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Effect of deep cervical flexor training and scapular stabilization exercises on forward head posture in school going children by the end of 4 weeks- A comparative study

Sarah Sayed[1], Sonal Patole[1], Sucheta Golhar[2]
[1] P.E.S. Modern College of Physiotherapy, Shivajinagar, Pune, Maharashtra, India
[2] Professor, P.E.S. Modern College of Physiotherapy, Shivajinagar, Pune, Maharashtra, India

Abstract
Background: The prevalence of forward head posture among school children's is 63% [1]
The frequent forward flexion causes changes in the cervical spine, curvature, supporting ligaments, tendons, and musculature, as well as the bony segments, commonly causing postural change and pain felt in the neck and other associated areas [3].
It causes compensatory actions, such as rounded shoulders, and abnormal muscle activity can be observed.
The change in posture can lead to a spatial change between the spine and the line of gravity, causing an overload on muscles and connective tissues [6]. It causes poor interactions between parts of the body making appropriate joint movements difficult to achieve [1]
Objective: To compare the effect of deep cervical flexor training and scapular stabilization exercises on forward head posture in school children's by the end of 4 weeks using craniovertebral angle
Methodology: Ethical clearance was obtained from the institution.
Informed consent was taken from the participants. Participants were screened according to inclusion and exclusion criteria. Purpose of study and procedure was explained to participants.
Participants were divided into two group by odd and even method. Sit and Reach test was taken prior and at the end of intervention.
Group A: Deep Cervical Flexor training
Group B: Scapular Stabilization Exercises
Result: Total 60 students of age group 12-16 years, with Forward head posture volunteered to participate in the study and have completed the program. Pre and post analysis was done within group using paired t test which showed significant results and unpaired test was done inter-group which also showed significant results and p value, mean and mean of difference was calculated. Results from the statistical analysis were tabulated and presented in graphical formats for better understanding and easier interpretations.
Conclusion: In this study, pre-treatment assessment and post treatment assessment showed significant results on outcome measures, craniovertebral angle, Both the Deep cervical flexor training and Scapular stabilization exercises are individually effective in increasing the flexibility, but, a comparison between the groups produced a significant difference of 1.22 which shows that Deep cervical traing has a clinical and statistical advantage than Scapular stabilization exersices for improving Forward head posture in school childrens

Keywords: forward head posture, deep cervical flexor training, scapular stabilization exercises

Introduction

- The prevalence of forward head posture among school children's is 63% [1]
- The frequent forward flexion in children causes changes in the cervical spine, curvature, supporting ligaments, tendons, and musculature, as well as the bony segments, commonly causing postural change and pain felt in the neck and other associated areas [3].
- Forward head posture causes weakening and lengthening in few muscles and shortening and tightening in few muscles [4].
- Weakened trapezius and rhomboid muscles allow the shoulder blades to tilt forward, further contributing to forward head posture [5].
- Forward head posture can lead to functional movement limitations, fatigue, pain in the head and neck area and causes overload on muscles and connective tissue around the cervical spine [6]
- A previous study reported that approximately 70% of patients with forward head posture exhibit decline in muscular strength and endurance of the deep cervical flexor muscles [7].

- The Deep cervical flexor muscles consist of the longus colli and longus capitis muscles, which play important roles in maintaining posture control and stability of the neck. In the comparison of muscular activation levels, the deep longus colli and longus capitis muscles were less activated than the superficial sternocleidomastoid muscle. Therefore, maintaining the muscular strength of the deep cervical flexor muscles is critical for controlling neck posture and stability [7].
- Scapular stabilization exercise is effective in the early rehabilitation and the balance of both sides of the trapezius with the movement and couple motion of the scapula [10].

Materials and Methodology
- Assent and Consent form
- Record sheet
- Floor mat
- ImageJ software
- Mobile phone camera
- Measuring tape
- Pen
- Paper
- Laptop

- Sample Size:60
- Study design: Comparative Study
- Sampling Method: Purposive sampling
- Study Population: School children
- Study Duration: 6 months
- Intervention Duration:4 weeks
- Study Setting: Various schools in and around the city will be visited

Criteria

The students were included in this study on the basis of following criteria
- Students willing to participate in the study
- Age:12-16 years [1]
- Both male and female students [12]
- Students having craniovertebral angle less than 49.9 degrees [16]
- Students having a minimum of grade 3 IMT of scapular stabilizer muscles
- Students attending school or attending online lectures for a minimum 3 hrs a day for 4 days a week or more

Students were excluded from the study if
- Cervical radiculopathy
- Carpel tunnel syndrome
- Infection or inflammatory arthritis in cervical spine
- Individuals having spinal cord compression
- Individuals having symptoms of Vertebral Artery Insufficiency.
- Any ongoing or previous history of spinal fracture with in last 1 year
- Cervical spine surgery with in last 6 months (19)
- Individuals having spinal instability
- Individuals having congenital, or acquired postural deformity

Procedure
- The study began with presentation to the ethical committee of P.E.S Modern College of Physiotherapy pune-05
- The participants were selected according to the inclusion and exclusion criteria
- Purpose was explained to the participants and written consent and assent will be taken
- Participants were divided into two equal groups by odd and even method
- Craniovertebral angle was taken prior and at the end of intervention (4 weeks)
- Group A received deep cervical flexor training
- Group B received scapular stabilization exercises
- Craniovertebralangle was calculated by the end of 4 weeks and data was be analysed

Group A

The Subjects Undergoing Deep Cervical Flexor Training
- An exercise protocol for a 4-week duration under the command of a therapist was followed
- The subjects were commanded to lie in crook lying positions
- Lock their finger to place their finger below the skull and retract the lower jaw and retract chin as far as possible.

- Subject was told to slightly raise his/her skull a few centimetres.
- Fingers should be touching the cranium but not supporting it.
- Subject was told to respire and hold the position.
- Subject was told to move out the chin.
- Stop exercise and restart again.
- Hold this position for 10 sec at the start of the exercise, increasing it by 10 seconds after 2 weeks
- Frequency: 3 days/week on alternate days
- Repetitions: 10 repts
- Rest interval: 2 min
- Sets:3 [15, 21, 8]

Fig 1: Deep cervical flexor training

Group B

The Subjects Undergoing Scapular Stabilization Exercises

- An exercise protocol for a 4 week duration under the command of a therapist was followed
- Subjects were asked to lie in prone lying position
- Subject were asked to lower both arms with thumbs up, make the "I shape" with the arms and raise them
- After this, the subject were asked to reach both arms up to 45 degrees to make a 'Y shape,' and raise both arms
- After this the subject were asked to reach both arms horizontally to make a 'T shape.' and raise both arms
- Lastly, the subject were asked to bent both arms to 90 degrees and horizontally to make a 'W shape.' and raise both arms
- Every activity was maintained for three seconds [10]

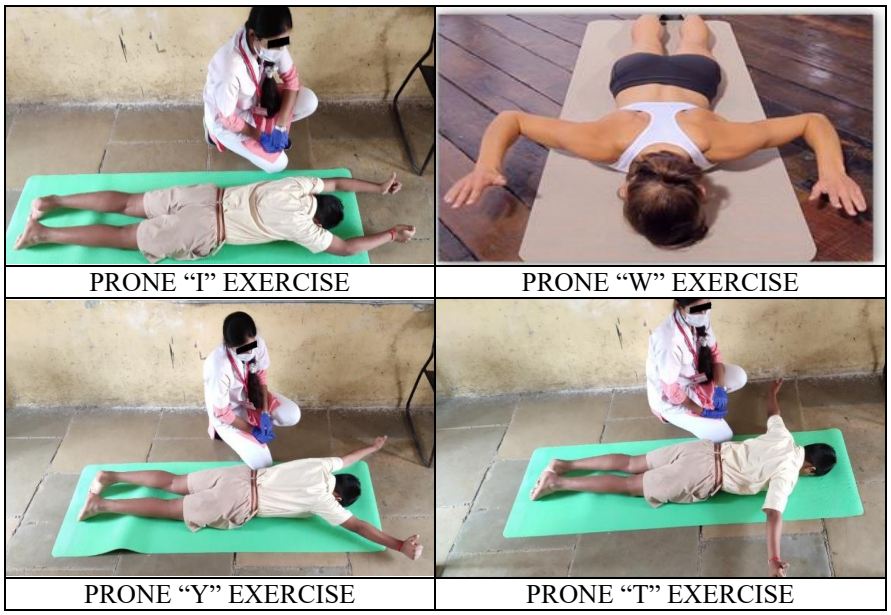

Fig 2: Scapular stabilization exercises

Outcome Measure

Craniovertebral Angle

- The craniovertebral angle is the angle between a horizontal line passing through the C7 spinous process and a line passing through the tragus of the ear and the C7 spinous process.
- Subjects were asked to expose their neck region and a photo from lateral view at a distance of 30cm was taken with a mobile phone camera
- The photo was transferred to the laptop and craniovertebral angel was calculated using imageJ software. A smaller craniovertebral angle indicates a greater degree of forward head positioning with a less than 49.9° defined as forward head posture [1, 13, 14, 16]
- The reliability of imageJ software is 0.976-0.988 [17]

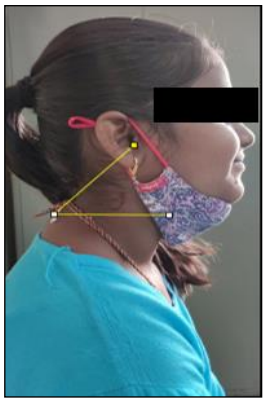

Fig 3: craniovertebral angle

Results and Statistical Analysis

Total 60 students of age group 12-16 years, with Forward head posture volunteered to participate in the study and have completed the program.

Pre and post analysis was done within group using paired t test which showed significant results and unpaired test was done inter-group which also showed significant results and p value, mean and mean of difference was calculated. Results from the statistical analysis were tabulated and presented in graphical formats for better understanding and easier interpretations.

Intra-Group Comparisons

Group A: Deep cervical flexor training

Group B: Scapular stabilization exercises

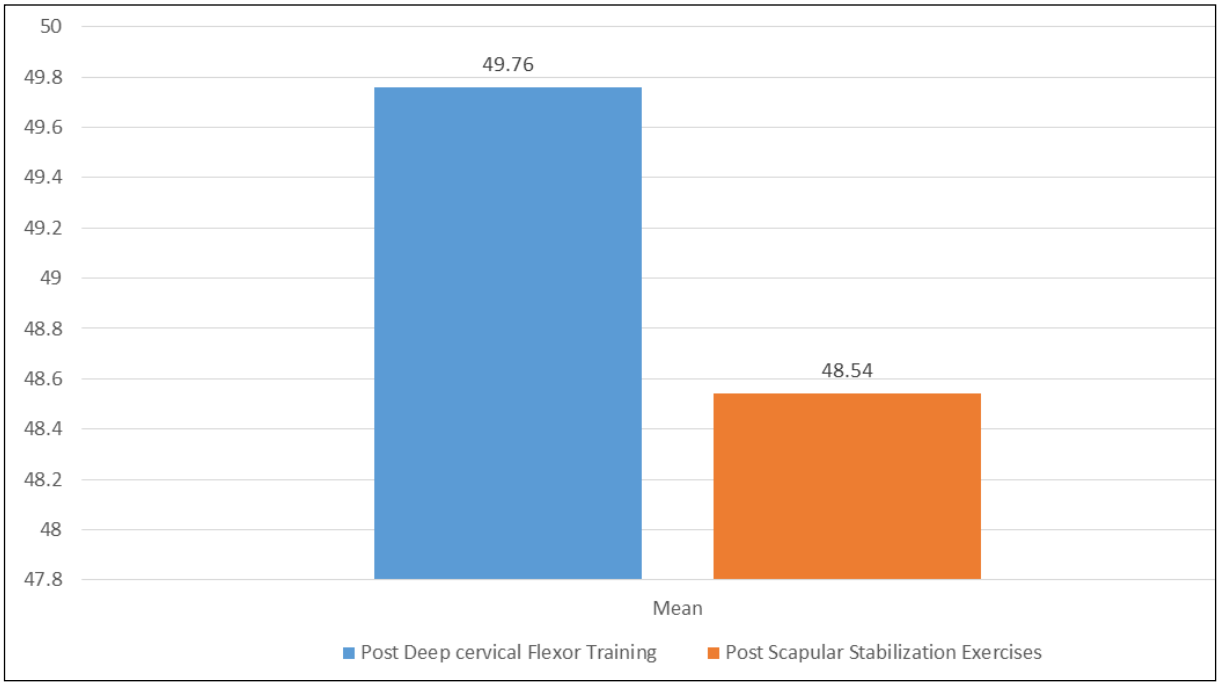

Fig 4: Comparison of Pre and Post values for craniovertebral angle of deep cervical flexor training

Table 1

	Deep Cervical Flexor Training (mean)		P value	T value	Result
Craniovertebral angle	Pre	Post	<0.0001	19.9378	Extremely significant
	46.15	49.76			

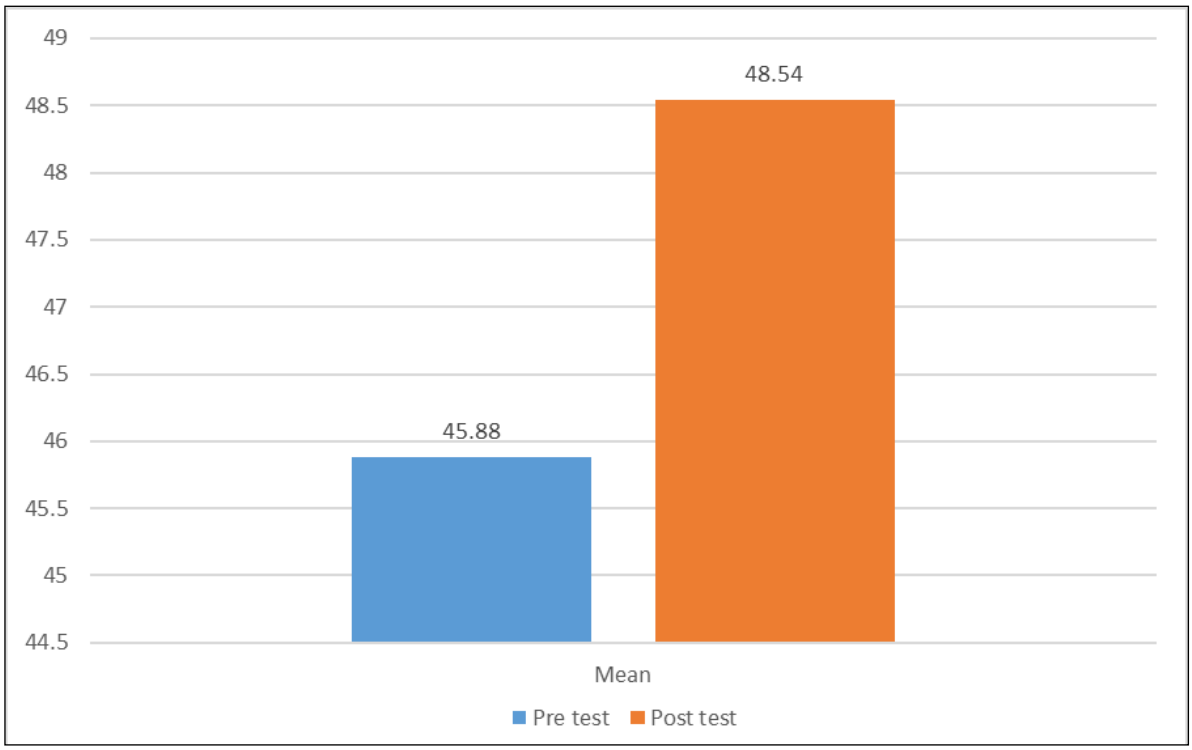

Fig 5: Comparison of Pre and Post values of craniovertebral angle for Scapular stabilization exercises

Table 2

	Scapular Stabilization Exercises (mean)		P value	T value	Result
Craniovertebral angle	Pre	Post	<0.0001	23.6119	Extremely significant
	45.88	48.54			

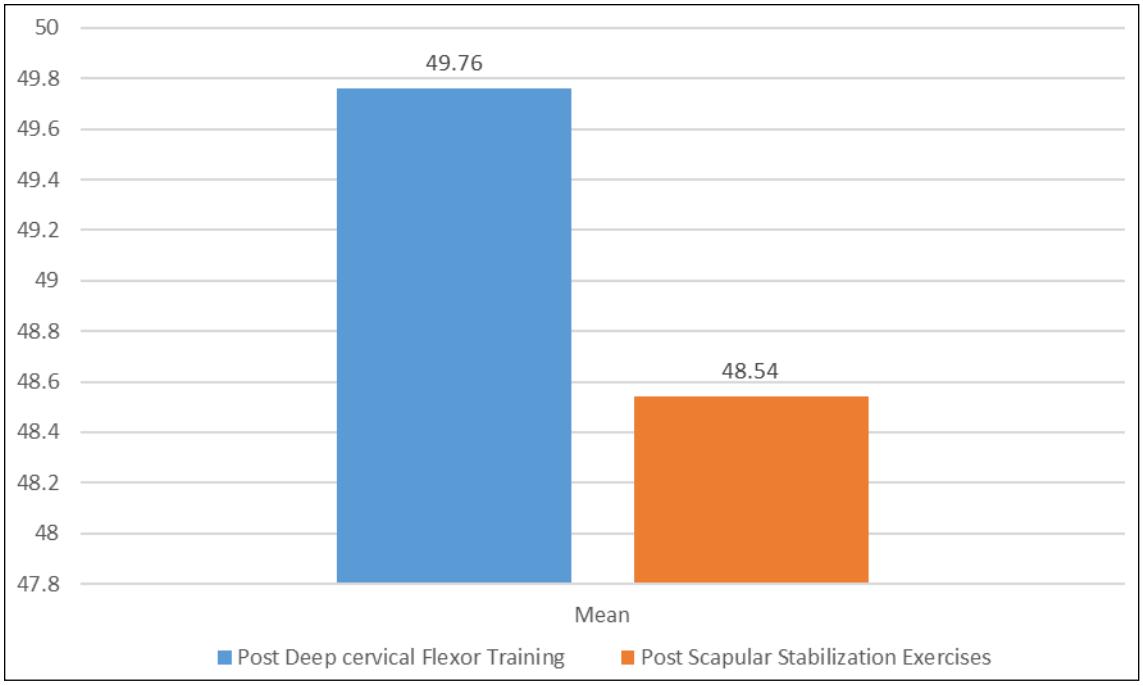

Fig 6: Comparison of Post values of craniovertebral angle of deep cervical flexor training and scapular stabilization exercises

Table 3

	Deep Cervical Flexor Strengthening- Scapular Stabilization Exercises (mean)		P value	T value	Result
Craniovertebral angle	Post Deep Cervical Flexor Training	Post Scapular Stabilization	0.0127	2.5713	Significant
	49.76	48.54			

Discussion

- Forward head posture can lead to functional movement limitations, fatigue, pain in the head and neck area and causes overload on muscles and connective tissue around the cervical spine [6]
- Forward head posture generally results in shortening of cervical extensors such as the, upper trapezius and SCM muscle, and in lengthening and weakening of the cervical flexors. An earlier research has suggested that when performance is impaired, the balance between the stabilizers on the posterior region of the neck and the deep cervical flexor is damaged, resulting in a loss of proper alignment and posture. This loss of alignment can then induce cervical impairment [22].
- This study aimed to compare the effectiveness of deep cervical flexor strengthening and scapular stabilization exercises on forward head in school going children. There were 60 participants selected according to the inclusion and exclusion criteria. The collected data was analysed. As there were two groups, within the groups paired t test were done and Pre and Post values were compared. To compare both the groups, unpaired t test was done.
- The primary outcome of this study was the significant increase in the craniovertebral angle ($p<0.0001$) with results being statistically significant and clinically significant.
- In the present study the group which received deep cervical strengthening also showed a significant improvement in forward head posture which is in accordance with the previous article as Deep cervical flexor muscles have been found to have a significant role in supporting and strengthening of the cervical spine. Craniocervical flexion is the principal action of these muscles. Deep cervical flexor training as a treatment for forward head posture, is based on rationale that it plays major postural function in straightening the cervical lordosis [20, 21].
- Tightness /over activity of upper trapezius causes change in the cervical spine angle resulting in the hyperextension of the upper cervical and flexion of the lower cervical vertebrae causing forward head posture. There is weakness and lenghtening of the middle and lower trapezius
- In the study it was shown that the craniovertebral angle showed a statistically significant increase post intervention for scapular stabilization exercises ($p<0.0001$) which is in accordance to the previous article.
- In the current study it was found that forward head posture significantly improved in both the groups, but Deep Cervical Flexor Training was more effective than Scapular Stabilization Exercise.
- Deep cervical flexor strengthening exercise increases the size of muscle fibres to improve deep anterior neck muscle force. It also stretches the short posterior superior neck muscles. Considering deep cervical flexor strengthening as a stretching-strengthening exercise and scapular stabilization exercises as an effective method to inhibit the overactivity of muscle (i.e., upper trapezius) and to facilitate the muscle with weak activity (i.e., lower trapezius and middle trapezius) for postural control, therefore it may be a possible reason for deep cervical flexor strengthening to be more effective in improving forward head posture among school children [24]

Conclusion

In this study, pre-treatment assessment and post treatment assessment showed significant results on outcome measures, craniovertebral angle, Both the Deep cervical flexor training and Scapular stabilization exercises are individually effective in increasing the flexibility, but, a comparison between the groups produced a significant difference of 1.22 which shows that Deep cervical traing has a clinical and statistical advantage than Scapular stabilization exersices for improving Forward head posture in school childrens

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