Journal of Bodywork & Movement Therapies (2016) 20, 316—323

Available online at www.sciencedirect.com

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journal homepage: www.elsevier.com/jbmt

PILOT STUDY

Onset and maximum values of electromyographic amplitude during prone hip extension after neurodynamic technique in patients with lumbosciatic pain: A pilot study

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Received 29 March 2015; received in revised form 11 August 2015; accepted 15 August 2015

KEYWORDS
Electromyography;
Lower back pain;
Sciatica;
Neuropathic pain;
Neurodynamic techniques;
Prone hip extension

Summary *Objective:* The mechanisms underlying the effects of neurodynamic techniques are still unknown. Therefore, the aim of this study was to provide a starting point for future research on explaining why neurodynamic techniques affect muscular activities in patients with sciatic pain.
Methods: A double-blind trial was conducted in 12 patients with lumbosciatica. Surface electromyography activity was assessed for different muscles during prone hip extension. Pre- and post-intervention values for muscle activity onset and maximal amplitude signals were determined.
Results: There was a significant reduction in the surface electromyography activity of maximal amplitude in the erector spinae and contralateral erector spinae ($p < 0.05$). Additionally, gluteus maximus ($p < 0.05$) activity onset was delayed post-intervention.
Conclusions: Self-neurodynamic sliding techniques modify muscular activity and onset during

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http://dx.doi.org/10.1016/j.jbmt.2015.08.006
1360-8592/

prone hip extension, possibly reducing unnecessary adaptations for protecting injured components. Future work will analyze the effects of self-neurodynamic sliding techniques during other physical tasks.

Introduction

To move normally, the nervous system needs to freely perform three mechanical functions — tension, sliding, and compression, with most complex mechanical tasks being performed through a combination of these three functions (Shacklock, 2005). Due to these mechanisms, neural tissue is able to adapt to different body movements. Furthermore, the onset of muscle activity and pain are related. Nevertheless, the means by which muscular responses are mediated remain unclear (Van der Heide et al., 2001). In turn, neural tension was first used to describe dysfunction in the peripheral nervous system (Butler, 2009). During neurodynamic (ND) assessments of the lower limbs, mechanosensitivity of the nervous system occurred as a normal protective mechanism to control symptomatic responses (e.g. pain), increase muscle tone and, subsequently, reduce the range of motion (Boyd et al., 2009). To overcome this limitation, neural tissue mobilization techniques using passive or active movements can be applied to restore tolerance of the nervous system to normal compressive, frictional, and tensile forces associated with daily and sporting activities (Nee and Butler, 2006). Furthermore, during neural tissue mobilization, both high and low-pressure zones are produced, resulting in noxious flux distribution derived from adverse neural tension (Ellis and Hing, 2008).

Much of the initial evidence supporting the use of neural mobilization was anecdotal (Medina and Yancosek, 2008). Indeed, early studies examining the influence of neural mobilization on nerve movement were conducted in cadavers (Butler and Coppieters, 2007; Coppieters et al., 2006). However, cadaveric models limited the ability of these studies to provide support for theoretical concepts regarding nerve mechanics. While advancements have been made, to date many of the perceived benefits of neural mobilization are founded in theory only and have not been directly supported with research evidence (Beneciuk et al., 2009; Ellis et al., 2012).

Highly related to neural mobilization is the study of ND, or investigation on the mechanics and physiology of the nervous system and how these relate to each other (Shacklock, 1995; Pitt-Brooke, 1997). Hypotheses for the effects of ND in manual therapy techniques have historically been biomechanics-based (Butler, 2009), but there has been a recent shift away from purely mechanical rationale towards including physiological concepts, such as the structure and function of the nervous system (Ellis and Hing, 2008). For example, a recent study in rats with severe peripheral nerve injury showed that passive ND exercises reduce nociceptive behavior, in addition to normalizing satellite glial cell responses in the dorsal root ganglion and astrocyte responses in the spinal cord (Santos et al., 2012). Moreover, the application of ND techniques on different pathologies related to normal nervous system movements appears to result in increased motion range, both passive and active; augmented grip and pinch forces; reduced disability and dysfunction; less pain; smaller symptom area; and lowered pressure pain (Ellis and Hing, 2008); however, the authors did not mention the effects of ND techniques on the central nervous system.

Restoration of restricted nerve movement is unlikely to be the main therapeutic effect of ND sliding exercises, and alternative consequences should be considered (Coppieters and Butler, 2008). For example, hamstring flexibility in male soccer players can be increased through ND sliding techniques (Castellote-Caballero et al., 2013). Moreover, normal protective muscle activity induced by the nervous system to avoid overstretching in healthy individuals should be taken into consideration when assessing the resistance felt during straight leg raise testing and when prescribing muscle and soft tissue stretches (Boyd et al., 2009).

Increased afferent discharge from abnormal impulse generation sites and sensitized nervi nervorum are thought to mediate the symptom response associated with ND assessments (Butler, 2000; Devor and Seltzer, 1999; Hall and Elvey, 1999). Symptomatic complaints during nerve palpation do not necessarily result in the identification of the neural tissue injury site since the entire neural tissue tract can become mechanically sensitive after injury to a particular nerve segment (Butler, 2009; Hall and Elvey, 1999). Furthermore, pain catastrophizing seems to be important factor to consider when evaluating evoked pain intensity reports during upper-extremity ND testing (Beneciuk et al., 2010). Research on participants believing muscle to be the pain source resulted in no changes in pain with provocative ND tests, whereas participants that believed pain was due to 'nerve irritation' experienced significant changes during straight leg raises and variations of this test. Interestingly, pain increased or decreased according to patient expectations (Coppieters et al., 2005).

Likewise, a number of studies have demonstrated altered activation patterns of the lumbo-pelvic muscles during various tasks in patients who suffer from lower back pain (LBP) (Arab et al., 2011). In patients with chronic LBP, there is an alteration in the hip extensors that affects pelvic stability in automatic responses (Bullock-Saxton et al., 1993). One way of automatically examining activity of hip extensor and spinal column musculature is through active prone hip extension (PHE) (Hungerford et al., 2003). However, PHE presents a comparatively variable pattern of activation, whereas gluteus maximus activation is the weakest and/or substantially delayed when the erector spinae on the ipsilateral side or even the shoulder girdle muscles initiate movement (Janda, 1983; Liebenson, 2006).