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Original article

Reliability and minimal detectable change of a modified passive neck flexion test in patients with chronic nonspecific neck pain and asymptomatic subjects

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ABSTRACT

Background: The Passive Neck Flexion Test (PNFT) can diagnose meningitis and potential spinal disorders. Little evidence is available concerning the use of a modified version of the PNFT (mPNFT) in patients with chronic nonspecific neck pain (CNSNP).
Objectives: To assess the reliability of the mPNFT in subjects with and without CNSNP. The secondary objective was to assess the differences in the symptoms provoked by the mPNFT between these two populations.
Design: We used repeated measures concordance design for the main objective and cross-sectional design for the secondary objective.
Method: A total of 30 asymptomatic subjects and 34 patients with CNSNP were recruited. The following measures were recorded: the range of motion at the onset of symptoms (OS-mPNFT), the range of motion at the submaximal pain (SP-mPNFT), and evoked pain intensity on the mPNFT (VAS-mPNFT).
Results: Good to excellent reliability was observed for OS-mPNFT and SP-mPNFT in the asymptomatic group (intra-examiner reliability: 0.95–0.97; inter-examiner reliability: 0.86–0.90; intra-examiner test-retest reliability: 0.84–0.87). In the CNSNP group, a good to excellent reliability was obtained for the OS-mPNFT (intra-examiner reliability: 0.89–0.96; inter-examiner reliability: 0.83–0.86; intra-examiner test-retest reliability: 0.83–0.85) and the SP-PNFT (intra-examiner reliability: 0.94–0.98; inter-examiner reliability: 0.80–0.82; intra-examiner test-retest reliability: 0.88–0.91). The CNSNP group showed statistically significant differences in OS-mPNFT ($t = 4.92$; $P < 0.001$), SP-mPNFT ($t = 2.79$; $P = 0.007$) and in VAS-mPNFT ($t = -10.39$; $P < 0.001$) versus the asymptomatic group.
Conclusion: The mPNFT is a reliable tool regardless of the examiner and the time factor. Patients with CNSNP have a decrease range of motion and more pain than asymptomatic subjects in the mPNFT. This exceeds the minimal detectable changes for OS-mPNFT and VAS-mPNFT.

1. Introduction

Neck pain is a common condition that affects approximately 30–50% of the world's population annually(Manchikanti et al., 2009). Neck pain reduces the abilities and quality of life of affected individuals and results in high costs for society(Guzman et al., 2008; Hogg-Johnson et al., 2009; Haldeman et al., 2010). Most chronic neck pain is classified as nonspecific(Binder, 2007b). This condition has a multifactorial nature, and its symptoms usually have a postural or mechanical basis(Binder, 2007a). Inflammatory processes in the zygapophysial joints and/or intervertebral discs, which are difficult to identify with radiological tests (Riley and Long, 1995), can irritate nerve tissue(Taylor and Taylor, 1996; Eliav et al., 1999).

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Mechanical stimulation in sensitized nerve tissue may causes hyperalgesic responses(Hall and Quintner, 1996). The alternatives that can be used to assess increases in the mechanosensitivity (sensitivity to mechanical stimuli) of the nervous system include the neural provocation/neurodynamic test(Elvey, 1997; Butler 2000). The neural provocation test consists of a sequence of movements that are designed to assess both the mechanics and physiology of a part of the nervous system by increasing the length and pressure of the peripheral nerve (mechanical tension) (Coppieters et al., 2002).

Previous studies evaluated the reliability of some neural provocation/neurodynamic tests in different regions, such as in the upper and lower extremities(Coppieters et al., 2002; Vanti et al., 2010; Oliver and Rushton, 2011; Trainor and Pinnington, 2011; Boyd, 2012; Talebi et al., 2012). However, little evidence is available concerning the reliability of the neural provocation test in assessing the neuromeningeal mechanosensitivity of the cervical region. In the available literature, the term neuromeningeal mechanosensitivity is used to describe the mechanosensitivity of the neuromeningeal structures within the vertebral canal(Tucker et al., 2007). To achieve this objective, therapists could use the Passive Neck Flexion Test (PNFT), which was described by Butler(-Butler and Jones, 1991). The PNFT consists of passively flexing the participant's neck and drawing the “chin to the chest” while the participant is supine. However, it is important to mention that there is currently no gold standard for determining if the symptoms provoked by the mPNFT are caused by neural components or musculoskeletal components. The PNFT (also known as Brudzinski's sign) assesses the consequences of sliding in the cranial direction of the neuroaxis and is an indicated test for diagnosing meningitis (sensitivity: 66%; specificity: 74%) (Curtis et al., 2010) and hypothesized to provoke neurological tissue that may be responsible for clinical symptoms such as headaches, or pain in the arms and legs of spinal origin(Butler and Jones, 1991).

To our knowledge, only one study has employed a modified version of the PNFT (mPNFT)(López-de-Uralde-Villanueva et al., 2016). The only change with respect to the original version of the test is the addition of a craniocervical flexion to the passive flexion of the participant's neck to increase neuromeningeal tension; this addition could increase the specificity of the test(Tencer et al., 1985). This craniocervical flexion is performed before passive neck flexion and is applied through two grasps: one grasp on the occipital region and the other grasp on the superior maxilla immediately below the participant's nose. The study conducted by López-de-Uralde-Villanueva et al. (2016) found differences in the symptoms provoked by the mPNFT between patients with chronic nonspecific neck pain and healthy subjects. Nevertheless, the measurement error of the mPNFT is not yet known. This uncertainty makes it difficult to determine whether or not a difference observed in this test is real. In addition, little evidence is available concerning the reliability of the mPNFT. Thus, the authors believe that it necessary to improve our understanding of this topic.

For the cervical region, there is limited evidence concerning the ability to detect differences in neural mechanosensitivity between patients with cervical pain and asymptomatic subjects using neural provocation tests(Sterling et al., 2002; Petersen et al., 2009; Smith et al., 2013; Ng et al., 2014; López-de-Uralde-Villanueva et al., 2016). According to the available literature, patients with cervical pain have increased neural mechanosensitivity in comparison to asymptomatic subjects when the Upper Limb Neural Test (ULNT) is applied(Sterling et al., 2002; Petersen et al., 2009; Smith et al., 2013; Ng et al., 2014; López-de-Uralde-Villanueva et al., 2016). The ULNT was selected to assess neural mechanosensitivity due to the fact that the brachial plexus consists almost entirely of cervical nerve roots. However, despite the fact that the ULNT produces displacement and strain of the cervical nerve roots (Lohman et al., 2015), the test does not assess possible overall neuromeningeal mechanosensitivity. Thus, it could be interesting to use the mPNFT to evaluate the presence of possible neuromeningeal mechanosensitivity. However, to our knowledge, only one study has shown that patients with chronic nonspecific neck pain experience symptoms at a lower range of motion than healthy subjects via the mPNFT (López-de-Uralde-Villanueva et al., 2016). This finding might suggest the existence of a greater neural mechanosensitivity in the cervical region. Thus, studies that assess differences between patients with chronic nonspecific neck pain and healthy subjects are needed.

The objective of this study was to assess the reliability (intra-examiner, inter-examiner and intra-examiner test-retest) and other measures of the mPNFT both in asymptomatic subjects and in patients with chronic nonspecific neck pain. The secondary objective was to assess the differences in the symptoms provoked by the mPNFT (range of motion at the onset of symptoms, range of motion when provoking submaximal pain and perceived pain intensity) between patients with chronic nonspecific neck pain and asymptomatic subjects.

2. Methods

2.1. Study design

This research study consists of two well-differentiated designs that satisfy the two proposed objectives. We used a repeated measures concordance design according to the directives of the Guidelines for Reporting Reliability and Agreement Studies (GRRAS)(Kottner et al., 2011). To assess differences in the symptoms provoked by the mPNFT between patients with chronic nonspecific neck pain and asymptomatic subjects, we used a cross-sectional design, according to the “Strengthening the Reporting of Observational Studies in Epidemiology” (STROBE) statement(von Elm et al., 2008). The Ethics Committee of the Centro Superior de Estudios Universitarios La Salle (Madrid, Spain) approved the implementation of this study (registration number: PI-089/2015).

3. Participants

The study population consisted of two groups: patients with chronic nonspecific neck pain and asymptomatic subjects. The patients with chronic nonspecific neck pain were recruited at the Primary Care Centre Miraflores de Alcobendas (Madrid, Spain) using consecutive sampling. The patients were required meet the following criteria to be included in the study: 1) age between 18 and 65 years; 2) nonspecific neck pain for more than three months; and 3) a pain intensity of 30–60 mm on the Visual Analogue Scale (VAS). Patients were excluded if they presented “red flags” (rheumatological disease, cancer, cervical radiculopathy, myelopathy, previous cervical surgery or whiplash) (Greenhalgh and Selfe, 2009), if they had any type of symptom in the arm/craniofacial region, or if they had undergone any type of treatment for their pain (physical therapy, medication, etc.) in the past three months.

The asymptomatic subjects were recruited through a snowball sampling process with the help of the enrolled patients (their relatives, friends, etc.). The subjects were required to be 18–65 years of age and to have not experienced any type of pain during the past three months. In addition, all subjects received a physical assessment to confirm their pain-free state. The exclusion criteria of the asymptomatic group included the following criteria: 1) previous cervical surgery and/or whiplash; 2) taking any medication during the past three months that could affect the test outcomes; 3) the presence of systemic disease such as cancer, rheumatoid arthritis, or fibromyalgia; and 4) any type of cognitive impairment that could limit communication or the comprehension of the tests.