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Original Research Article

Inter-rater and intra-rater reliability of head-mount laser device on assessing cervical spine proprioception in patients with cervicogenic headache

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ABSTRACT

Background: Relationship exist between the occurrence of cervicogenic headache (CGH) and head posture, due to a reduction in proprioception from the cervical spine. Active joint position sense of the cervical spine can be assessed using head-mount LASER device. This study evaluated the reliability of the head-mount LASER device in assessing cervical proprioception in adults with CGH.
Methods: A total of 50 adults of both genders with a clinical diagnosis of CGH were recruited for the study. The assessment for cervical proprioception was done using the device using a pre-determined test protocol, by two different therapists. The tests were repeated on the next day as well. The accuracy of relocation of the LASER pointer from the pre-determined target spot were evaluated in centimeters, during both flexion and extension.
Results: The study found good inter-rater reliability for flexion (ICC=0.888; 95% CI: 0.743 to 0.945) and extension (ICC=0.873; 95% CI: 0.754 to 0.931), and good to excellent intra-rater reliability for the device (ICC for flexion and extension being 0.952 and 0.951, respectively).
Conclusions: This study concluded that head-mount LASER device can be used as a clinical tool in assessing cervical proprioception, and demonstrated good inter-rater and intra-rater reliability when used on patients with cervicogenic headache.

Keywords: Cervical proprioception, Cervicogenic headache, Head-mount LASER device, Inter-rater reliability, Intra-rater reliability

INTRODUCTION

Headache is a common symptom for most people. According to the available data, 90% of the entire population have experienced headache, and 66% of men and 57% of women suffer from headache at least once per year. Patients with chronic headache account for 2-3 percent of the population. In the grown-up population, 2.5% of people experience headache, and patients with relapsed chronic headache account for 15-20%.[1] Attack rate increases to 53% after whiplash injury.[2] Headache with neck pain is the under-stage of a kind of headache related to damage to cervical musculoskeletal structure.[3] Norwegian physician Dr. Ottar Sjaastad coined the term cervicogenic headache (CGH) in 1983 by recognizing a sub group of headache patients with concomitant head and neck pain: therefore CGH are considered secondary headaches.[4]

Cervicogenic headache has been classified by the International Headache Society (IHS) and accounts for 15% to 20% of all chronic and recurrent headaches. Individuals with long term cervicogenic headache experience considerable restriction of daily function, limitation of social participation, and emotional distress. The IHS defines cervicogenic headache as "pain, referred from a source in the neck and perceived in one or more regions of the head and/or face".[5]

Headache can arise from a various structures such as cervical spine, including the zygapophyseal joints at C3 level of spinal cord. CGH have found to have male to female ratio of 50:50. CGH usually is found to be unilateral without side-shift. Pain is located at occipital to fronto-parietal and orbital. CGH is a chronic condition with moderate to severe pain with a duration of 1 hour to weeks.[6] Patients complain of non-throbbing and non-lancinating pain, usually starting at the neck. Neck movements, prolonged postures, decreased range of motion (ROM), and pressure over C0-C3 trigger the pain. Associated symptoms are usually absent or may be similar to migraine but milder. The importance of examination of the C1-C2 segment in cervicogenic headache diagnosis has been supported by many.

The occurrence of CGH and forward head posture in individuals are interlinked. Forward head posture is the anterior positioning of the cervical spine, which is considered as a "bad" head posture and is commonly found in patients who experience problems with the head and neck.[7] As people in modern society spend an increasing amount of time sitting in front of computers at work, forward head posture has become quite prevalent in recent years. Increased load in the muscles and cervical spine as a result of forward head posture is considered a major cause of musculoskeletal disorders. This deformation causes injuries to soft tissues, thereby inducing non-specific neck pain, restricting the range of motion of the joints, and even causing radiating pain or myalgia, depending on the region of neuromuscular lesions, when the deformation becomes severe.[8] Individuals with forward head posture have hypomobility of the upper cervical and upper thoracic spine, mid-cervical hypermobility, and alterations in muscle length-tension relationships and muscle function.[9] Therefore, recovery from FHP is considered very important for relieving neck pain.

Forward head posture is also related to a reduction in proprioception. 50% of all cervical proprioceptors are present in the joint capsules of C1 to C3. Dysfunction of the deep muscular proprioceptors in the upper cervical spine leads to abnormal input to the vestibular nuclei, causing cervical dizziness which includes symptoms such as poor balance, neck stiffness, headache, and less often visual disturbances, nausea, ear fullness, sweating, tinnitus, problems with swallowing, temporomandibular joint pain, upper extremity radiculopathy, general weakness and psychological symptoms such as anxiety and disturbances in concentration and memory.[10]

Various techniques are being used in the assessment of cervical proprioception in the clinical setting. The systematic review by English et al, reported assessment involving the sense of movement tests and sense of force test.[11] The active joint position sense for the cervical spine can be assessed using the head mounted LASER pointers, by measuring the difference in starting point and end point during an active movement.[12] The device is reported to be reliable and valid when compared to sophisticated laboratory equipment.[13,14] A difference of more than 4.50 is considered to be an abnormal proprioception.[15]

The authors of this study have developed a head-mount laser device to assess the cervical proprioception of patients diagnosed with cervicogenic headache by the consultant neurologist at the institution. This study was intended to analyse the reliability of a head mounted LASER device in assessing the cervical proprioception in adults with cervicogenic headache.

METHODS

The study was conducted at KMCH College of Physiotherapy and KMCH Hospitals, Coimbatore, for a period of three months, from February 2019 to April 2019. A total of 50 patients were recruited for the study who were diagnosed to have cervicogenic headache. Those who were willing to participate in the study were recruited and signed informed consent was obtained from the participants. The study criteria were as follows:

Inclusion criteria

Patients of both genders, between the ages of 18 and 50 years. Patients with a clinical diagnosis of cervicogenic headache, after evaluation by the consultant neurologist and physiotherapist of the institution. Patients who were willing to participate in the study.

Exclusion criteria

Patients who were participating in any form of exercises for the neck or upper body for the last three months. Patients with any concomitant orthopedic or neurological illness which can influence the study results. Patients who were already experienced in using the device.

Study protocol

The protocol was adopted from the study by Alahmari et al.[16] Participants who were recruited for the study was explained regarding the study protocol. The participants were made to sit upright on a comfortable chair with feet placed on the floor and back rested on the backrest of the chair. The LASER device was then attached using a headband and fastened with Velcro bands (Figure 1).

Figure 1: Head-mount LASER device.

The therapist then moved the head slowly into flexion with the LASER projector pointing on a predetermined target spot in front of the patient, placed at 50% of the maximum ROM. The head was kept in this position for three seconds and the patients were asked to remember the position of the head and neck. The patient was asked to bring the head to the neutral position and then was blindfolded. The patient was then asked to repeat the flexion movement and repeat the target position as precisely as possible. The accuracy of relocation of the target was assessed by measuring the distance of LASER point made at relocation from the initial predetermined target spot, in centimeters. The same was performed three times and the mean value of three trials were documented. The test was then repeated for extension movement, in a similar manner to flexion movement.

The initial assessment was performed by therapist 1. The participants were then asked to take a break for 10 minutes, during which they were not restricted for any activities. The next assessment was performed by therapist 2 after the break. The participants were called back again on the next day, and the assessments were repeated by both therapists at the same time of the day, with a rest period of 10 minutes in between.

Statistical analysis

Descriptive statistics were used to explain the demographic details. The inter-rater and intra-rater reliability of the device was assessed using intra-class correlation coefficient (ICC) and the confidence interval was also reported. The analysis was performed using IBM SPSS software (version 20.0).

RESULTS

The study included 50 adults with a mean age of 25.6±3.6 years. The population consisted of 21 males and 29 females. All participants completed the assessments for both days. The demographic details of the participants are summarized in Table 1.

Table 1: Demographic details of the study population.

Demographic characteristics	Data
Number of participants (N)	50
Mean age	25.6±3.6 years
Male-female ratio	21:29

Table 2: Intraclass correlation coefficient analysis for the assessed parameters.

Description	Active movement	Intraclass correlation	95% CI	P value
Inter-rater reliability				
Therapist 1 versus therapist 2 (day 1)	Flexion	0.888	0.743 to 0.945	0.000
	Extension	0.873	0.754 to 0.931	0.000
Therapist 1 versus therapist 2 (day 2)	Flexion	0.765	0.563 to 0.870	0.000
	Extension	0.783	0.613 to 0.878	0.000
Intra-rater reliability				
Therapist 1 versus therapist 1	Flexion	0.952	0.916 to 0.973	0.000
	Extension	0.951	0.915 to 0.972	0.000
Therapist 2 versus therapist 2	Flexion	0.942	0.897 to 0.967	0.000
	Extension	0.940	0.894 to 0.966	0.000

The ICC analysis was performed for the collected data, which is being summarized in the table below (Table 2).

Inter-rater reliability

This study found good inter-rater reliability for the device in measuring active cervical proprioception for both flexion and extension movement. The highest reliability was reported between therapist 1 and 2 on the first day of assessment, with ICC for flexion being 0.888 (95% CI: 0.743 to 0.945) and extension being 0.873 (95% CI: 0.754 to 0.931), demonstrating good reliability. The analysis was also statistically significant ($p<0.001$).

Intra-rater reliability

Good to excellent intra-rater reliability was reported for the device in assessing active joint proprioception when assessed after 24 hours by the same assessor. The ICC values for flexion and extension was 0.952 and 0.951 respectively for therapist 1, and was statistically significant ($p<0.001$).

DISCUSSION

Over half of the world's population experiences headaches within their lifetime, making headaches a significant burden on society. Cervicogenic headaches are secondary headaches related to a cervical disorder or neck pain. Studies have shown that cervical dysfunction leads to a change in proprioception.[17]

Muscle spindle is major sensory receptors in neck region. Because of muscle imbalance, certain muscles are lengthened and certain muscles are shortened. Especially cervical neck flexors develop weakness with shortening of the neck extensors muscle groups.[18] These changes in the muscles can lead to affect sensory fibres from the muscle spindles, which may lead an adverse effect on head position sense. Abnormality in the muscle spindle plays a vital role in the poor proprioception in forward head posture. In forward head posture, the upper cervical flexion and lower cervical extension form of misalignment and more load is placed on upper cervical region.

Reddy et al has described the test-retest reliability of measurements of cervical proprioception assessment using active ROM, and reported an ICC between 0.66 (95% CI: 0.1 to 0.8) and 0.93 (95% CI: 0.8 to 0.9).[19] The correlation analysis found there are high, and significant correlations between the test and retest results indicating that the reliability of the test can be established. Our study also reported good inter-rater and excellent intra-rater reliability in using the device for assessing cervical proprioception. Various studies have recommended head repositioning accuracy measurements assessed using LASER device as an alternative method in cervical proprioception evaluation.[20,21] However, the study by Ntenezakos et al reported variable test-retest and inter-rater reliability in the assessment of cervical proprioception evaluation using LASER beam, demanding caution when using the same in clinical practice, and advised to use with confidence only in specific directions with least measurement error.[22] They also suggested the need for further studies with larger sample size and with subgroups of neck pain with disability and range of pain.

The study had few limitations. The patients who were diagnosed with cervicogenic headache were all below the ages of 30 years, limiting the generalisation of results in older individuals. The reliability of the device in a long-term evaluation was not explored in the study duration.

CONCLUSION

This study concluded that head-mount LASER device can be used as a clinical tool in assessing cervical proprioception, and demonstrated good inter-rater and intra-rater reliability when used on patients with cervicogenic headache.

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