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Technical and measurement report

The craniocervical flexion test: An investigation of performance in young asymptomatic subjects

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ABSTRACT

Introduction: The Deep Cervical Flexors (DCFs) provide support and segmental stability to the cervical spine. However, their endurance capacity can be reduced in cervicogenic disorders. The Craniocervical Flexion Test (CCFT) is regarded as the most effective means of assessing the contractile performance of these muscles. However, limited normative data exists to serve as a reference point during diagnosis.
Aim: This study examined CCFT performance in a group of young asymptomatic subjects and investigated the influence of physical activity levels, age and gender on CCFT score.
Method: The most recent CCFT protocol as described by Jull et al. (2008) was used. Baseline assessment scores along with certain patient characteristics were recorded on one occasion.
Results: For testing, 34 asymptomatic subjects were recruited (24 females, 10 males with a mean age of 21.5 ± 2.15 years). The median baseline assessment score was 24 mmHg (interquartile range = 3). Physical activity levels, age or gender did not significantly correlate with DNF endurance ($P > 0.05$).
Conclusion: The Median Baseline Assessment score was 24 mmHg (interquartile range = 3). Between-subject variability was high while physical activity levels; age or gender did not appear to influence the DCF muscle tonic holding capacity. The small heterogeneous sample involved in this study highlights the need for high quality normative studies to validate these findings.

1. Introduction

The deep cervical flexors (DCFs), longus capitis and longus colli, provide support and segmental stability to the cervical spine. However, their tonic holding capacity can be reduced in cervical disorders (Jull et al., 1999, 2004). The low-load craniocervical flexion test (CCFT) (Jull et al., 1999) was devised in response to the perceived need for more targeted exercises for patients with cervical disorders. The test is one of precision and control and is regarded as the most effective means of assessing and retraining the contractile performance of these muscles (Cagnie et al., 2008). They serve in the flexion of the upper cervical spine, together with a subtle flattening of the cervical lordosis, which are the anatomical functions of the DCFs (Mayoux-Benhamou et al., 1994; Kamibayashi and Richmond, 1998; Vasavada et al., 1998). In contrast, superficial cervical flexors (SCFs) such as the sternocleidomastoid (SCM) muscle are better structurally suited to flexing the lower cervical spine (C2–C7) (Vasavada et al., 1998).

The CCFT involves five incremental stages of craniocervical range of motion (ROM) (Falla et al., (2003a), guided by feedback from a Pressure Biofeedback Unit (PBU; Stabilizer™, Chattanooga Group, Australia). These incremental changes in pressure can be used as an outcome measure, serving as a reference point during DCF re-education and training (James and Doe, 2010). Jull (2000) has described ideal neuromotor control as the ability to achieve the increasing pressure targets and maintain these for ten seconds, with negligible activity in the SCFs. Compensatory SCFs involvement is an indication of poor DCF performance (Falla et al., 2004).

A myriad of studies have shown that the CCFT activates the intended muscles, establishing its construct validity (Falla et al., 2003a; Falla et al, 2003b; Falla et al., 2004; O'Leary et al., 2007; Cagnie et al., 2010). In addition, the CCFT also demonstrates excellent intra-rater reliability (Jull et al., 1999; James and Doe, 2010). Consequently, this test has a role in the diagnosis and treatment of patients with cervical dysfunction. Jull et al. (1999) defined ideal endurance capacity of the DCFs as an increase in

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pressure of 10 mmHg from a baseline of 20 mmHg, which can be held for ten seconds and repeated ten times consecutively. However, there is limited normative data, with variations from ideal neuromotor control frequently reported in the asymptomatic population (Chiu et al., 2005; Fernandez-de-las-Penas et al., 2007; James and Doe, 2010). Hence, the diagnostic application of the CCFT is somewhat inadequate (James and Doe, 2010), highlighting the need for high quality normative studies (Chiu et al., 2005). Therefore, the principal aim of this study was to examine CCFT performance in young healthy subjects whilst evaluating correlation with parameters such as physical activity levels, age and gender.

2. Methodology

2.1. Participants

Asymptomatic physiotherapy students, aged 18–30, were invited to participate in this study through an email distributed by a gatekeeper. Moderately active participants, as established by the Baecke activity questionnaire (Baecke et al., 1982) were eligible for inclusion if they had full pain-free range of motion (ROM) of the cervical spine. Subjects were excluded if they had; undergone neck surgery, current neck pain, frequent headaches (>one per month), or previous cervical spine trauma. Furthermore, those with temporomandibular joint (TMJ) dysfunction, any serious medical condition (e.g. diabetes), long-term steroid usage, or who had undergone dental work in the previous 12 months were ineligible for participation.

Activity levels were quantified using the Baecke activity questionnaire, a reliable and valid assessment tool (Baecke et al., 1982; Jacobs et al., 1993). A score of 4.2 indicated moderate activity levels (Barber, 1994). The same one student researcher assessed cervical ROM in standing. Patients were screened for exclusion criteria using a study-specific neck-screening questionnaire. Lastly, informed consent was obtained and documented prior to data collection with each participant being assigned an individual identification number. The Faculty of Health Sciences Research Ethics Committee in Trinity College Dublin granted ethical approval. Testing lasted 30 min per subject and was carried out in the Trinity Centre for Health Sciences, St. Jame's Hospital, Dublin.

2.2. Instrumentation

Prior to testing, participants' weight and height were measured. Individual scores of the Baecke activity questionnaire indicated physical activity levels and this figure, together with other participant characteristics such as age and gender, were recorded. A stopwatch was utilised to time rest periods and contractions, with the same one researcher responsible throughout testing. A PBU (Stabilizer™, Chattanooga Group, Australia) was used for the CCFT.

2.3. Preparation

This experimental study utilised the CCFT as described in the most recent protocol by Jull et al. (2008). The researcher responsible for carrying out the CCFT was deemed the most competent by the supervising academic staff member and received an additional one-hour of training to perfect skills.

The CCFT entails that the patient is supine, crook lying with both forearms resting on the abdomen. To standardise the craniocervical and cervical spine position, subjects were positioned in supine with the forehead and chin positioned horizontally. An imaginary line parallel to the plinth extended from the tragus of the ear, bisecting the neck longitudinally. Layers of towel were utilised as necessary. The same testing procedure and equipment were utilised for all participants.

2.4. Procedure

Participants were informed that the CCFT is one of precision rather than strength and the required movement is a slow head nodding action (as if saying "yes"). In addition, all participants were advised to place the tongue on the roof of the mouth, with lips together but teeth slightly apart, to minimise jaw musculature activity (Jull, 2000). If an apical breathing pattern was evident, the test was performed during expiration (Cagnie et al., 2008).

Once set-up was complete, the dial of the PBU was turned to the patient and a practice sequence commenced to ensure the subject understood the task required. Each subject was requested to slowly feel the back of their head slide up the plinth in a head nod action to elevate the target pressure from 20 to 22 mmHg and hold this for two to three seconds before relaxing and returning to the starting position (20 mmHg). This was repeated at each 2 mmHg increment to 30 mmHg, with verbal and visual cueing on correct technique provided by one researcher. This researcher monitored the movement of the head and the muscle activity in the SCF by observation only. Palpation was avoided as this may have facilitated or inhibited the subjects' performance of the test (Sterling et al., 2001). The motion is a head rotation of progressively increasing range with negligible activity observed in the SCF until the last two pressure increments (Jull et al., 2008). Signs of poor activation of the DCF include; the motion is performed with speed, the pressure dial does not return to the starting position, but instead reads a pressure greater than 20 mmHg, the ROM of head rotation does not increase with progressive increments of the test but rather a neck retraction movement strategy is observed. Once researchers were confident the subject was able to perform a craniocervical flexion action, a ten-second-rest period ensued.

Then, the participant was instructed to raise the pressure to 22 mmHg, holding this for ten seconds. Three repetitions were required before the participant was progressed to the next pressure increment (24, 26, 28, 30 mmHg) with a ten-second-rest interval between contractions. Throughout testing, the same researcher provided standardised instructions and the subject was monitored to ascertain the quality of the movement. The test was continued in the same fashion until successful completion (three ten-second holds at 30 mmHg) or substitution strategies were observed. These compensatory mechanisms include increased SCF activity (Jull, 2000), overshooting target pressure, neck retraction (Falla et al., 2004) and dial needle flickering. The participant was notified that the test had concluded and participation in the study was acknowledged.

2.5. Data analysis

The baseline assessment score, representing the highest-pressure level that can be maintained for three ten-second holds, without compensatory strategies (Jull et al., 2008) were entered in Microsoft Excel 2011. Anthropometric measurements were also inputted and data analysis was undertaken using SPSS 16.0 (SPSS, Chicago, IL, USA). Descriptive statistics such as mean and standard deviation were calculated for patient characteristics. The median baseline assessment score and interquartile range was chosen over the mean value, to represent the sample population's normative value. Given the non-Gaussian distribution, this value would be better represented by the median rather than the mean, with the median also being less sensitive to outliers (D'Addio et al., 2010). A Spearman's correlation coefficient was utilised to investigate the influence of physical activity levels and age on the baseline