# *Neurodynamic assessment and the effects of neurodynamic treatment in sport rehabilitation*

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Lucerne, 31/1/2016

## Introduction

The present essay will critically evaluate the literature regarding neurodynamic assessment and the effects of neurodynamic treatment in sports rehabilitation. Moreover, this essay will discuss how neurodynamic assessment and effects of treatment will influence clinical practice. “The body is the container of the nervous system (N.S.)” (Shacklock, 2005). Central and peripheral nerves consists the Nervous System (NS), which consist of the Spinal and radicular canals, cranial nerves, meninges, nerve roots and the later of the nerve bed in the limbs and torso. When the human body moves, mechanical forces are applied in neural tissues. Sliding, elongation, tension and alteration in pressure are some of these mechanical effects. These mechanical stresses provoke changes in blood flow, axonal transport and impulse traffic in neural tissues.

The term “Neurodynamic” includes mechanical and physiological characteristics, which are combined in one mechanism. Neurodynamic tests (NDTs) are neural tension tests, which provoke mechanical and physiological responses (Shacklock, 2005). Recently, mobilizations of the nervous system, including techniques which slide and elongate the nerve bed, are widely used by the therapists in order to assess and treat neurogenic related pain symptoms. More specifically, the use of these tests is the mechanically stimulation of the neural tissues, which provides information about the mobility and sensitivity of neural structure (Shacklock, 2005). The upper limb neurodynamic tests and the straight leg raise are some neurodynamic tests for the brachial plexus and the sciatic plexus, respectively. Their role is to evaluate peripheral nerve sensitivity to mechanical tension movement and detect an underlying pathology, such as injury or neural compression (Boyd *at al.*, 2005). However, the NTs are used also as an adjunct to treatment (Shacklock, 2005) in order to improve the neural mobility and mechanosensitivity (Lobacz, 2015). “Strain of nerve, a measure of tissue deformation, is defined as the change in nerve length compared to its resting or initial length” and “excursion is the movement of a nerve in relation to the surrounding nerve bed”, as defined by Boyd *at al.* (2005).

Based on the above characteristics of a nerve, two types of techniques have been developed to treat nerve sensitivity and mobility: commonly described as “Sliders” and “Tensioners” (Lobacz, 2015). The “Sliders” technique produces mobilization of the nerve and its surrounding soft tissues, using neural gliding techniques. It is also important to mention, that the range of the performance of these techniques should be pain-free. On the other hand, “Tensioners” technique includes oscillatory physiological movements of the nerves. The aim of these techniques is not the stretching of neural structure, but its harmonic adaptation in daily movements (Lobacz, 2015). Regarding to the reliability of NDTs, for example, the Upper Limb Tension Test (ULNT) seem to be reliable when they are used as clinical tools (Nee *at al.*, 2012). Similarly, the Straight Leg Raise (SLR) test is also commonly applied, due to its high specificity. Patients, who suffer from root compression and a surgery is required, they can be good identified. Additionally, for patients suffering from lumbar disc herniation, the Slump test can be used thanks to its high sensitivity (Majlesi *at al.*, 2008).

The NDTs can be also used to assess and treat athletes, especially when a multi-structural treatment is required. For instance, athletes with a diagnostic of sports injuries such as a hamstring strain can be treated with the use of these manual techniques or NDTs (Shacklock, 2005). Moreover, these manual techniques are helpful in athletes, suffering from compressive radiculopathies, peripheral

neuropathies and ankle inversion sprains (Nelson and Hall, 2011). Comparing the two tests, the "Sliders" technique is suggested more in athletes, with an acute injury or if the therapist aim to maintain the sliding capacity of a nerve, while the "Tensioners" tests are more aggressive approaches of therapy and are indicated to athletes when the main source of their pathology is not a neural structure (Shacklock, 2005). Nevertheless, due to the fact that tensioners are a more aggressive way of a mobilization, as it is mentioned above, the sports physiotherapists should apply these techniques in their patients with caution (Lobacz, 2015).

## Main Body

While we are moved, our musculoskeletal system stresses the neural structures. The way and the grade of stress depend on the pattern of our movement and the anatomical features of every person (Shacklock, 2005). Many of symptoms of the musculoskeletal system have their origin in neural tissues. The behavior of the nerve system follows a non-uniform pattern of movement (Shacklock, 2005). Changes in mechanosensitivity can result a painful experience, during a movement or a specific posture of the body (Sharma *at al.*, 2016). An important tool of clinicians all over the world for the assessment and the treatment of a variety of pain syndrome is the mobilization of the nerve system (Mehta *at al.*, 2014).

Neural mobilization techniques are used by therapists especially for the athletes with musculoskeletal disorders, who need a multi-structural treatment (Shacklock, 2005). For that reason neurodynamic mobilization has been developed (Torres *at al.*, 2015). These techniques of manual therapy aim to stress the neural tissues through the positioning and the movement of the joints (Torres *at al.*, 2015). This approach targets towards to the reduction of the intraneural pressure and the improvement of blood flow. Other benefits are the improvement of axonal transport, nerve conduction and the capacity of a nerve to glide during a physiological movement (Torres *at al.*, 2015). Additionally, another very essential point is the treatment of neuropathic pain, following a peripheral nerve injury. It has been found that after a peripheral injury, the activation of glial cells in the spinal cord provokes neural excitability in dorsal horn, which results in neuropathic symptoms. Join Mobilization seems to be an effective method, in order to reduce neuropathic pain. These analgetic effects of Mobilization are due to descending inhibitation mechanism (Martins *at al.* 2011). Many theories try to explain the effects of neural mobilization, but the exact mechanism is still unclear (Ellis *at al.*, 2012).

The clinicians use nerve mobilization techniques, aiming to enhance the joint mobility and mainly the flexibility of the nerve system (Bertolini *at al.*, 2009). The therapy seems to improve the neyrodynamic and axoplasmic flow and the nerve regains their elasticity. Furthermore, the patients seem to benefit from decrease of intraneural edema, of dorsal horn activation as well as supraspinal sensitization (Ellis et al, 2012). In addition to the above mentioned effects, the nerve mobilization prevents the formation of adhesion around the nerve and reduces its compression, friction and tension (Bertolini *at al.*, 2009). It has been proposed that neurodynamic treatment seems to activate the descending pain inhibition analgesic mechanism. The Periarticular Grey (PAG) is the area which controls nociception and consists of the dorsolateral (dPAG) and vertolateral PAG (vPAG). Activation of dPAG results in an immediate reduction of pain and increased sympathetic nervous system (SNS) activity whereas the activation of vPAG after 20-60 minutes of treatment results in reduced

nociception and pain as well as decreased SNS activity (Wright, 1995). Thus, neurodynamic treatment is a stimuli which possibly activates the descending pain inhibitory systems (Visenzino *at al.*, 1994; Sterling *at al.*, 2001). It should be mentioned that the aforementioned studies have investigated the neurophysiological effects of joint mobilisation and these effects could be extrapolated in neurodynamic treatment with caution (Buttler, 2000).

The most commonly tests to mobilize the neural tissues are: Straight Leg Rise (SLR), Passive Neck Flexion (PNF), Prone Knee Bend (PKB), Slump test and Upper Limb Tension Tests (ULTTs) (Shacklock, 2005):

**Passive Neck Flexion test (PNF):** The patient lies supine in the resting position, while the therapist stands at the caudal end of the treatment table and flexes passively the neck of the patient. If during this test, neck flexion reproduces the symptoms of the patient, the test is considered positive.

**Straight Leg Rise test (SLR):** The patient lies supine in the resting position and the therapist stands at the caudal end of the treatment table. The therapist elevates passively the extended leg of the patient (with the ankle in dorsal flexion) until the movement stops or the patient feels "his pain". With this test, the clinician examines patients with Low Back pain while stresses the involved nerve root, trying to reproduce the pain of the patient.

**Upper Limb Tension Tests (ULNTs):** The aim of ULNTs is to determine the involvement of the neural tissues to the patient's symptoms or the presence of a radiculopathy. During the examination, the nerves (Medial, Ulnar, Radial) are stressed. In the presence of pathology of these nerves, the symptoms, such as pain, tingling, numbness, stretching sensation, are produced.

**Slump Test**: During this test, the patient is seated upright with hands held together behind his/her back. The examiner tells to the patient to flex his spine (slump), followed by neck flexion. The examiner then places his hand on top of head and has the patient perform knee extension, and dorsiflexion of foot. Finally, the patient is told to return the neck to neutral. The test is considered positive if symptoms are increased in the slumped position and decreased as the patient moves out of neck flexion. The results of this test can be interpreted in multiple ways. Like other neural tension tests, the test may indicate if a patient is experiencing symptoms related to nerves adhering to various tissues while travelling throughout the body. The patient can feel stretching, pain, or other neurological sensation in the area of adhesions. With this test the therapist can detect disc herniations. The results of the test should be interpreted based on the patient's pain or symptoms for which they are seeking treatment (Petty, 2011).

These neural tension tests contribute to the mobilization of the Nerve System. The therapists try to understand how mobile and sensitive is a nerve to mechanical stresses, according to the performance of these tests. Nevertheless, the tests are performed not only to assess neural tissues, but also as a treatment (Shacklock, 2005). During a rehabilitation program, the therapists use both "Sliders" and "Tensioners" methods to assess and treat athletes. In an earlier stage of a sport injury a "Sliders" technique is more suitable. In the opposite direction, in the later stages "Tensioners" techniques are more appropriate (Coppieters *at al.*, 2015). According to Ellis *at al.*

(2012), a “Sliders” approach is a sequence of joint movements. This treatment results in the increase of the nerve elongation and tension from one end of the nerve and the decrease at the same time from the other end. As a result the nerve is mobilized and its total tension remains the same. Contrary to “Sliders”, during “Tensioners” technique the connective tissue of an elongated nerve bed is stretched. Overall, a slider technique provokes a bigger excursion of the nerve rather than a tensioner. As it is mentioned above, the neurodynamics are widely used as an evaluation and treatment method in musculoskeletal disorders. Nelson and Hall (2011) found that the neurodynamic treatment techniques can good treat the pain, originated in peripheral nerve disorders. According to this study, pain-syndromes such as hamstring strains and ankle inversion sprains, are a result of peripheral neuropathic pain mechanism (Nelson and Hall, 2011). Shacklock (2005) supports also, that neurodynamics are very important techniques especially of the sport injuries. The clinicians can use these techniques as exercises as a part of rehabilitation program concerning athletes who suffer from an injury (Shacklock, 2005). Moreover, regarding to another study a lot of musculoskeletal impairments, such as Low Back Pain, Sacroiliac Joint disorders, Hamstring injuries are due to reduced hamstring flexibility. According to this study, the neurodynamics can improve the flexibility of those muscles through the improvement of the mechanosensitivity of the sciatic nerve. Additionally, it is interesting to say, that the alterations in mechanosensitivity of neural structures limit the hamstring length which is examined in a health sample (Sharma *at al.,* 2016).

## Conclusion

In summary, the present essay has critically evaluated the neurodynamic assessment and the effects of neurodynamic treatment in sport rehabilitation. According to the contemporary literature, there are not many studies, which have investigated the effects of neurodynamic assessment and treatment in athletes. The most of these studies have used healthy participants or cadavers. A great amount of our knowledge regarding to neurodynamics is based mainly on laboratory studies on animals and it is not known if these effects occur in humans. Nevertheless, despite the limited clinical studies, the mobilization of the nerve system appears to have positive effects in treatment of many musculoskeletal disorders, consisting an important tool for the assessment and therapy of many pain syndroms and the neuropathic pain. It can be used as an adjunct of the therapy in rehabilitation programs. In the current early stage, we cannot fully explain how these techniques affect the neural tissues, nor in which stage of rehabilitation should be applied. However, it seems that the nerve mobilization is a promising area of research and future studies are recommended in order to focus on including symptomatic and athletic population, respectively.

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