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Comparison Between Cervical Proprioception and Flexor Endurance in Asymptomatic Individuals with and Without Forward Head Posture

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ABSTRACT

Background: Cervical proprioception and endurance are important elements to aid in injury prevention, support the functional movement, maintain proper posture, and promote overall health. Enhancing cervical proprioception and strengthening cervical muscles to enhance endurance can help to achieve better stability and mobility, thereby improving overall posture, physical performance, and health
Objective: This study aims to compare cervical proprioception and cervical flexor endurance in students with and without forward head posture.
Materials and Methods: Twenty-four healthy students aged 20 to 24 years participated in the study. The participants were divided into two groups according to their CV angle. If the CV angle was more than 48, then those students were allocated to group A, i.e., neutral head posture (NHP) and if it was less than 48 then, the students were in group B, i.e., forward head posture (FHP). Cervical proprioception was assessed using the head repositioning accuracy test, and cervical muscle endurance was evaluated using the pressure biofeedback for cervical endurance.
Statistical Analysis: The Shapiro-Wilk test was conducted to assess the normality of the data from the cervical proprioception test and cervical muscle endurance. These data were summarized using mean and standard deviation and an Independent T-Test was used to compare proprioception and cervical muscle endurance.
Results: The mean value of cervical flexor endurance is higher in group A (142±15.5) when compared to group B (79±10.6) and cervical proprioception is lower in group A (4.7±1.16) when compared to group B (6.8±2.25). There is a significant difference between cervical proprioception (t== -2.9, p== 0.08) and cervical flexor endurance (t== 3.3, p== 0.03) in asymptomatic college students with and without FHP, indicating that individuals with forward heads have both lower endurance and lower proprioceptive accuracy than those without forward heads.
Conclusion: Cervical flexor endurance is comparatively higher in NHP and proprioceptive measurement is comparatively less in FHP indicating that NHP have better cervical head proprioception and endurance.

Keywords: Body position, Muscle Strength, Neck Muscles, Proprioception.

INTRODUCTION

Forward Head Posture is very common, affecting about 85.5% of the general population, and 53.5% of children and teenagers. Studies show that gender may influence the likelihood of developing FHP. This posture problem isn't just about appearance; it has serious effects on musculoskeletal health. FHP disrupts the balance in the neck muscles, increasing their activity and restricting neck movement. It also impairs cervical proprioception, the body's ability to sense neck position and movement, leading to discomfort and decreased functional capacity. [(1)]

The cervical flexor muscles are crucial for stabilizing and controlling the head and neck. When these muscles are weak or dysfunctional, it can lead to poor head support and posture issues, causing pain and instability in the neck. Neck muscle fatigue can also alter motor control and reduce proprioceptive sensitivity in people with FHP. [(2)]

The proprioceptive system is an important part of our nervous system that helps us stay balanced and steady on our feet by coordinating our movements with our vision and vestibular systems. This sensory system provides the brain with information about the position and movement of the body's parts, enabling precise and controlled physical activity. When proprioception is diminished, it can significantly affect joint stability, particularly in individuals with hyper-mobile joints. These joints, already more flexible and prone to excessive movement, become even more unstable without adequate proprioceptive feedback. The body's capacity to recognize and react appropriately to changes in joint position and movement is impaired, which in turn raises the likelihood of injuries including sprains and dislocations. Thus, it is critical for the health of the musculoskeletal system and the avoidance of injuries to keep the proprioceptive system operating properly. [(3).]

Patients with cervical spine issues often adopt a forward head posture (FHP), in which the patient positions their head forward, to alleviate the curvature of the cervical spine. Mechanical cervical discomfort and other disorders are greatly exacerbated by this curvature loss in the cervical spine. Key factors contributing to persistent cervical discomfort include constant muscular contraction and weariness caused by muscle weakening. Therefore, the strength of neck muscles is crucial for cervical stabilization. The deep neck flexors along with the shoulder girdle muscles, play a vital role in controlling and supporting the neck, stabilizing the head, and bearing its weight against gravity. [(4)] Mechanoreceptor function and cervical spine stability might be significantly impacted by this as well. So, it is thought that malfunction in cervical position sensing is caused by damage to these muscles and mechanoreceptors. [(5)]

This study aims to explore the link between deep neck flexor endurance and cervical proprioception in people with and without FHP. If a positive connection is found, early endurance training could help improve proprioception in FHP patients.

METHODOLOGY

Screening subjects and grouping them:

The craniovertebral (CV) angle was used to identify healthy people with a normal body mass index (BMI) who were 20 to 24 years old. With 12 people in each group, a total of 24 people took part in the research. No one could participate if they were currently receiving medical or physiotherapy treatment for a recent injury, musculoskeletal or neurological discomfort, vestibular or systemic illness, or if they had any other preexisting conditions. The individuals' body mass index (BMI), age, weight, and height were documented. For the purpose of participant classification, the CV angle was used, which is the angle formed between the horizontal line and the line that connects the C7 spinous process to the tragus of the ear. People were said to be in forward head postures (FHP) if their CV angle was less than 48 degrees, and neutral head postures (NHP) if it was more than 48 degrees. The kids with non-HHP were grouped into Group

A, whereas the children with FHP were grouped into Group B.

Outcome Measures:

Assessment of Cervical Proprioception

1) The LASER Method was used to measure proprioception by evaluating cervical head positioning accuracy (HPA), demonstrating good test-retest reliability and excellent correlation with an ultrasound technique for JPE measurement. Four cervical spine movements—flexion, extension, right rotation, and left rotation—were assessed using the HRA test. A laser attached to a lightweight headband on the participant's head was used while the participant wore a blindfold to prevent visual feedback. The participant's head was moved to approximately half the reported normal range of motion for each movement to avoid end-range pain or stretch. The difference between the starting and relocation positions for each movement was recorded. Averaging three repetitions of each exercise was done with a fifteen-second break between each repetition of the same movement and a sixty-second break between each movement. The units of measurement used were centimeters. (6)

2)

Fig 1: Head Repositioning Accuracy Test

Assessment of Cervical Flexor Muscle Endurance

Participants were instructed to maintain a constant pressure of 20 mmHg on a sphygmomanometer placed under the occiput while holding a chin tuck position in a supine lying posture. The duration was recorded, and the stopwatch was stopped when the pressure deviated from the desired level (from 60 mmHg to 80 mmHg). Three attempts were made, and the average of all three readings was calculated. "The test was stopped if:

(1) the participant's head touch pressure dropped below 80 even for 1 s,

(2) the skin folds began to separate due to a loss of chin tuck,

(3) The subject expressed a want to terminate the experiment because of fatigue or discomfort."

Using a stopwatch, the duration of muscular endurance holding was recorded in seconds. A diary was used to document the reason for test termination. For each endurance test, we ran it three times and averaged the results. A minimum of five minutes of resting time was permitted between measurements. (7)

Fig 2: Cervical Muscle Endurance Test

STATISTICAL ANALYSIS

Sample Size Estimation

This study's estimated sample size was 12 individuals per group, with a 95% confidence interval and 80% power, according to the research by Ravi Shankar Reddy et al.(3)

Statistical Methods

Age, height, weight, body mass index (BMI), and gender were some of the demographic variables summarized using descriptive statistics. The results of the Shapiro-Wilk test, which looked at the data for signs of normality, showed that all the values followed a normal distribution. The groups with and without forward head position were compared using an independent t-test for cervical proprioception and endurance. Data analysis was conducted using SPSS v.16, with a 95% confidence interval. Furthermore, the presentation of results was facilitated through the utilization of SPSS graphical editors, ensuring clear and informative tables were generated.

Descriptive Statistics

Table 1: Test of Normality (Shapiro-Wilk)

POSTURE	VARIABLES	SIG
NHP	Age	.038
	BMI	.069
	Endurance	.262
	Proprioception	.894
FHP	Age	.010
	BMI	.937
	Endurance	.223
	Proprioception	.835

Table 2 presents the demographic data. The data indicated a normal distribution for all variables, as confirmed by the Shapiro-Wilk test (Table 1).

Table 2: Demographic Data

GRP	VARIABLES	N	RANGE	MINIMUM	MAXIMUM	MEAN	SD
NHP	AGE	12	4	20	24	22.7	1.13
	BMI	12	5.90	18.5	24.4	21.7	2.01
FHP	AGE	12	2	21	23	21.8	0.83
	BMI	12	6.10	18.5	24.4	21.6	1.82

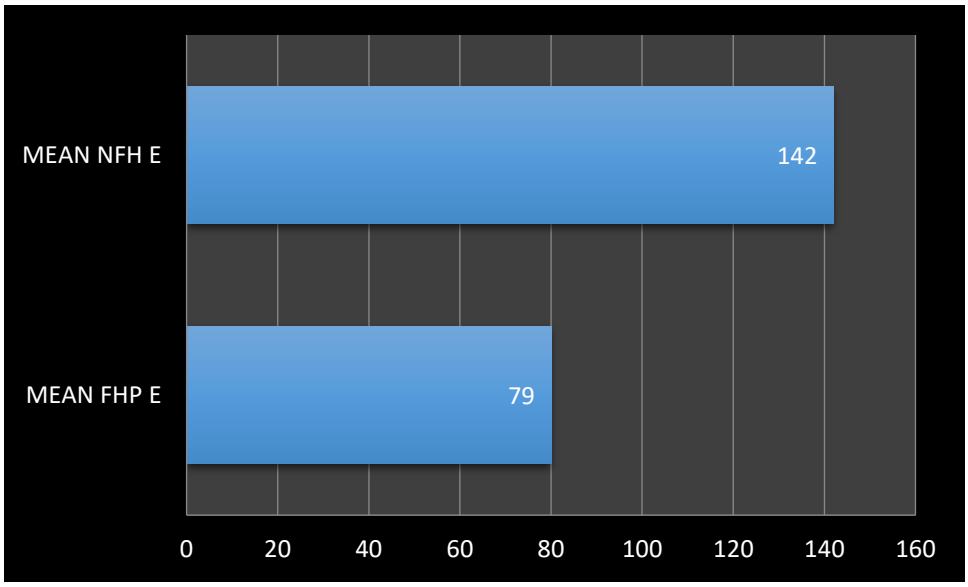
RESULT

Group A's neck muscles are way stronger, with an average endurance (142±15.5), compared to Group B's weak (79±10.6). Group A also has much better neck awareness (4.7±1.16), while Group B is at a poor (6.8±2.25). NHP individuals showed better endurance compared to individuals with FHP. “There was a statistically significant difference between the endurance of NHP and FHP individuals (t =3.3; p=0.003) which concludes that FHP individuals have lower endurance and vice versa. NHP individuals showed better proprioception compared to individuals with FHP. There was a statistically significant difference between the endurance of NHP and FHP individuals (t =-2.9; p=0.008) which concludes that FHP individuals have lower proprioception and vice versa.

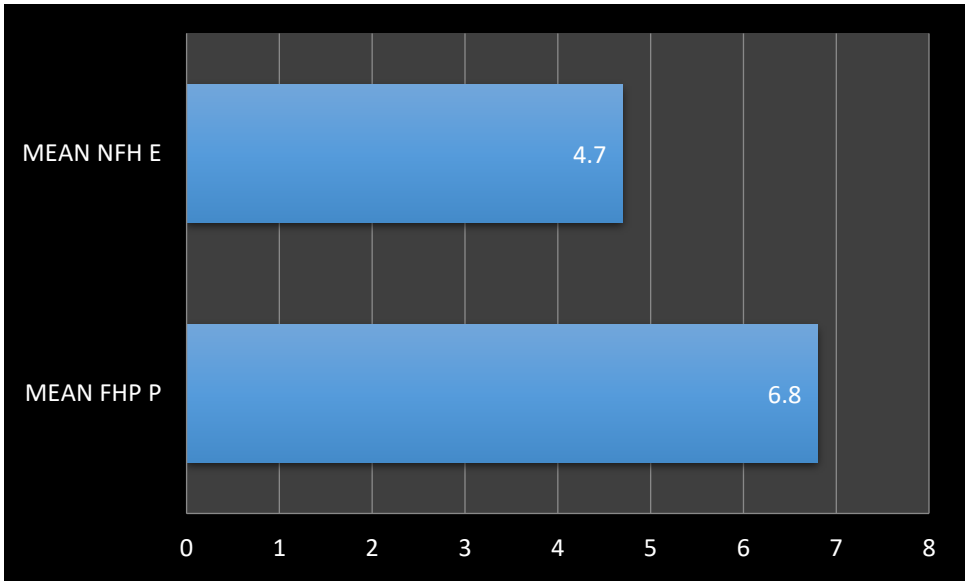
Table 3: Comparison of Cervical Muscle Endurance Test and Head Reposition Accuracy Test in individuals with and without FHP.

	NHP		FHP		t	df	Sig(2 tailed)
	MEAN	SD	MEAN	SD			
Endurance	142	15.5	79	10.6	3.3	22	0.003
Proprioception	4.7	1.16	6.8	2.25	-2.9	22	0.008

Graphs:



Graph 1: Comparison between mean values of endurance of individuals with and without Forward Head Posture



Graph 2: Comparison between mean values of proprioception of individuals with and without Forward Head Posture

DISCUSSION

The purpose of this study was to compare the cervical proprioception and flexor muscle endurance of students with and without forward head posture. The findings of this study suggest that poor proprioception and weak flexor endurance are seen in individuals with forward head posture when compared to individuals with non-forward head posture. This could be because forward head posture (FHP) alters the alignment of the cervical spine, which changes the length and tension of the neck muscles." Because of the extra strain this misalignment puts on the posterior capsule and facet joints, they are forced to carry heavier weights. As a result, mechanical stress affects the muscle fibers, potentially leading to muscle fatigue and discomfort. Moreover, the altered loads impact mechanoreceptors, the sensory receptors that respond to mechanical pressure, disrupting their signals. This

disruption impairs proprioception and coordination, perpetuating postural instability and contributing to chronic pain and musculoskeletal dysfunction. [1,7]

According to the study by Ravi Shankar Reddy et al, reduced joint stability and muscle strength can lead to neck pain and other upper and lower limb sports or musculoskeletal injuries. [3] In a study comparing cervical joint position sense between forward head posture (FHP) and control groups, variable error (VE), reflecting the consistency of results, was higher in FHP subjects. Despite this, absolute and constant errors showed no significant difference, indicating FHP didn't affect joint position sense accuracy. Possible reasons for higher VE in FHP include altered motor synergy strategies and muscle spindle signaling changes. FHP subjects showed slightly lower but insignificant absolute error (AE), possibly due to compensatory muscle activation. VE emerged as a sensitive indicator for joint position sense. [8] Both mine and the study by Ravi Shankar Reddy et al highlight the impact of forward head posture (FHP) on cervical spine function, with my study showing that FHP leads to poorer proprioception and weaker flexor muscle endurance, while the study by Ravi Shankar Reddy et al. found that FHP increases variable error (VE) in joint position sense

Forward Head Posture (FHP) affects muscle length, potentially impacting muscle spindle activity, crucial for joint position sense. Prolonged FHP can strain the cervical spine, altering muscle lengths and affecting muscle spindle function. Thus, FHP correlates with reduced proprioception, worsening as FHP severity increases. [9] When researchers compared groups with varying degrees of neck pain, they found that those with pain had less endurance in their neck muscles, higher scores on the affective dimension of the SFMPQ and disability questionnaires, and less ability to rotate to the left and right at the second assessment. According to these results, disability surveys, range of rotation, SFMPQ scores, and neck muscular endurance may differentiate between groups with different degrees of neck discomfort. In ten Joint position sense may be improved with therapeutic activities that target FHP. Patients suffering from acute or idiopathic neck pain often have impaired kinesthetic awareness, whereas those with chronic neck pain frequently have impaired sensorimotor ability. The activation patterns of the neck muscles are altered in patients suffering from neck discomfort, as they exhibit less activation of the deep neck flexors and more activation of the superficial ones. There is no guarantee that this disturbance in neuromotor control will go back to normal the moment the discomfort goes away. Chronic or recurring neck discomfort might be caused by problems with neuromotor control or with sensing the position of the head and neck. [11] This highlights the importance of addressing FHP to maintain proprioceptive function and overall musculoskeletal health. [9] Both my study and the studies discussed emphasize the negative impact of forward head posture (FHP) on cervical proprioception and muscle function. While my study found that FHP leads to poorer proprioception and weaker flexor muscle endurance, the other studies highlight that FHP affects muscle spindle activity and joint position sense, indicating a broader impact on sensorimotor abilities. The findings suggest that addressing FHP through therapeutic exercises could improve joint position sense and proprioception, as both my study and the other studies underscore the importance of maintaining proper neck alignment and neuromotor control to prevent chronic neck pain and musculoskeletal dysfunction.

A study compared prolonged computer use effects on cervical proprioception and balance in males and females. Both genders showed no significant differences in age, weight, height, or BMI. However, females had larger cervical repositioning errors and reduced balance measures compared to males. Differences in musculoskeletal symptoms between genders and posture were noted, with females requiring more muscle work for balance. The present article doesn’t

show any significant difference between males and females. [6] Both studies highlight the impact of posture on cervical proprioception, though this study found that FHP leads to poorer proprioception and muscle endurance, while the other study indicates that gender differences affect cervical repositioning errors and balance, with females showing larger errors and reduced balance compared to males. Despite the current study is not focusing on gender differences, the other study suggests that gender may play a role in how posture affects cervical proprioception and balance, indicating a potential area for further research to explore how FHP impacts different demographic groups.

Researchers also found no statistically significant difference in cervical muscle strength between those who slouch forward and those who do not, suggesting that the two groups are unrelated. Muscle imbalance occurs when there is abnormal posture. This muscle imbalance is caused by incorrect mechanical pressure on the neck area which disables muscles from properly performing their functions [2] The current study found that individuals with forward head posture (FHP) exhibit poorer proprioception and weaker flexor muscle endurance, likely due to altered alignment and increased mechanical stress. However, the other study suggests that cervical muscle strength does not significantly differ between individuals with and without FHP, implying no direct relation between FHP and muscle strength.

Despite the disagreement regarding muscle strength, both studies agree that muscle imbalance and mechanical stress caused by abnormal posture, such as FHP, can lead to dysfunction. This suggests that while overall muscle strength may not differ, the specific impact on proprioception and muscle performance still warrants attention.

Limitations and Future Scope

There should have been more students in the sample to increase the study's statistical power; there were only 24 total, 12 split evenly between the two groups. This study did not consider the cervical range of motion of the individuals which may have an impact on the endurance and proprioception of the cervical joint. The use of specific tools and methods to measure HRA and endurance tests might introduce biases. Incorporating multiple measurement methods with more advanced technology could enhance the accuracy of the result.

CONCLUSION

The study indicates that there is a significant difference between cervical proprioception and cervical flexor muscle endurance. Enhancing cervical proprioception and endurance is essential for young, healthy students. These elements are important for injury prevention, functional movement, maintaining proper posture, and leading a neck pain-free life which ultimately promote an individual's overall health and better quality of life.

Declaration by Authors

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Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Krishna, H. S., Shetty, S., & Reshma, R. (2021). Relationship between cervical proprioception and deep neck flexor endurance in subjects with forward head posture: A pilot study. Int. J. Sports Health Phys. Educ., 8(4), 290-293.
2. Bokaee F, Rezasoltani A, Manshadi FD, Naimi SS, Baghban AA, Azimi H. Comparison of isometric force of the craniocervical flexor and extensor muscles between women with and without forward head posture. CRANIO®. 2016 Sep 2;34(5):286-90.
3. Reddy RS, Tedla JS, Alshahrani MS, Asiri F, Kakaraparthi VN. Comparison and correlation of cervical proprioception and muscle endurance in general joint hypermobility participants with and without non-specific neck pain—A cross-sectional study. PeerJ. 2022 Mar 11;10:e13097.
4. Gong W, Kim C, Lee Y. Correlations between cervical lordosis, forward head

posture, cervical ROM and the strength and endurance of the deep neck flexor muscles in college students. J Phys. Ther. Sci 2012;24(3):275-7.
5. Rahnama L, Abdollahi I, Karimi N, Akhavan N, Arab-Khazaeli Z, Bagherzadeh M. Cervical Position Sense in Forward Head Posture versus Chronic Neck Pain: A Comparative Study. J Clin. Physiother. Res 2017;2(1):39-42
6. Sahu, P. K. (2020). Cervical Proprioception and Dynamic Balance in Computer Users: A Comparison between Male and Female Healthy Adults. Indian J. Public Health Res, 11(12), 263-269
7. Reddy RS. The influence of forward head posture on cervical proprioception in dentists. King Khalid University J. HEALTH.Sci. 2020 Jan 1;5(1):26-32.
8. Sajjadi E, Olyaei GR, Talebian S, Hadian MR, Jalaie S. The effect of forward head posture on cervical joint position sense. Arch.Adv.Biosci. 2014 Nov 25;5(4).
9. 9.Lee, M.-Y., Lee, H.-Y., & Yong, M.-S. (2014). Characteristics of cervical position sense in subjects with forward head posture. J. Phys.Thera, 26(11), 1741-143.
10. Lee H, Nicholson LL, Adams RD. Neck muscle endurance, self-report, and range of motion data from subjects with treated and untreated neck pain. J Manipulative Physiol Ther. 2005 Jan;28(1):25-32.
11. Elsig S, Luomajoki H, Sattelmayer M, Taeymans J, Tal-Akabi A, Hilfiker R. Sensorimotor tests, such as movement control and laterality judgment accuracy, in persons with recurrent neck pain and controls. A case-control study. Elsevier 2014 Dec 1;19(6):555-61.

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