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Neck Proprioception in Chronic Neck Pain Patients with Different Typing Speeds: A Pilot Study

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Abstract

BACKGROUND: Chronic neck pain (CNP) is one of the most common musculoskeletal pains. It limits the daily functional activities up to 11% to 14% of the workers. Patients with CNP suffered from decreased neck proprioception, especially in head-eye coordination. The COVID-19 pandemic accelerated computer usage. A fast- typing speed can be easily achieved if there is good typing skill and head-eye coordination. However, the relationship between neck proprioception and typing speed in patients with CNP remains unclear. This study aimed to investigate neck proprioception among CNP patients with slow and fast typing speeds.
METHOD: A total of 15 patients with CNP, aged 22.4±2.44 years old were recruited in this study. Participants with typing speed >45 words per minute (WPM) were recruited into the SLOW group (n=8) and <45WPM into the FAST group (n=7). Neck proprioception was assessed using the joint position error (JPE) test for neck flexion, extension, right and left rotation. Independent t-tests were conducted using SPSS 17.0 software with a significance level of less than 0.05.
RESULTS: The SLOW group showed a significantly increased in neck flexion JPE (5.239±2.151 vs 2.913±0.8, p=0.019) compared to the FAST group. However, no significant difference was found in JPE for neck extension (3.695±2.169 vs 3.771±1.754, p=0.941), right rotation (3.498±1.18 vs 3.967±0.758, p=0.372) and left rotation (3.923±1.335 vs 3.237±1.687, p=0.395) in the SLOW group compared to the FAST group.
CONCLUSION: Decreased neck proprioception, especially neck flexion, was significantly shown in CNP patients with slow typing speed. Hence, aside from pain management and postural education, neck proprioception and typing speed training should be offered to CNP patients who demonstrated slower typing speeds and have poorer neck proprioception performance.

Keywords

Neck Proprioception, Joint Position Error, Chronic Neck Pain, Typing Speed

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Introduction

Chronic neck pain (CNP) is a common work-related musculoskeletal disorder that affects the economy of this modern era (Huang et al., 2012). CNP is a pain in the neck that lasts longer than three months and has a high possibility to affect the nerves, discs, vertebrae, or facet joints. Muscle or tendon strain, ligament sprains, and nerve compressions are the common causes of CNP. The past 20 years have seen a surge in research into the way in which neck pain impacts the cervical motor system, posture, and movement. Patients with neck pain had impaired motor output of cervical muscles, decreased muscle strength, endurance, force steadiness, and altered cervical muscle behavior. Besides, decreased activity of deep postural muscles reduced directional specificity, delayed onset of muscle responses, muscle fatigability, and increased neck muscle co-contraction were commonly found in patients with neck pain (Blomgren et al., 2018). The main muscles responsible for supporting the weight of the head are the neck flexors, the deep longus capitis, and colli muscles, and the superficial muscles, sternocleidomastoid (SCM), and anterior scalenes (AS) (Blomgren et al., 2018).

Neck proprioception encompasses the sensation of joint which consists of joint position sense and kinesthesia. An impaired cervical joint position error will affect the muscular and neuronal control of the normal neck joint function (Reddy et al., 2019). Neck pain interferes with afferent signals from the proprioception of the neck, leading to inaccurate proprioceptive information. When neck pain increases, muscle tension increases as the pain carries activity to motor neurons in the same spinal segment. The cervical spine has a very intricate mechanism, especially in controlling posture and balance (Morningstar et al., 2015). Proprioceptive dysfunction is typically measured by joint position error (JPE) tests. JPE measurements are considered to reflect the proprioceptive functioning of the head and neck. Eyes, head, and body movements are controlled and constantly rearranged to modify the input system of the neuromuscular pathway. This is because the mechanoreceptors are found abundantly in the upper cervical spine, and it directs the afferent information to the central nervous system (Quartey, 2019).

Typing involved the coordination of finger, head, and eye motions. Typing skills are affected by several factors involving central and peripheral control mechanisms (Szeto et al., 2005). According to Kalava et al. (2014), typing skills can be assessed by calculating the net words per minute (WPM). Less than 35 net WPM is classified as slow, 35 to 45 net WPM is considered intermediate, and greater than 45 net WPM is classified as fast typing speed (Kalava et al., 2014).

Head-eye coordination subserves the rapid transference of gaze shifts and gazes stability on stationary or smoothly moving targets. Therefore, the deficits in gaze stability and head-eye coordination may be related to disturbed reflex activity associated with decreased head ROM and increased neck pain intensity (Treleaven et al., 2011). Typing required perception of the orientation of the head in space as well as on the trunk, and proprioceptive information from the neck and likely from other body regions (Smith et al., 2019).

Patient with neck pain presented with decreased neck proprioception and head-eye coordination. Typing required proper coordination for the head and eye. However, the relationship between typing speed and neck proprioception in patients with CNP was still unclear. Therefore, the aim of this study was to investigate neck proprioception in CNP patients with slow and fast typing speeds. We hypothesized that CNP patients with slow typing speed demonstrated decreased neck proprioception compared to CNP patients with fast typing speed.

Methodology

Participants

A total of 15 patients with CNP were recruited in this study. The inclusion criteria involved participants with (1) 18 to 60 years old, (2) chronic or recurrent pain in the head, neck, and shoulder area for 3 months. The exclusion criteria were (1) ankylosing spondylitis, (2) past traumatic injuries, (3) surgical intervention in their neck and upper limb regions, (4) trauma-related neck pain, (5) cervical radiculopathy, (6) vestibular dysfunction, (7) comorbid medical conditions such as cancer, type 1 diabetes, and heart disease, as well as (8) anxiety or depression. The procedures were explained to the participants and informed consent was obtained prior to the assessment. This study was approved by the INTI University Research and Ethical Committee

Procedures

This was a cross-sectional study. Prior to testing, the typing speed of each participant was assessed using the LiveChat tool, 2020. Participants with typing speed >45 words per minute (WPM) were recruited into the SLOW group (n=8) and <45WPM into the FAST group (n=7). Neck proprioception was assessed using the JPE test in neck flexion, extension, right rotation, and left rotation.

Joint position Error test (JPE)

Neck proprioception was assessed using the JPE tests. The participant was seated with a specific laser head placed on top of the head, facing the target on a wall 90cm away. The participant started by pointing the laser to the center of the target (Figure 1). Participants were instructed to perform neck flexion, extension, and rotation to the left and right with the eye closed. The distance between the starting position and the final position of the laser beam on the wall was measured. Three measurements were taken, and the average finding was recorded. The distance error was measured in centimeters and then converted into degrees. The formula (angle = tan- 1{error distance/90 cm}) was used (Peng et al., 2021).

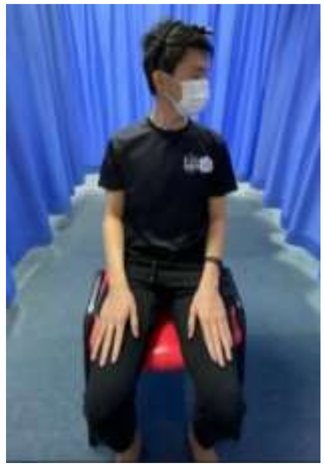

Figure 1. JPE test position

Statistical analysis

Statistical analysis was completed using the SPSS version 17.0 software. The significance level was set as 0.05. Data were presented as mean ± standard deviation. The Shapiro-Wilk test was used to test the normality of the data distribution. An Independent T-test was used to investigate the difference between the neck proprioception in the SLOW group and the FAST group.

Result

Demographic Data

A total of 15 patients with CNP, aged 22.4 ± 2.44 years old were recruited in this study. Participants were separated into the SLOW group (n = 8) and the FAST group (n = 7). Demographic data between the SLOW and the FAST group showed no significant difference. The demographic data was summarized in Table 1.

Table 1. Demographic data in SLOW and FAST Group.

Characteristic	SLOW group (n = 8)	FAST group (n = 7)	p-value
Age (y/o)	20.875 ± 1.727	23.286 ± 2.812	0.078
Gender (F:M) b	4:4	4:3	0.782
Weight (kg)	60.125 ± 7.643	64.286 ± 11.982	0.449
Height (cm)	171.250 ± 13.916	161.000 ± 7.937	0.110
BMI (kg/m2)	20.761 ± 3.686	24.859 ± 4.759	0.091
VAS (cm)	3.188 ± 2.024	2.843 ± 2.500	0.776
NDI (%)	16.500 ± 8.864	14.571 ± 8.223	0.669

[a] Data was indicated as mean ± standard deviation. [b] Data was interpreted using the Chi-Square test. Abbreviation: Visual Analog Scale (VAS), Neck Disability Index (NDI)

Neck Proprioception

Table 2 summarized the neck proprioception assessment using the JPE test in neck flexion, extension, right and left rotation between the SLOW group and FAST group. The neck flexion JPE was significantly increased in the SLOW group compared to the FAST group. However, the JPE for neck extension, right rotation, and left rotation showed no significant difference in the SLOW group compared to the FAST group.

Table 2. Neck proprioception between the SLOW group and FAST group.

JPE Test	SLOW Group (n = 8)	FAST group (n = 7)	p-Value
Flexion	5.239 ± 2.151	2.913 ± 0.800	0.019*
Extension	3.695 ± 2.169	3.771 ± 1.754	0.941
Rt Rotation	3.498 ± 1.180	3.967 ± 0.758	0.372
Lt Rotation	3.923 ± 1.335	3.237 ± 1.687	0.395

Abbreviation: Neck Flexion (Flexion), Neck Extension (Extension), Right Rotation (Rt Rotation), Left Rotation (Lt Rotation). * Indicated as significant level $p < 0.05$.

Discussion

This is the first study to investigate neck proprioception in CNP patients with different typing speeds. Our study demonstrated that CNP patients with slow typing speed were significantly increased in JPE especially in neck flexion compared to the fast-typing group. However, no changes were found in the JPE test during extension, right rotation, and left rotation in CNP patients with slow and fast typing speeds. In a nutshell, CNP patients with slow typing speed demonstrated a significant decrease in neck proprioception in neck flexion compared to CNP patients with fast typing speed.

JPE in neck flexion was significantly increased in CNP patients with slow typing speed. Four studies concluded that patients with non-traumatic neck pain presented with increased JPE than healthy adults (Revel et al., 1991; Rix & Bagust, 2001; Kristjansson et al., 2003; Cheng et al., 2010). Rix and Bagust (2001) found similar results as our study in that patient with CNP showed a significant increase in JPE, especially in neck flexion.

Patients with CNP demonstrated impaired head-eye movement control (Della Casa et al., 2014). Typing is a skill that requires the coordination of the neck, head, and eye. It was observed that most of the patients with slow typing speed demonstrated altered eye movement with rapid head nodding during typing. Compared to the CNP patients with fast typing speed, most of them practice smooth pursuits of eye movement with their heads in a neutral position during the typing job. Theoretically proven that neck pain caused impairment to the head’s eye coordination and the intensity of the pain directly influences the proprioception of the neck. Moreover, the increased sequential head and eye movement during slow typing skills are believed to lead to the provocation of neck pain and decreased neck proprioception. This might be due to the repetitive flexion-extension movement on the impaired neck muscle spindles provide (Bolton et al., 1998) and receive information from the central nervous system (Prud'homme & Kalaska, 1994; Hellström et al., 2005) to achieve neck proprioception.

No changes were found in JPE in neck extension, right rotation, and left rotation in CNP patients with slow and fast typing speeds. This might be due to some limitations found in the study. First, this is a pilot study and consists of only a small sample size of 15 participants. This could easily cause a bias and type II error in the result of the study. Besides, the VAS and NDI for the patients of CNP in this study were considered mild. The mild symptoms of the CNP in the younger age of patients can lead to a ceiling effect in this study. A larger sample size with mild, moderate, and severe CNP patients was recommended for future study. Besides, further investigation on typing speed training in patients with CNP can be implemented.

Conclusion

CNP patients with slow typing speed demonstrated a significant decrease in neck proprioception, especially in neck flexion. Hence, aside from pain management and postural education, neck proprioception and typing speed training should be offered to CNP patients who demonstrated slower typing speeds and have poorer neck proprioception performance. Future studies should investigate typing speed training in CNP patients to improve neck proprioception. The mechanism of cervical proprioception is complex and might be affected by multi factors such as visual processing and cognitive function. Moreover, its relationship with typing speed might be affected by hand and finger dexterity. Therefore, future studies that involved these factors are more likely to provide a clearer understanding of the relationship between cervical proprioception and typing speed.

Conflict of interest

The author(s) have no conflict of interest to report.

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