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Correlation between pain and cervical proprioception in individuals with chronic non-specific neck pain

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Abstract

Background:
This study aims to determine the correlation between pain and cervical proprioception in individuals with chronic non-specific neck pain.

Methodology:
Before the assessment, demographic data, including the participant's name, age, gender, dominance, address, and contact information, were collected.

Results:
In the analysed data, we found that the mean age of the participants was 23.68 ± 4.56, and that 59% of the participants were female. Males were 41%; 99% of the participants are right-hand dominant, and 1% are left-hand dominant. The mean differences in Range of motion for flexion are 9.16, extension is 6.78, lateral flexion is 2.12, and rotation is 5.3, and the correlation of pain on activity with flexion is 0.107.

Conclusion:
The study concludes that there is a correlation between pain and cervical proprioception in individuals with chronic non-specific neck pain. In this study, cervical proprioception was markedly affected in flexion and mildly affected in extension and lateral flexion in individuals with chronic non-specific neck pain.

Keywords: *chronic nonspecific neck pain, Numerical pain rating scale NPRS, Goniometry, Physiotherapy.*

1. Introduction:

Pain is both a sensory and an emotional experience. The intensity of the stimulus, individual vulnerability, and personal experience of pain all affect the involvement of pain. Self-report is frequently the main (and primary) source of data used in the valuation of pain. Neck pain is a widespread issue that affects around 33% of the population each year. Non-specific neck pain (NP) is characterized by pain in the back and sides of the neck between the superior nuchal line and the spinous process of the first thoracic vertebra, without any signs or symptoms of important structural pathology and without neurological signs or specific pathologies (1). Neck pain is categorized as non-specific when it lacks pathognomonic signs and symptoms. When symptoms persist for more than 12 weeks, they are considered chronic and are commonly referred to as non-specific chronic neck pain (NCNP) (2).

Proprioception, or cumulative neural information, is delivered to the central nervous system by mechanoreceptors, specialized nerve endings located in the epidermis, ligaments, muscles, tendons, and joint capsules. Proprioception is a specific variation of the sensory modality of touch and encompasses the sensations of joint motion and joint position (3). This concept of self-perception represents one's capacity to have a sense of body orientation and position as well as a sense of body and limb motion.8 Proprioceptors play a crucial part in motor planning (feedforward for anticipatory, preparatory, and reaction planning) as well as in the quick wiring of adaptation mechanisms to affect performance changes while task execution is taking place (feedback). Joint position sense is often assessed utilising either active or passive reproduction of joint positioning (4).

The cervical muscles communicate with and receive commands from the central nervous system. Afferent data from the cervical muscles converges in the vestibular nucleus, as does information about head movement from the visual and vestibular systems. Without vestibular input, accurate head-on-trunk orientation is possible. This shows that cervical spine proprioceptive information is critical for head-on-trunk alignment. The cervical Joint position sense error is measured by examining participants' ability to appropriately reposition their head to the trunk relative to a specified target (typically the neutral position of the head) after a cervical movement with their eyes closed (5).

2. Material and Methodology:

After obtaining Institutional Ethics Committee approval, the study was initiated in September 2022. The study was conducted in Dr D.Y. Patil College of Physiotherapy in Pimpri-Chinchwad, Pune, India.

The observational study was conducted on subjects with chronic non-specific neck pain residing in Pimpri-Chinchwad and Pune, India. The samples were collected according to inclusion and exclusion criteria. Before the assessment, demographic data were collected, including participants' names, age, gender, occupation, address, and contact number. This study was a cross-sectional analysis of 80 subjects aged 21 to 40 years with chronic non-specific neck pain. NPRS score was assessed on a scale of 10, and the patient was asked to circle the number (6). Zero means no pain, and 10 represents unbearable pain. Unlike VAS/GRS, NPRS has a fixed number of responses, i.e. 11 possible answers (0 – 10). Although the responses are less than VAS/GRS, they are easy for patients to understand and use. Previous studies show that NPRS has a positive relationship with other pain assessment methods and is a more reliable, widely accepted measurement tool.

The assessment method is similar to that of Lee et al. The participants were made to sit upright in the chair with their spines straight and their heads in a neutral position. The study procedure was explained to the participants, and instructions were provided during the testing phase. With the above position maintained, the examiner calibrated the goniometer to a neutral position. The examiner assessed the cervical range of motion for flexion, extension, side flexion, and rotation.

To assess participants' proprioception, the therapist held their heads and then moved them to the targeted head position, which was half the maximum range of CROM. The position was held for 3 seconds; participants were instructed to memorize the position, and then the head was returned to the neutral position. The patient was then asked to reach the previously attained position actively. The therapist identified the error, and the reposition accuracy error was determined in degrees. Each direction procedure was repeated three times to reduce error, and a single investigator administered all the tests.

3. Observations and Results:

The analysis was conducted using SPSS v21 and Microsoft Excel, with 80 participants aged 21-40 years with chronic non-specific neck pain. It consists of 41% of males and 59% of females.

The data, when analysed, gave results for: The mean age distribution of the participants was 23.68+/-4.56. The gender distribution of the participants' females 59% and males 41%. The total dominance of the participants 99% were right-hand dominant, and 1% were left-hand dominant. The mean differences in ROM for flexion (9.16), followed by extension (6.78), lateral flexion (2.12) and rotation (5.3). The correlation of pain on activity with movements: Flexion 0.107, Extension 0.264, Lateral Flexion 0.136, Rotation -0.226, The mean and SD for pain on activity (4.6+/-0.66), pain on rest (2.27+/-0.69), Range of motion with eyes open: Flexion (22.63+/-1.69); Extension (22.27+/-1.96); Lateral Flexion (21.53+/-1.50); Rotation (35.57+/-1.90), Range of motion with eyes closed: Flexion (31.75+/-2.63); Extension (28.43+/-5.31); Lateral Flexion (22.61+/-2.00); Rotation (40.12+/-4.20) and Range of motion difference: Flexion (9.16+/-3.04); Extension (6.78+/-4.89); Lateral Flexion (2.12+/-1.67); Rotation (5.30+/-3.21).

Measures	Mean+/-SD
Pain on activity	4.6+/-0.66
Pain on rest	2.27+/-0.69
Range of motion (eyes open)	
Flexion	22.63+/-1.69
Extension	22.27+/-1.96
Lateral flexion	21.53+/-1.50
Rotation	35.57+/-1.90
Range of motion (eyes closed)	
Flexion	31.75+/-2.63
Extension	28.43+/-5.31
Lateral flexion	22.61+/-2.00
Rotation	40.12+/-4.20
Range of motion (difference)	
Flexion	9.16+/-3.04
Extension	6.78+/-4.89
Lateral flexion	2.12+/-1.67
Rotation	5.30+/-3.21

Measures (Pain and Difference in ROM)	Pearson's correlation
Pain on activity and Flexion	0.107
Pain on activity and Extension	0.264
Pain on activity and Lateral Flexion	0.136
Pain on activity and Rotation	-0.226

4. Discussion:

The following study was an observational study to determine the correlation between pain and proprioception in patients with chronic non-specific neck pain. The main aim of this study was to determine the correlation between pain and Cervical proprioception in individuals with Chronic neck

pain. The study included 80 individuals with chronic non-specific neck pain. The objectives were to assess pain in individuals with Chronic neck pain and to assess proprioception of the cervical joints in individuals with Chronic non-specific neck pain. Proprioception is the ability of an individual to integrate sensory data from mechanoreceptors to detect body segment locations and movements in space (7). The participants were assessed for pain and cervical range of motion using the NPRS (Numerical Pain Rating Scale) and Goniometry, respectively. The cervical spine possesses a very delicate proprioceptive system that controls posture and balance, coordinates the vestibular and visual systems, and indicates the head's location relative to the trunk (8).
Deborah L. Falla, Gwendolen A. Jull, and Paul W. Hodges conducted a study of individuals with neck pain and reduced EMG activity in the deep cervical flexor muscles during the movement. The craniocervical flexion test assesses the function of the deep neck flexor muscles. The study shows that an individual with weak neck flexors progresses through the test. This causes reduced performance, which is linked to weakness and poor postural control of deep cervical muscles. These are required for neck support. The improvement in deep neck flexor muscles is reflected in better performance in the craniocervical flexion test (CCFT) (9).

The data from this study, when analysed, showed a strong positive correlation between pain on activity and flexion. Flexion can be affected because the activation of deep flexors is impaired in patients with neck pain, which was found out in a study done by Deborah Falla, Gina Bilenkij and Gwendolen Jull on the topic altered pattern of neck muscle activation is noticed in individuals with neck pain during upper limb function performance tasks (10). A study was conducted to assess the effect of therapeutic exercises on the activation of deep cervical flexor muscles in individuals with chronic neck pain. The study concluded that the endurance of muscles such as craniocervical and cervical flexors decreases in patients with neck pain, and therefore, rehabilitation plays a significant role (11). Results also showed there was a weak positive correlation between pain on activity and extension & pain on activity and lateral flexion. A negative correlation was seen between pain on activity and rotation.

Neck pain lasting for more than 4 months can alter the sense of the receptors that innervate the surrounding cervical structures. The proprioceptors are present in the ventral and dorsal neck muscles, joints, and ligaments. Around the cervical spine, which give joint position sense to the CNS, Cervical sensorimotor control entails the central integration and processing of all afferent information (i.e., visual, vestibular, and cervical proprioceptive inputs), as well as motor program execution via the cervical muscles, which contributes to the maintenance of head posture and balance, as well as the stability of cervical joints. Cervical sensorimotor control abnormalities caused by neck pain are thought to be a defensive response designed to limit further stimulation of the affected region. In the long run, such disturbances may induce more tissue damage, increase pain through peripheral and central nervous system sensitisation, and promote abnormal movement patterns (12).
The results of the present study show that chronic neck pain significantly alters cervical joint position sense, with increased JPE in subjects with chronic nonspecific neck pain. The JPE testing method used in this work provides a simple, rapid, and less expensive means of evaluating cervical joint position sensation. The changes in cervical JPE in chronic neck pain subjects can be attributed to many factors. According to the data, pain can block gamma motor neurons, leading to erroneous afferent signals sent to higher centres and, consequently, faulty proprioceptive signals. It is also speculated that pharmacological compounds released in reaction to pain may sensitise free nerve terminals, resulting in aberrant pain afferent discharge. This could influence the gamma motoneuron and, as a result, the function of the muscle spindle, interfering with proprioceptive afferent activity.

5. Conclusion:

Thus, this study concludes that there is a correlation between pain and cervical proprioception in individuals with chronic non-specific neck pain. Cervical proprioception was markedly affected in flexion and mildly affected in extension and lateral flexion in individuals with chronic non-specific neck pain.

6. Footnotes:

- **Conflict of Interest***:* None
- **Data Availability Statement**: The data that support the findings of this study are available from the authors, upon reasonable request.
- **Acknowledgement**: None
- **Funding**: None
- **Author's Contribution**: NT conceptualized the topic, PB accumulated the data, NT and PB approved the final draft.

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