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Review article

Effects of lower body quadrant neural mobilization in healthy and low back pain populations: A systematic review and meta-analysis

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ABSTRACT

Background: Neural mobilization (NM) is widely used to assess and treat several neuromuscular disorders. However, information regarding the NM effects targeting the lower body quadrant is scarce.
Objectives: To determine the effects of NM techniques targeting the lower body quadrant in healthy and low back pain (LBP) populations.
Design: Systematic review with meta-analysis.
Method: Randomized controlled trials were included if any form of NM was applied to the lower body quadrant. Pain, disability, and lower limb flexibility were the main outcomes. PEDro scale was used to assess methodological quality.
Results: Forty-five studies were selected for full-text analysis, and ten were included in the meta-analysis, involving 502 participants. Overall, studies presented fair to good quality, with a mean PEDro score of 6.3 (from 4 to 8). Five studies used healthy participants, and five targeted people with LBP. A moderate effect size ($g = 0.73$, 95% CI: 0.48–0.98) was determined, favoring the use of NM to increase flexibility in healthy adults. Larger effect sizes were found for the effect of NM in pain reduction ($g = 0.82$, 95% CI 0.56–1.08) and disability improvement ($g = 1.59$, 95% CI: 1.14–2.03), in people with LBP.
Conclusion: Evidence suggests that there are positive effects from the application of NM to the lower body quadrant. Specifically, NM shows moderate effects on flexibility in healthy participants, and large effects on pain and disability in people with LBP. Nevertheless, more studies with high methodological quality are necessary to support these conclusions.

1. Introduction

Neural mobilization (NM) techniques are widely used to evaluate, and improve, the mechanical and neurophysiological integrity of the peripheral nerves (Shacklock, 1995) in clinical populations (Butler, 2000). These techniques include combinations of joint movements that promote either neural tensioning (i.e. through displacement of the nerve endings in opposite directions) or sliding (i.e. through displacement of nerve endings in the same direction (Coppieters et al., 2009). Several studies have successfully used NM to improve flexibility, in both healthy (Herrington and Lee, 2006) and clinical populations (Coppieters et al., 2003), and also to induce different amounts of neural excursion (Coppieters et al., 2015). This is particularly relevant because it has been reported that nerve properties (e.g. cross-sectional area) are altered in certain peripheral neuropathies (Lee and Dauphinée, 2005), and in upper limb nerve entrapment syndromes (Hough et al., 2007; Kantarci et al., 2013). These changes in the nerve properties may be associated with a compromised nerve function (Li and Shi, 2007; Rickett et al., 2010). In addition, it has also been shown that people with peripheral neuropathy have a higher lower body quadrant mechanosensitivity (Boyd et al., 2010). Consequently, the NM techniques are used as treatment for different neuromuscular disorders.

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Studies performed in participants with cervicobrachial pain (Allison et al., 2002; Nee et al., 2012), lateral epicondylalgia (Vicenzino et al., 1996), and carpal tunnel syndrome (Pinar et al., 2005) have shown positive effects of NM interventions in pain relief. Some of these studies also found a positive effect in pain-free grip strength (Vicenzino et al., 1996; Pinar et al., 2005), and in self-reported activity limitations (Nee et al., 2012). The positive effects of NM reported in these studies are related to the upper body quadrant disorders (i.e. cervical spine, shoulder, elbow and wrist). Still, few studies have examined the NM effects on the lower body quadrant (i.e. trunk, thigh, leg and foot).

Low back pain (LBP) is a common lower body quadrant problem, and represents an important cause of disability with strong economic impact (Hoy et al., 2012; Global Burden of Disease Study, 2013 Collaborators, 2015). Several interventions, such as exercise therapy (Hayden, 2005), massage (Furlan et al., 2009), or lumbar stabilization techniques (Haladay et al., 2013) are used to treat people with LBP, but with limited evidence regarding its effectiveness. In addition, NM has also been used to treat LBP (Schäfer et al., 2011; Čolaković and Avdic, 2013), with the objective of reducing the patient's mechanosensitivity of the lower body quadrant (Coppieters et al., 2005).

Previous systematic reviews (Ellis and Hing, 2008; Su and Lim, 2016) examined the effects of NM interventions exclusively in clinical populations, and mostly in the upper body quadrant dysfunctions. Considering the recent NM studies published in both healthy and LBP populations, and the lack of meta-analytical data supporting the effects of NM, the purpose of this study was to systematically review appropriate randomized controlled trials (RCTs) that aimed to determine the effectiveness of NM techniques targeting the lower body quadrant. Specifically, we analyzed the effects of NM on flexibility in healthy adults, and the effects of NM on pain and disability in people with LBP.

2. Methods

The protocol of this systematic review was registered on the International Prospective Register of Systematic Reviews (PROSPERO; CRD42015023602). This systematic review followed the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) statement (Moher et al., 2009).

2.1. Search strategy and study selection

A comprehensive electronic search of scientific articles was conducted by one researcher (TN) on the following electronic databases: PubMed, PEDro, Web of Science, Scielo, and Cochrane Central Register of Controlled Trials. The following search terms were used (an example of a search strategy is shown in Appendix 1): neurodynamics, neural mobilization, neural tension, neural stretching, lower body quadrant, lower limb, low back pain, sciatica, flexibility, range of motion, physical therapy, neural stiffness, slump, straight leg raise test. This search was complemented by manually detecting references from bibliography of the included studies and previous reviews. A researcher (TN) identified the studies by their title and abstract, and manually removed the duplicate articles. When studies fulfilled the inclusion criteria, three researchers (TN, SF, and RO) read the entire manuscripts and gave their recommendation for inclusion.

2.2. Inclusion and exclusion criteria

2.2.1. Population

Studies using NM techniques in both healthy, and LBP participants, over 18 years of age were included. Low back pain was defined as the presence of pain and discomfort below the costal margin and above the gluteal folds with or without leg pain (Koes, 2006). Studies involving populations presenting other neuromuscular or rheumatic disorders, post-surgical conditions, and pregnancy were excluded.

2.2.2. Intervention

Eligible studies had to include any form of NM (i.e. sliding or tensioning) targeted to the lower body quadrant. Studies also had to compare NM against other forms of interventions (e.g. lumbar stabilization exercises, lumbar spine mobilization, static stretching, or standard treatment), or a control condition (no intervention or placebo). Due to the low number of studies that analyzes the effects of NM, a specific comparison intervention was not selected. Moreover, the objective was to assess the effects of the NM techniques, regardless of the interventions used as comparison, and not to conclude if NM is more effective than one determined intervention.

2.2.3. Outcomes

Eligible studies included at least one of the following outcomes: pain intensity (measured with a visual analogue scale or a numeric rating scale), disability (measured by the Oswestry Disability Index or the Roland and Morris Disability Questionnaire), or lower limb flexibility (measured by the straight leg raise test – SLR, or the active knee extension test – AKE).

2.2.4. Study characteristics

Studies had to meet the following inclusion criteria: a) written in English or Portuguese language; b) randomized controlled trials (RCTs); c) published between January 1995, and May 2015; and d) use any form of NM technique (i.e. sliders or tensioners) targeting the lower body quadrant. Studies involving animal or cadaveric investigations were excluded.

2.3. Quality assessment

Methodological quality assessment (Table 1) of the selected studies was independently performed by two reviewers (TN, LG) using the PEDro scale (Verhagen et al., 1998). Initial disagreements were resolved by a consensus meeting between both reviewers. External validity was assessed using the first item of the scale. However, this criterion was not considered for the final PEDro score. Items 2–9 assess internal validity; items 10 and 11 refer to the study's statistical analysis (Maher et al., 2003). Depending on their PEDro score, studies were classified as excellent (PEDro score > 8), good (PEDro score between 6 and 8), fair (PEDro score between 4 and 5), and poor (PEDro score < 4) (Foley et al., 2003). The reliability between the two reviewers was determined using the Kappa statistics.

2.4. Data extraction

Data extraction was performed by one author (TN). The following information was extracted from each study: 1) bibliographic information (authors and year of publication); 2) objectives; 3) characteristics of the participants (age, sex, healthy/LBP participants, symptoms duration); 4) characteristics of NM interventions [technique type (i.e. sliders or tensioners), number of sessions, number of repetitions, and duration); 5) type of control condition (e.g. static stretching, manual therapy, exercise, standard treatments, placebo interventions, no intervention, and respective frequency and duration); 6) outcomes measured (e.g. pain, disability, lower limb flexibility). All outcomes variables were continuous. Effect sizes were determined using the following data: sample sizes, means, and standard deviations (SD), both at baseline and post-treatment, for all groups (i.e. treatment and control). In one study (Castellote-Caballero