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INTER-RATER RELIABILITY STUDY

Cervical extensor endurance test: A reliability study

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Summary *Background & purpose:* The purpose of this study was to determine the inter-rater reliability in detecting the presence of weakness of the neck extensors and differentiate the presence of weakness of the superficial versus the deep neck extensors in a symptomatic population. The presence of weakness of the neck extensors has been described to cause pain and dysfunction in the cervical region.
Methods: 30 patients with a diagnosis of neck pain were randomly assigned and examined by two musculoskeletal physical therapists at a time, in order to determine the presence of weakness of the superficial versus the deep neck extensors. With the patient lying prone and head and neck past the edge of the table and the cervico-thoracic junction stabilized, the ability of the individual to sustain a chin tuck position in neutral for 20 s was evaluated. A positive finding for weakness of the deep neck extensors is the 'chin length' increasing with neck extension, as observed on the inclinometer, indicating a dominance of the superficial extensors of the neck. Weakness of both deep and superficial neck extensors was identified by the presence of neck flexion indicating an inability to hold the head up. Inter-rater reliability was determined using the Cohen's un-weighted kappa statistic.
Results: For the cervical extensor endurance test, the inter-rater reliability was 'very good' ($k = 0.800$, SE of kappa = 0.109, 95% CI).
Conclusion: The cervical extensor endurance test may be incorporated as a simple yet effective test to determine the presence of weakness of the neck extensors and differentiate the presence of weakness of the superficial versus the deep neck extensors in a symptomatic

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population. The accuracy of the CEET as a test is still debatable, as it has not been compared to a diagnostic gold standard. Based on the results of this study, we speculate the CEET may still offer an initial sense of direction for clinicians treating neck dysfunction.

Introduction

Dysfunction of the supporting musculature of the neck has been described in patients with neck pain and the deep neck flexors have received attention in this regard (Cagnie et al., 2010). They have been described to exhibit difficulty in performing and sustaining a task called cranio-cervical flexion, which is the neutral position of the cervical spine. The deep cervical extensor muscle group is also considered to be important in performing this task (O'Leary et al., 2009), however poorly documented. It is only recently that the activation pattern of cervical extensors and the change in activation pattern of these muscles in patients with neck pain are being discussed (Cagnie et al., 2011; Schomacher and Falla, 2013; Lee et al., 2005).

A distinct anatomic division has been described between the neck extensors as a superficial and deep group (Elliot et al., 2010). The superficial neck extensors being the Splenius Capitis (SpC) and Semispinalis Capitis (SCa) and the deep neck extensors the Multifidus (Mul) and Semispinalis cervicis (SCe). The superficial group has been described to be best activated in cranio-cervical extension (CCE) while the deep group in cranio-cervical flexion (CCF) (Lee et al., 2007; Schomacher and Falla, 2013; Elliot et al., 2010).

Clinically, CCF is the activity that has been encouraged in therapeutic intervention as this has been described to optimize the load distribution and functional ability of the cervical region, thereby minimizing risk for dysfunction (Jull et al., 2007). De-conditioning of the deep cervical flexors are described as contributors to the inability to perform this activity. The Mul and SCe are also at risk for de-conditioning due to their complementary stabilizing function, potentially contributing to dysfunction in weakened states (Cagnie et al., 2011). A clinical test has been instituted to identify the presence of weakness of the deep cervical flexors (Arumugam et al., 2011), which has aided in indicating appropriate therapeutic (strengthening) intervention (Falla et al., 2007). Appropriate identification of dysfunctional states of the deep neck extensors may similarly be necessary to indicate appropriate therapeutic intervention in subjects with neck dysfunction.

Current evidence based practice suggests clinical tests to have 'diagnostic utility' prior to administration in clinical practice (Tweed and Wilkinson, 2012). It suggests that a clinical test should first have an operant definition based on it's clinical need and be reliably reproducible between examiners. Subsequently, the sensitivity, specificity, likelihood and odds ratios are calculated. It is obvious that when an operant definition of a clinical test has been established based on the clinical need, studying it's reliability would be an essential precedent.

In the presence of neck dysfunction, ideally the test should identify the presence of neck extensor weakness and be able to differentiate between weakness of the superficial and deep group weakness, or both, as it may suggest the type of intervention needed. The cervical extensor endurance test (CEET) aims to be able to identify weakness of both superficial and deep neck extensors. As the test has not been previously described, it does not have a published, agreed upon operant definition. The aim of this study was to identify an operant definition for the potentially, clinically useful, cervical extensor endurance test (CEET). Subsequently the intent was to test the reproducibility of the test between raters.

Methods

Three orthopaedic board certified and orthopaedic manual therapy fellowship trained physical therapists, with 22 years of experience in orthopaedic physical therapy, conducted a pilot training on students. The intention was to first familiarize the methodology of performing the CEET and subsequently establish an operant definition. With the subject lying prone and head and neck past the edge of the table and the cervico-thoracic junction stabilized, the ability of the individual to sustain a chin tuck position in neutral for 20 s was evaluated (Fig. 1a). A positive finding for weakness of the deep neck extensors is the 'chin length' increasing with neck extension, as observed on the inclinometer, indicating a dominance of the superficial extensors of the neck (Fig. 1b). The inclinometer has been described to be a valid tool for measuring active range of motion in the cervical region (De Koning et al., 2008; Balou et al., 2014). A physiological neutral is difficult to establish in the maximal cranio-cervical flexion position owing to the varying degrees of tightness in the sub-occipital musculature, atlanto-occipital joint capsule and ligamentum nuchae. Hence a deflection of 5—10° from a maximal cranio-cervical flexion position to a relative cranio-cervical extension position for the deep cervical test and a flexion deflection of more than 10° for the global test were considered a positive finding. While the inclinometer helps to visually quantify the amount of deflection seen for purposes of establishing reproducibility, it may not be required in routine clinical practice as the direction of cranial movement can be visualized by a trained eye. Weakness of both deep and superficial neck extensors (global weakness) was identified by the presence of neck flexion indicating an inability to hold the head up (Fig. 1c). A statistical analysis was not done for the pilot training as the intent was to simply understand the methodology for consistency of performing the test, prior to conducting the study. Once the 'operant definition' for consistency of performance was clearly understood by the participating clinicians, the study proceeded.