Cervical Flexor (DCF) strengthening. Further research should also compare DCF strengthening with other rehabilitation approaches and determine the optimal exercise dosage for improving balance and postural stability in elderly individuals with cervical proprioceptive decline.

INFORMED CONSENT

Written informed consent was obtained from all participants before enrollment in the study. Participants were informed about the study objectives, procedures, potential benefits, and their right to withdraw from the study at any time without any consequences.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest regarding the publication of this study.

AUTHORS' CONTRIBUTION

Vinayagamoorthi R: Conceptualization, methodology, participant recruitment, data collection, manuscript preparation, and manuscript revision.

Dr. Darrius B J A C: Study conception and design, supervision, methodology, validation, interpretation of results, critical revision of the manuscript, and final approval of the manuscript.

Dr. P Bright Alwin Victor: Administrative support, overall academic guidance, and final approval of the manuscript.

DATA AVAILABILITY STATEMENT

The datasets generated and analysed during the current study are available from the corresponding author upon reasonable request.

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