The reliability of the cervical relocation test on people with and without a history of neck pain

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Background: Physical therapy intervention is often sought to treat cervical spine conditions and a comprehensive physical therapy examination has been associated with more favourable outcomes. The cervical relocation test (CRT) is one method used to assess joint position sense (PS) integrity of the cervical spine. Previous research has found significant differences in the CRT between symptomatic and asymptomatic subjects. Impaired kinaesthetic awareness in the cervical spine may be associated with degenerative joint disease, chronicity of the complaint and increased susceptibility to re-injury.
Purpose: The purpose of this study was to determine the intertester and intratester reliability of cervical relocation using the cervical range of motion instrument (CROM) and an affixed laser (AL) device among subjects with and without a history of neck pain. In addition, it was hypothesised that those individuals with a history of neck pain would have greater difficulty on the CRT.
Methods: A total of 50 asymptomatic subjects (n=50) were assigned to two researchers. The CRT was performed for each tester by the subject rotating the cervical spine for three trials to the right and left for the CROM and AL.
Results: The results indicate a significant intertester reliability of the CROM (interclass correlation coefficient (ICC)=0.717[0.502–0.839]; 0.773[0.595–0.873]) for the subjects in this sample.
Conclusion: This study demonstrated that the CROM is a reliable device for measuring cervical relocation between different testers. Future research should investigate if the CRT is predictive of prognosis in patients with cervical pathology.

Keywords: Cervical relocation test, CROM, Laser

Introduction

Chronic neck pain is a common orthopaedic complaint, which results in medical expenses and lost wages totalling in the billions of dollars.[1] The 1 year incidence of neck pain is between 10.4 and 21.3%.[2] Of those individuals who had experienced an episode of neck pain, 22% of women and 16% of men reported chronic neck pain, or pain lasting greater than 6 months. Approximately 54–60% of people present with chronic neck pain following whiplash injury.[3] Although medical intervention is often sought for pain relief, proprioceptive deficit is also associated with chronic neck condtions.[4] Moreover, neck pain has a direct influence on an individual's ability to gain accurate proprioceptive information relative to position sense (PS) and alignment.[5] However, research methods vary relative to the specific procedure employed to measure a subject's ability to return to the neutral head position (NHP).[4]

The cervical relocation test (CRT) is used to assess joint PS integrity of the cervical spine.[4,6,7] Multiple reports indicate significant differences between symptomatic and asymptomatic subjects when assessed by the CRT.[4–7] The majority of previous research examined the ability to relocate to NHP using an affixed laser (AL) pointer,[4] 3-Space Fastrak system (electromagnetic motion device)[6,7] or an ultrasound-based motion system.[8] Current research examining the intertester and intratester reliability of cervicocephalic relocation using the CROM is limited. Furthermore, few studies have established the interrater or intrarater reliability in cervical relocation using the CROM device.

Cervical relocation testing using a CROM is a clinically applicable and inexpensive alternative to more costly and complex CRT equipment and adjunct software. The CROM may be an inexpensive and reliable method for CRT if the intraclass

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correlation between testers is ≥0.75. Assessment of a person's ability to relocate the head to the NHP has been examined in people with and without a history of neck trauma,[4,5] with neck trauma potentially leading to a chronic state which requires treatment.

Chronic Neck Pain Intervention

A majority of research investigating the CRT has included subjects not only those who may have a history of trauma but also in those with and without cervical spine symptoms. The CRT may be influenced by nonspecific cervical pain that accounts for approximately 42% of common musculoskeletal disorders annually.[5] Wibault *et al.*[9] assessed reposition accuracy with the CROM tool in both healthy subjects and people with cervical radiculopathy and found head relocation accuracy differed. Relocation accuracy may also be a factor in people with chronic neck pain,[4] and neck related dizziness is a complaint often related to chronic symptoms.[10] While chronic neck pain may be addressed through various forms of strengthening,[11] the cervicogenic dizziness that accompanies neck pain may require non-thrust manipulation[12] or more specific deep neck muscle activation to improve postural stability.[13]

In previous studies examining PS, NHP and Joint Position Error (JPE), researchers implemented an electromagnetic- or ultrasound-based motion sensor system,[5–7] or a laser pointer.[4,5] A study conducted by Chen *et al.*[7] analysed the efficacy of the modified JPE with a torsion manoeuvre to measure cervical afferent dysfunction. Rotation of the trunk on a still head causes relative rotation of the head on the trunk and therefore excites the cervical proprioceptors without stimulating the vestibular afferents. Significantly, greater JPE was found in the group of subjects with neck pain when using both the Fastrak and laser measurements. Therefore, treatments for neck pain should include the goal of improving feedback from the proprioceptive system.

Research suggests that pain reduction improves joint PS and that cervical proprioception may correlate with symptom severity.[4] However, assessing joint proprioception with the CRT may aid in guiding exercises that address the loss of neuromuscular control associated with cervical spine joint hypermobility and instability. A number of testing devices exist on assessing the CRT. Kristjansson and colleagues[6] used the Fastrak system to measure the subject's relocation, which is currently the gold standard in measuring the CRT.[6] Other researchers such as Lee and colleagues[8] used the ultrasound motion detection device for the CRT and found the interclass correlation coefficient (ICC) to range from 0.45–0.80. Pinsault *et al.*[4] used an AL with a computer recording system and was able to determine excellent test–retest reliability when administering the CRT. Research has demonstrated that the CROM is a reliable method of measuring cervical relocation compared to the Fastrak system.[14]

Methods

Participants

A group comparison study was conducted between two samples of 25 subjects. Subjects were screened for eligibility prior to participating in the study. Subjects were excluded if they fit any or all of the following criteria: 1) were under the age of 18; 2) had previous spinal surgery; 3) were currently pregnant; 4) were currently receiving treatment for neck pathology. The study protocol was approved by the Daemen College Human Subjects Research Review Committee. All participants signed an informed consent form prior to inclusion in the study and then were assigned to either pair of testers. The subjects were sequentially numbered to track the total number of participants. The 50 subjects were split into an A and B group based on convenience. The A group was paired with tester 1 and 2 to perform the CRT using the two devices. The 25 subjects in each group were analyzed independently of each other.

Cervical range of motion device NHP

The cervical range of motion device (CROM) was used in this study to analyse the subject's ability to return to the NHP. Examiners conducted the testing with the CROM initially, then proceeded to the AL device. For the CROM measures, a blindfold was placed over the subject's eyes to eliminate visual input and force the participant to use their cervical proprioceptors to achieve their NHP. A magnetic strap was used to stabilise the CROM device on the subject's head. The CROM was strapped firmly on the subject's occiput. At that time, the participant was asked to rotate the cervical spine to the right and left, pausing at end range to allow the examiner to document the CROM measure. Once returned to the NHP, the clinician asked the subject to rotate the head to the right, taking a brief pause at the end range and then return back to their perceived neutral, which was recorded. This process was repeated for a total of three trials to the right side. The subject was then asked to sit with his/her best posture to reestablish the NHP and then rotate to the left, again taking a brief pause and return to neutral with the range documented as it was with right rotation. This process was repeated a total of three trials to the left as well. Figure 1 shows the cervical relocation with the CROM device.

AL NHP

The AL device was also utilised to determine the subject's ability to return to their perceived NHP. The blindfold was placed over the subject's eyes to

Figure 1 Cervical relocation cervical range of motion (CROM)

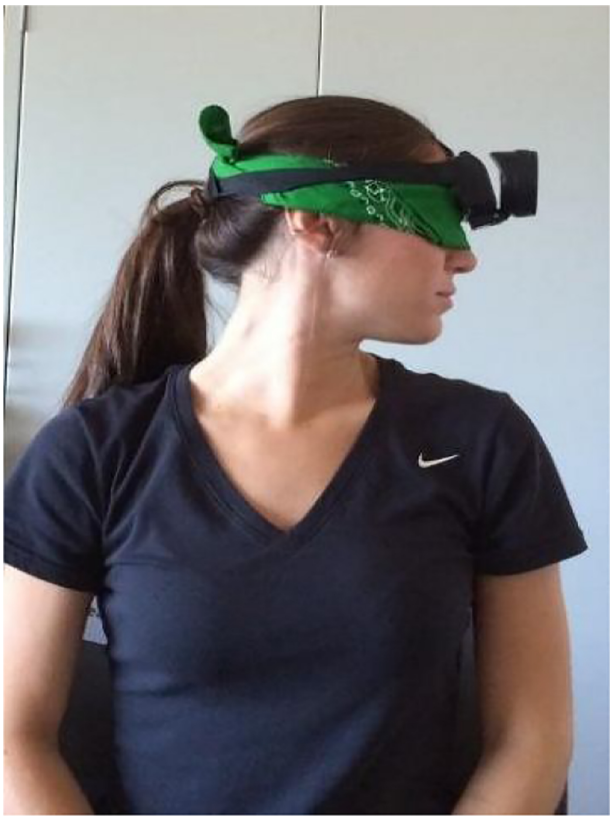

Figure 2 Cervical relocation laser

eliminate visual input and force the participant to use their cervical proprioceptors to return to their NHP. A modified bicycle helmet, with an affixed light pointer attached, was placed on the crown of the head and the straps were secured. Each subject's NHP was recorded based on the projection of the red light pointer from the helmet to a circular target on the wall three feet in front of the subject. The same procedures as the CROM were followed. Subjects rotated the cervical spine to the right and left respectively, taking a brief pause in at end range and then returning to their perceived neutral position. At that time, the examiner recorded the relocation position on the target based on the position of the red light pointer. This process was repeated for a total of three trials. The three trials for each direction of neck rotation were averaged to determine a single score for right head rotation and another for left head rotation in each subject. The right and left rotation values were determined to be separate observations for each subject creating a total of 50 observations for the 25 subjects in group A, as well as group B. Figure 2 shows the cervical relocation measures with the AL.

Results

A Type C ICC was run to determine the intratester and intertester reliability assessing one tester's results on the same subject between devices (Table 1) and the results of each tester on the same subject using the same device (Table 2), respectively.

Good interrater reliability was found between testers (Pair 1: 0.717[0.502–0.839], Pair 2: 0. 773[0.595–0.873]) using the CROM for the CRT (Table 2). The intertester reliability of the AL was more variable between tester pairs (Pair 1: 0.589[0.276–0.767], Pair 2: 0.750[0.554–0.860]. Less consistency between testers was determined for the AL device, resulting in an ICC average value of 0.670. A paired *t*-test was run to examine the relationship between the subjects' accuracy to relocate using the CROM and whether the subjects experienced a past history of neck pain. No significant differences were found between subjects with a history of neck pain and those without.

Discussion

Previous research has assessed the validity of the CROM and AL in measuring the return to NHP.

Table 1 Interclass correlation coefficient (ICC) for intratester reliability between the cervical range of motion (CROM) and laser device

Testers	Intraclass correlation	95% Confidence interval	
Tester 1	0.253	−0.317	Tester 1
Tester 2	0.386	−0.083	Tester 2
Tester 3	0.488	0.087	Tester 3
Tester 4	0.556	0.208	Tester 4

Table 2 Interclass correlation coefficient (ICC) for intertester reliability between the cervical range of motion (CROM) and laser device

Tester and device	Intraclass correlation	95% Confidence interval	
Tester 1 + 2 with CROM	0.717	0.502	0.839
Tester 1 + 2 with affixed laser (AL)	0.589	0.276	0.767
Tester 3 + 4 with CROM	0.773	0.595	0.873
Tester 3 + 4 with AL	0.750	0.554	0.860

A study by Wibault *et al.*[9] compared neck-healthy individuals (n=171) to those with cervical disc disease (CDD, n=71) using the CROM and the AL. The researchers determined validity of an ICC range of 0.43–0.91 between the CROM device and the laser in neck-healthy individuals (n=12). The authors later concluded the criterion validity between the CROM and AL was questionable due to the large ICC range and difference in population size between the two groups. This study also looked at neck healthy individuals, but qualified whether these people had a history of neck pain, which was thought to potentially affect the results.

Furthermore, Audette *et al.*[14] and Tousignant *et al.*[15] identified the reliability of the CROM as compared to electronic measuring system. Research by Audette *et al.*[4] found high interrater and intrarater reliability for both the 3-Space Fastrak and CROM with ICC values >0.8016. Additionally, research by Wibault *et al.*[9] analysed test–retest of only the CROM with an ICC value of 0.79–0.85. The present study found interrater reliability for the AL to range from 0.589 to 0.750. An electronic measuring system was not used in this investigation, but the utilization of devices which may be more available to the clinician was thought to improve potential generalizability to the clinical setting.

A study by Audette *et al.*[14] indicated a high interrater reliability for the laser while using the 3Space Fastrak with ICC, finding values >0.8016. Interrater reliability using the CROM to measure CRT in the present study found ICC values >0.75, indicative of good reliability between testers using the same device. Similarly, Audette *et al.*[14] found ICC values >0.8016 for the CROM. Capuano-Pucci *et al.*[16] also found good intertester reliability for the CROM when measuring cervical rotation ROM. Their study found a correlation coefficient range from 0.74 to 0.87.[16] These investigations assessed people with cervical pain[15] and without,[17] but both included a greater number of subjects than the present study. The relatively few number of subjects was a weakness of this investigation. In addition, lack of randomization of subjects and assessing asymptomatic, college age individuals limits the implications that may be drawn from the study. Another limitation involved familiarity with set-up and use of the CROM and AL. Additionally, the device fit and stabilisation was more challenging with the AL because of varying subject head size and the fact that a single bike helmet was utilized. An additional factor which may explain the reliability of the AL measure was the small target size. Subjects would frequently rotate their heads back to their perceived neutral but would not relocate on the paper target. Conversely, positioning the CROM was more familiar to the examiners who had considerable classroom and clinical practice with goniometric measures of cervical range of motion.

The fact that no significant differences in relocation between those with and without a history of neck pain may have been related to the fact that the subjects were asymptomatic at the time of examination. Cervical relocation found in previous research[4–7] has been found to be more difficult in those with pathology, particularly among chronic pain groups.

Conclusion

Based on this sample, the CROM was found to be a reliable tool for measuring return to NHP between different testers. The CROM may be a practical and relatively inexpensive tool for measuring relocation, compared to the setup and cost of other devices. Further research needs to examine outcome tracking for patients with neck pathology to determine if the CRT could be used as additional assessment method for people with neck pain.

Disclaimer Statements

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