

## Original Article

## Cervical Joint Position Sense Error In Healthy Young Adults

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### Abstract

**Objective:** To determine average cervical joint position sense error in healthy young adults.

**Study design:** It is a Cross-Sectional study design.

**Place and duration of study:** The study was conducted in different universities of Islamabad over a time period of six-month duration from June 2022 to December 2022.

**Material and Methods:** This study was conducted on 400 adults between the age limit of 18-30 in universities of Islamabad. Forward head posture, shoulder symmetry and trigger points were checked prior to procedure. Modified headgear with integrated laser and a circular grid were used. The distance of head gear from the grid was 90cm. Cervical spine flexion, extension, left and right-side bending, left and right rotation with close eyes and 3 repetition were performed. Value  $\geq 4.5$  is considers as error.

**Results:** Results were based on Mean and frequency distribution. Mean was less than 4.5 that showed no error in flexion, extension and right-side bending. While right left rotation and left side bending showed significant error i.e., mean value is more than 4.5. Out of 400 participants, 149 and 147 individuals had error in flexion and extension respectively, 168 had error in right side bending, 219 had error in left side bending, 259 had error in right rotation and 249 had error in left rotation. This means no error exists in flexion, extension and right side bending while in right rotation, left rotation and left side bending error exists.

**Conclusion:** This study concludes that cervical joint position sense error exists in flexion, extension and right side bending while no error exists in right rotation, left rotation and left side bending.

**Keywords:** Forward Head Posture, Left Rotation, Side Bending, Right Rotation, Shoulder Symmetry.

### 1. Introduction

The term proprioception is commonly used to get sensory signals from the receptor to the coordinator of central nervous system; therefore, it plays role in the maintenance of proper alignment of body.<sup>1</sup> It is a sense of the body position, which comprises of joint position sensing and kinesthesia (movement sensing).<sup>2</sup> Joint position sense (JPS) is a perception of the position and movement of the joints and kinesthesia is the feelings of force and heaviness along with contractions and sensations related to the active and passive movements.<sup>3</sup> It is concerned with the information that is arising from the receptors to central nervous system. This specific information plays a vital part in the

neuromuscular control during movement.<sup>4</sup> This ascending information (proprioceptive) coming from body travels to the nervous system through a pathway known as afferent pathway.<sup>2</sup> Most vertebrates have three basic types of receptors for proprioception: muscle spindles that are present in voluntary musculature. Golgi tendon organ, that are present at the boundary of tendons, muscles and joint receptors, with low threshold mechanoreceptors present inside capsule of joints.<sup>5</sup>

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It has been reported that multiple factors like age, neck pain, injuries like whiplash etc. have a prominent effect on muscle size, muscle strength and cervical joint position sense. Effect of chronic neck pain on joint position error (JPE) has been studied in different researches that show there is a positive impact of it on JPE. It is seen in the previous studies that there is lack of research on JPSE in healthy young adults having no pathology i.e. neck pain etc.<sup>6</sup>

To date, while checking head and neck position sense both the position –matching activities which involve relocation to the neutral head position or relocation to the fixed point or angle have been the methods of choice. Subject's accuracy of performance is considered by the difference among the reference and the reproduced position or angle. The vestibular system plays an integral part in determining the ability of a person to sense his/her position of head in space. Vestibular system comprises of peripheral and central parts. The detection of rotating acceleration of head is done by the peripheral component via semicircular canals and the straight-line acceleration is detected via saccule and utricle. Information from these components along with the outputs from eyes and neck proprioceptors is integrated to determine the location of head in space and relative to the body.<sup>11</sup>

The anatomical structures and physiological mechanisms involved in producing accurate positions of joints is very important to be discussed here. General perception is that, the muscle spindle is a basic receptor which is responsible for the sense of joint position. Along with it there is an afferent input come from the joint and cutaneous receptors which also provide an additional information to the CNS. Previous studies involved animals and highlighted that the muscles controlling the neck's movement and its stability are far more complex than those found in the limbs. There are highly specialized structured arrays of parallel running, paired forms of muscle spindles found in the cervical region muscles.<sup>11</sup> The information of proprioception coming from the muscle receptors mainly stays inside the dorsal and ventral cerebellar tracts before it goes to the cerebellum.<sup>11</sup> When information reaches

cerebellum, it is passed onto the rubrospinal tract which is basically a small extrapyramidal tract that stems from the midbrain. To a lesser extent the proprioception also has its neurological basis in tendon organs.<sup>12</sup>

The goal of this research is to check, what is the average joint position sense error, and identification of which cervical movement has the most error in the healthy young adults. Cervical joint position sense error (JPSE) is actually a measurement of abnormality of the afferent inputs from the cervical region that is resulting in a compromised cervical position. Cervical joint position sense is healthy individual sense.<sup>9</sup> There exist numerous methods to check cervical JPSE. The most common is the active movement angle reproduction test. In this method the participant is asked to rearrange the position of head to the neutral or the preset position set by the investigator. JPSE which shows a person's ability to bring back his head to a preset objective with accuracy after cervical movement.<sup>5</sup>

## 2. Materials & Methods

A Cross-sectional study, approved by ethical review committee of Shifa tameer-e-millat university is conducted over a time period of six-month duration from the June 2022 to December 2022. A convenient Sampling Technique was used to collect data from 400 healthy young adults aged 18 to 30, from both genders Participants having Cervical radiculopathy, Cervical spondylosis, Cervical spondylolisthesis, Cervical Spondylitis, vision problem, balance problems, inner ear problems or pathology, Cervical arterial Dysfunction, whiplash injury and any other systemic pathologies were excluded from the study.

A Modified headgear with integrated lase having intraclass correlation coefficient (ICC) value 68%)<sup>7</sup> and target grid with 3 markers (Red, Blue and Green) were used to gather the data. Before the assessment of CJPSE, participants were asked to fill the questionnaire and were instructed to let the researcher assess their Forward head posture (FHP) by standing them against the wall. If the back and head was able to touch the wall than participants have no FHP.

Along with FHP, Shoulder symmetry and trigger points in the neck region was also assessed by palpating muscles of neck.

The participant was instructed to obtain a sitting position wearing a modified headgear with integrated laser in it, pointing at the center of target grid. A Circular grid with diameter of 40 cm, 2 perpendicular line bisecting at the center of circular grid making 4 equal quadrants. A small circle drawn on the grid at the radius of 4.5 cm. A value equals to or more than 4.5 degrees will consider as error. The distance from the head of the individual to the targeted grid was 90 centimeters.<sup>8,9</sup> The subjects were educated to perform all cervical movements, i.e. flexion or extension, right or left side bending, right or left rotation and were asked to reposition the laser beam in the center of the grid with closed eyes.<sup>8</sup> 3 trials were completed for every direction of motion assessed and then the mean of three movements was taken.<sup>8</sup> The diameter of the grid was 40 cm, we drew circles of 2cm consecutively (10 circles). For every 1 circle there will be a value starting from the center (origin) to 10<sup>th</sup> circle. Number Zero represents excellent coordination and number 10 poor coordination.<sup>10</sup>

**3. Results**

A total of 400 participants participated and data was taken from all participants. Minimum age of participants was 18 years and maximum age was 30 years. Mean age of participants was 22.31± SD4.00 years.

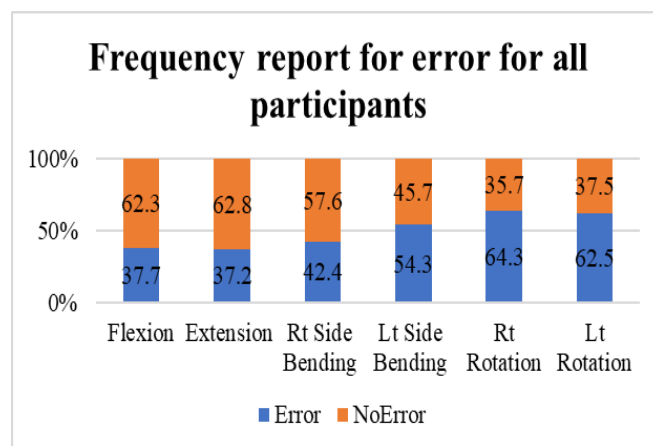
Both genders were included in our study, 291 Males and 109 Females. Mean age female is 21.16 years, median 20.00 years, mode 20.00 years and SD±2.43 years. Mean age of male is 22.75 years, median 23.00 years, mode:17.00 years and SD±4.39 years.

Before the assessment of CJPSE, Forward head posture was also assessed by standing them against the wall. Results shows that in total of 400 participants, 219 participants have forward head posture and 184 did not had. Along with FHP, Shoulder symmetry and trigger points in the neck region was also assessed. Analysis by

finding the Frequency shows that 191 participants out of 400 have their shoulder in symmetry while 212 had asymmetric shoulders. 186 has trigger points in their neck and upper trapezius muscles and 217 had no trigger points.

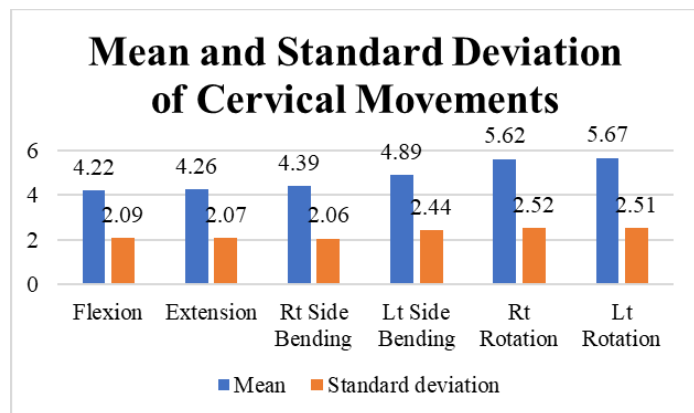
The frequency distribution for CJPSE shows that out of 400 participants 149 participants had flexion error,147 had extension error,168 had right side bending error,219 had left side bending error,259 had right rotation error and 249 had left rotation error which shows that no error in right side bending and flexion extension as the participants with error are less than the participants without error movement. While in left side bending and right left rotation more participants have error in repositioning of their head to its neutral position.

Movements	Frequencies		Percentages	
	Error	No error	Error	No error
Flexion	149	251	37.7%	62.3%
Extension	147	253	37.2%	62.8%
Rt Side Bending	168	232	42.4%	57.6%
Lt Side Bending	219	181	54.3%	45.7%
Rt Rotation	259	141	64.3%	35.7%
Lt Rotation	249	151	62.5%	37.5%



Mean is also calculated for each movement. Error will be considered if the mean value is greater or equal to 4.5 degrees.

Mean of flexion error is 4.22°, for extension error is 4.26°, for right Side Bending error is 4.39° for left Side Bending error is 4.89°, for right Rotation error is 5.62° and for left Rotation error is 5.67°.



In accordance with that no error is present in flexion extension and side bending to right i.e., Means is less than 4.5. On the other hand, right left rotation and side bending left shows significant error i.e., mean value is more than 4.5.

**4. Discussion**

J. de Vries et al. conducted a study on comparison of JPSE in neck among persons with neck pain vs healthy group. No of repetitions is the crucial aspect in properly administering the JPSE assessment in Four out of Fourteen subjects. It also stated that subjects with neck pain from trauma had a substantially greater JPSE as compared to healthy group.<sup>11</sup>

While in current study, we did not make any association with pain and categorizes the groups after the study as participants with significant error and participant with no error. We also took three readings for each movement for the accuracy of the performance.

A case-control study done by Bahar Shaghayegh et al. in 2014 for cervical position sense evaluation in participants with forward head posture and correlate with normal participants independent t-tests was used to analyze absolute and constant errors of rearrangements. The absolute error showed no significant difference, while the constant neutral angle error showed a significant difference. The relationship between body mass index (BMI) and CVA was also

significantly correlated. This demonstrates how a rise in BMI may cause a drop in CVA. According to the study's findings, FHP patients made more repositioning errors during some neck movements than healthy controls.<sup>12</sup>

But in current study, we did asses the forward head posture and analyzed by finding the frequency of participants having FHP and not having FHP Majority of them have had FHP.

The angle used to fine the error was an imaginary triangle from the origin of the grid to the marked point after the repositioning. Hypotenuse and base were originated from the head of the participants making tan  $\theta$ , thus finding the value of theta''  $\theta$ ". Using formula  $\tan^{-1} \theta$ .

In order to assess the proprioception and repositioning errors among participants with Cervical spondylosis with subject's gender and age, Ravi Shankar Reddy et al. did a study in 2012. Proprioceptive reposition errors were measured by the cervico-cephalic kinesthetic sensibility tests. The two repositioning tests were carried out in all the planes i.e., sagittal, transverse, and frontal planes. The errors in the repositioning in subjects having cervical spondylosis were checked in relation using an independent t-test with the normal, age- and gender-matched participants. This had demonstrated that, when compared to age and gender matched normal persons, cervical spondylosis patients exhibited increased proprioceptive errors in all planes throughout both the Head-to-neutral repositioning tests and the head to preset repositioning tests.<sup>13</sup>

While in this study movements were also performed in all the cardinal plans but regardless of age and gender, the major error was shown in those movements that was performed in other than sagittal plans i.e., side bending and rotations.

**Conclusion:**

This investigation comes to the conclusion that during cervical movements there is no error in flexion, extension, and right-side bending, as indicated by Means being less than 4.5. However, in left side bending, right rotation and left rotation error is present, as indicated by Means being greater than 4.5.

**Conflict of Interest:**

The authors disclose that they have no conflicts of interest. The funders did not participate in the study design, data collection, analysis or interpretation, manuscript writing, or the decision to publish the findings.

**References:**

1. Lee M-Y, Lee H-Y, Yong M-S. Characteristics of cervical position sense in subjects with forward head posture. *Journal of physical therapy science*. 2014;26(11):1741-3.
2. Reddy RS, Tedla JS, Dixit S, Abohashrh M. Cervical proprioception and its relationship with neck pain intensity in subjects with cervical spondylosis. *BMC musculoskeletal disorders*. 2019;20(1):1-7.
3. Han J, Waddington G, Adams R, Anson J, Liu Y. Assessing proprioception: a critical review of methods. *Journal of Sport and Health Science*. 2016;5(1):80-90.
4. Strimpakos N, Sakellari V, Gioftsos G, Kapreli E, Oldham J. Cervical joint position sense: an intra-and inter-examiner reliability study. *Gait & posture*. 2006;23(1):22-31.
5. Tuthill JC, Azim E. Proprioception. *Current Biology*. 2018;28(5):R194-R203.
6. Alahmari KA, Reddy RS, Silvian P, Ahmad I, Nagaraj V, Mahtab M. Influence of chronic neck pain on cervical joint position error (JPE): comparison between young and elderly subjects. *Journal of back and musculoskeletal rehabilitation*. 2017;30(6):1265-71.
7. Ashton J, Jones PA. The Reliability of Using a Laser Device to Assess Deceleration Ability. *Sports (Basel)*. 2019;7(8).
8. Kristjansson E, Treleaven J. Sensorimotor function and dizziness in neck pain: implications for assessment and management. *journal of orthopaedic & sports physical therapy*. 2009;39(5):364-77.
9. Torbe DA, Torbé A, Lubkowska A. Laser Tracker-a handy device that verify proprioception of neck and head. *Journal of Education, Health and Sport*. 2017;7(9):155-66.
10. Chen X, Treleaven J. The effect of neck torsion on joint position error in subjects with chronic neck pain. *Manual therapy*. 2013;18(6):562-7.
11. de Vries J, Ischebeck B, Voogt L, Van Der Geest J, Janssen M, Frens M, et al. Joint position sense error in people with neck pain: a systematic review. *Manual therapy*. 2015;20(6):736-44.
12. Shaghayegh-Fard B, Ahmadi A, Maroufi N, Sarrafzadeh J. The evaluation of cervical position sense in forward head posture subjects and its comparison with normal subjects. *Rehabilitation*. 2015;16(1).
13. Reddy RS, Maiya G, Rao SK. Proprioceptive reposition errors in subjects with cervical spondylosis. *International Journal of Health Sciences & Research*. 2012;1(2):65-73.