Universidade de Aveiro

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Jessica Filipa Almeida Ferreira

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Dissertação apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Fisioterapia, realizada sob a orientação científica da Prof.ª Doutora Anabela Gonçalves Silva, Professora Adjunta da Escola Superior de Saúde da Universidade de Aveiro.

Para a minha avó São, o meu maior exemplo de luta e coragem, que ficaria orgulhosa por festejar esta conquista.

O júri

Presidente	Prof.ª Doutora Alda Marques Professora Adjunta da Escola Superior de Saúde da Universidade de Aveiro
Arguente	Prof. Doutor Raúl Oliveira Professor Auxiliar da Faculdade de Motricidade Humana da Universidade de Lisboa
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Palavras-chave Mobilização neural; jogadores de futebol; controlo postural; performance funcional; hop tests.

Resumo

Introdução: A mobilização neural é comummente utilizada em Fisioterapia, podendo, de uma forma geral, ser realizada em tensão ou em mobilidade. Contudo, estudos que comparem o efeito de ambas as técnicas são escassos. O objetivo deste trabalho é comparar os efeitos da mobilização neural em tensão vs mobilização neural em mobilidade do membro dominante no controlo postural estático e na performance funcional de ambos os membros inferiores.

Métodos: Trinta e sete jogadores de futebol da primeira e segunda divisão distrital participaram neste estudo randomizado e controlado. Os participantes foram randomizados em dois grupos: mobilização em mobilidade (n=18) e mobilização em tensão (n=19). O controlo postural foi avaliado com uma plataforma de forças e a performance funcional com hop tests antes, imediatamente após e 30 minutos depois da intervenção.

Resultados: Não foram encontradas diferenças iniciais entre grupos ($p>0,05$). Houve uma diminuição significativa ($p<0,05$) no deslocamento total do COP e na velocidade com olhos abertos e fechados após a intervenção. Verificou-se, também, um aumento da distância total percorrida no single leg hop test e no crossover hop test, e uma diminuição do tempo no 6 meters timed hop ($p<0,05$) após a intervenção. No primeiro teste, verificou-se, ainda, uma interação entre o fator tempo e o fator membro dominante ($p<0,05$). Não houve diferenças significativas entre as intervenções ($p>0,05$).

Conclusão: Mobilização neural em mobilidade e tensão têm efeitos imediatos positivos e semelhantes no controlo postural estático e na performance funcional de jogadores de futebol, e as melhorias mantêm-se 30 minutos após a intervenção. A mobilização do membro dominante produz efeitos positivos neste e, também, no membro não dominante.

Keywords Neural mobilization; football players; postural control; functional performance; hop tests.

Abstract

Background: Neural mobilization is commonly used by physiotherapists, and in broad sense, it could be used either as tension mobilization or as gliding mobilization. Nevertheless, studies comparing the effects of both techniques are scarce and mainly devoted to flexibility. The aims of this study is to compare the effects of tensioning neural mobilization versus sliding neural mobilization of the dominant lower limb on static postural control and on the functional performance of both lower limbs.

Methods: Thirty-seven football players of the first and second district league participated in this randomized controlled trial. Participants were randomized into two groups: sliding group (n=18) and tensioning group (n=19). Postural sway was assessed with a force plate and functional performance with hop tests. The assessment was taken before, immediately after and 30 minutes after the intervention.

Results: At baseline, no differences were found between groups ($p>0,05$). There was a significant decrease ($p<0,05$) of total displacement of COP and velocity with eyes opened and closed after intervention. There was also an increase in total distance for the single leg hop test and the crossover hop test and a decrease of time for the 6 meters timed hop. On the first test, there was also an interaction between time and dominant limb ($p>0,05$).

Conclusion: Sliding and tensioning neural mobilization have immediate positive and similar effects on postural control and lower limb functional performance in football players and these effects are maintained at 30 minutes post intervention. Mobilization of the dominant limb can produce effects on the non-dominant and non-mobilized limb.

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List of abbreviations

CTS	Carpal tunnel syndrome
NS	Nervous system
ICC	Intraclass correlation coefficient
COP	Centre of pressure
COPy	anterior-posterior displacement
COPx	mid-lateral displacement
SLHT	Single leg hop test
6MTH	6 meters timed hop
COHT	Crossover hop test
ST	Sliding technique
TT	Tensioning technique
SLR	Straight leg raise
SD	Standard deviation

1. Introduction

The structural organization of peripheral nerves gives the axons the possibility to conduct impulses while allowing the individual interactions with the world. Axons, Schwann cells, and endoneurial components are bundled by a sheath of perineurium to form a nerve fascicle. Several fascicles are held together by epineurial tissue to form a nerve. This complex but organized web enables nerves to function by tolerating and adapting to stresses placed upon them by the movement of body segments. They are exposed to combinations of tensile, shear, and compressive stresses that, within certain limits, result in nerve excursion, strain, and transverse contraction, which are adaptive responses that allow movement without compromise of neural function (Shacklock, 2005; Topp & Boyd, 2006). When joint motion causes elongation of the nerve bed, the nerve is inherently placed under tensile stress and accommodates the stress by both elongating and gliding. The deformation or change in nerve length induced by longitudinal tensile stress is called strain and is expressed typically as percent elongation. Displacement or gliding of a nerve relative to the surrounding nerve bed is called excursion (Topp & Boyd, 2006).

When the adaptive responses of the nervous system (NS) are compromised, its function may be impaired. For example, if the ability of the NS to glide in relation to adjacent structures is decreased, joint movement may result in increased internal pressure in the nerve with a subsequent impairment of blood supply and axonal transport (Butler, 1989). Research has revealed that in some pathologies, such as carpal tunnel syndrome (CTS), cervicobrachialgia or epicondylitis, there is compromise of the adaptive mechanisms of the NS (Beneciuk, Bishop, & George, 2009). One study on CTS with 19 patients and 37 healthy controls analysed the degree of excursion of the median nerve evoked by finger extension. Controls' mean longitudinal excursion of the median nerve was significantly greater (11.2±2.8 mm) than patients (8.3±2.6 mm) when finger extension was performed with the elbow extended (Hough, Moore, & Jones, 2007). Another study included 37 patients with CTS and 18 controls and studied the median nerve cross-sectional area and stiffness using shear wave elastography and ultrasound. The investigators concluded that the median nerve is stiffer in participants with severe or extremely severe CTS (101,4 kPa), and even the ones with mild or moderate severity (55,1 kPa) had significant higher stiffness measures than the control subjects (32,9 kPa). They suggest that the increased stiffness may be due to possible nerve fibrosis or oedema, or it may indirectly reflect carpal tunnel pressure, or both (Kantarci et al., 2014). Peripheral nerve compression may disrupt the ability of the nerve to stretch and slide, potentially affecting function (Brown et al., 2011). Increased

thickness of the radial nerve has also been proposed in wrist extensor tendinopathy (Fernandez-Carnero, Fernandez-de-Las-Penas, de la Llave-Rincon, Ge, & Arendt-Nielsen, 2009; Fernandez-de-Las-Penas et al., 2010; Gurcay et al., 2017). Studies on individuals with type 2 diabetes have shown that the peripheral nerve elasticity is reduced even before the onset of diabetic neuropathy, and deteriorated in proportion to the severity of neuropathy, and seems to affect nerve conduction velocity (Ishibashi et al., 2016; Malik et al., 2005; Watanabe et al., 2010). One study using football players reported that the nerve conduction velocity of the deep peroneal and tibial nerves of the players who had suffered ankle sprains was significantly lower than the conduction velocity for the same nerves in healthy football players and healthy non athletes (Jazayeri Shooshtari, Didehdar, & Moghtaderi Esfahani, 2007). Nevertheless and contrary to the findings of previously reported studies, one study showed that the longitudinal sciatic nerve excursion at the posterior thigh during a modified SLR is not different between asymptomatic individuals and patients with spinally referred leg pain (Ridehalgh, Moore, & Hough, 2015). This may suggest that different pathologies might affect the peripheral NS differently and that some pathologies might not be associated with changes in the normal adaptive mechanisms of the peripheral NS to movement.

One of the possible strategies to facilitate mobility and function of the NS and help restore its normal biomechanics and function is through neural mobilization, which consists of combinations of joint movements, usually specific to each nerve (Butler, 1989). Neural mobilization techniques have been widely used to evaluate and improve the mechanical and neurophysiological integrity of the peripheral nerves in clinical populations (Butler, 2000). Neural mobilization techniques can be subdivided into tensioning techniques and sliding techniques. The first consists of performing joint movements that elongate the nerve till patient symptoms appear and then using the joint movement distal to the region where the nervous structure is believed to be impaired to mobilize away from symptoms. Biomechanical studies have demonstrated that a joint movement that elongates the nerve bed increases strain (as it increases the ratio between elongation and the original length in the NS), and that cumulative increases in strain occur if several joint movements that stretch the nerve are combined (Alshami, Babri, Souvlis, & Coppieters, 2008; Boyd, Topp, & Coppieters, 2013; Coppieters & Alshami, 2007). The second consists of using at least 2 joints, which are moved simultaneously in such a manner that the movement in one joint counterbalances the increase in nerve strain caused by movement in the other joint. Sliding techniques were designed and are implemented with the assumption that they are associated with much larger excursions of the NS relative to surrounding

structures, but without the potentially large increases in nerve strain. As such, sliding and tensioning techniques may be indicated at different stages of a rehabilitation program or for different conditions (Butler, 2000; Coppieters et al., 2015; Coppieters & Butler, 2008). A review about the amount of excursion and tension in peripheral nerve structures concluded that nerves can glide longitudinally up to 12.5 mm in response to joint movement. However, the amount of longitudinal movement varies depending on the position of the adjacent joints, the number of joints mobilized and the direction of movement performed at each joint (Silva et al., 2014).

Regarding the effectiveness of neural mobilization, a systematic review dated from 2008 found that evidence for the use of NS mobilization was limited and inconclusive (Ellis & Hing, 2008). Nevertheless, more recent studies have been more positive about the effects of NS mobilization. A systematic review found positive effects for pain, pressure pain threshold and function after median nerve sliding mobilization in patients with carpal tunnel syndrome (Ballestero-Pérez et al., 2017). Another review suggests that there are short term positive effects on the application of neural mobilization to the lower body quadrant. Mentioned studies showed moderate effects on flexibility in healthy subjects and large effects on pain and disability in people with low back pain immediately after the intervention (Neto et al., 2017). Another recent systematic review corroborates these findings by concluding that neural mobilization improves pain and function in groups of patients who are often resistant to treatment, such as those with chronic nerve-related low back and neck pain and plantar heel pain (Basson et al., 2017).

Individual studies investigating the effect of neural mobilization on hamstrings flexibility reported neural sliding mobilization to be superior to both no intervention (Castellote-Caballero et al., 2013) and to static muscle stretching (Castellote-Caballero, Valenza, Puentedura, Fernández-de-las-Peñas, & Alburquerque-Sendín, 2014) .

Regarding the comparison of effects between both neural mobilization techniques, literature shows that any of them when combined with static hamstrings stretching is better at improving flexibility than static hamstring stretching alone and that no differences exist between sliding or tensioning (Saurab Sharma, Balthillaya, Rao, & Mani, 2016). Another study compared the effects of neurodynamic tensioning, neurodynamic sliding and placebo effects on pressure pain threshold and found that both neural mobilizations induce hypoalgesic effects, but the neurodynamic sliding technique was superior to the neural tensioning technique (Beltran-Alacreu, Jimenez-

Sanz, Fernandez Carnero, & La Touche, 2015). Further studies are needed exploring the potential distinct effects of both techniques of neural mobilization.

In summary, tension and sliding are two ways of mobilizing the NS that have different biomechanical implications and, conceivably, can have different implications in the function of the NS. Nevertheless, studies comparing the effects of both techniques are scarce and mainly devoted to flexibility. Therefore, this study aims to compare the effects of tensioning mobilization versus sliding mobilization of the dominant lower limb on static postural control and lower limb functional performance of both limbs. The specific objectives are to compare the immediate post-mobilization effects and the effects at 30 minutes post mobilization on i) unipedal postural control of both the dominant and non-dominant limb and on ii) functional performance of both the dominant and non-dominant limb.

2. Procedures

This chapter presents a detailed description of the sample, methodological procedures and instruments used, as well as the statistical analysis that was carried out on the results.

2.1. Study Design

This is a randomized, controlled and double blind trial. The study design is presented in Figure 1.

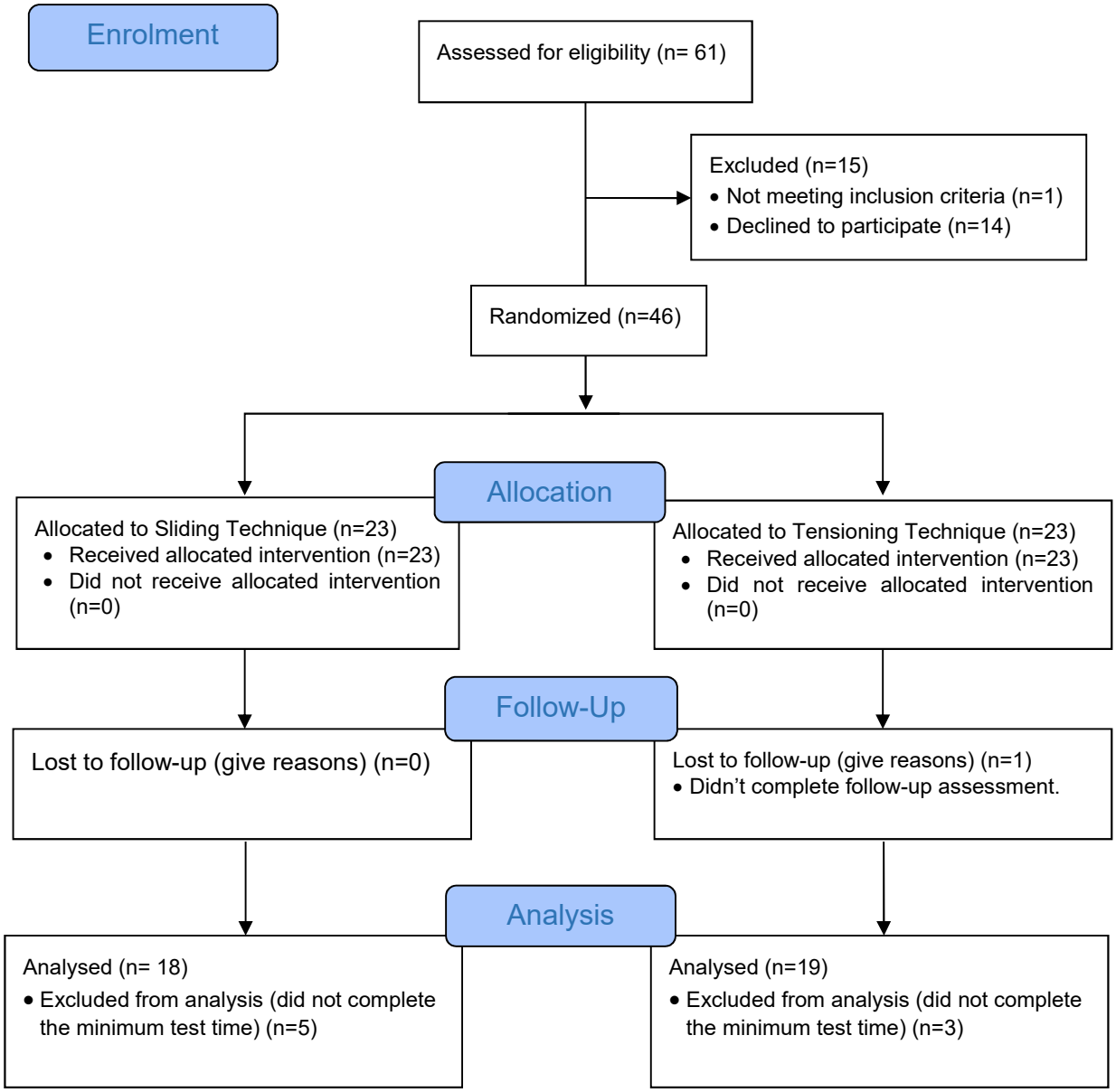

Figure 1. CONSORT flowchart.

2.2. Methods

2.2.1. Ethical considerations

The presented study was approved by the Ethical commission from the University of Aveiro (Annex 1). An information document containing the description of the study's objectives and procedures was delivered to all the participants (Appendix 1). Before entering the study, participants were asked to sign a written informed (Appendix 2). Participants were informed that they could quit the study anytime, without any penalty or justification.

2.2.2. Participants inclusion and exclusion criteria and group allocation

Participants were invited to join the study by the main investigator. They were football athletes from teams of the first and second district league of Aveiro. To be included in the present study, participants had to be 18 years or older, naïve to neural mobilization and report no injuries in the last 3 months and no surgeries in the last 6 months. Participants were excluded if they reported any neurologic, cardiorespiratory, rheumatic or cancer pathology.

The randomization of participants to group was performed by a researcher not involved in participants' recruitment, assessment or treatment using the software Randomizer (www.randomizer.org). to generate a random sequence of numbers 1 and 2. Number 1 represented the application of sliding neural mobilization and number 2 represented the application of tensioning neural mobilization. Information on which treatment each participant would receive was conveyed to the researcher performing the intervention only and immediately before it.

2.2.3. Procedures

The study was performed in the Human Movement Lab in Aveiro University Health School. Data collection ran from December 2015 to March 2016.

Participants in both groups were assessed previously (T0), immediately after (T1) and 30 minutes post intervention (T2). At T0 each participant was assessed for: demographic, anthropometric and clinical data, sports practice, static postural control, functional performance and hip range of motion and symptomatology during the straight leg raise. Measurements procedures and tests were applied in the same order to standardize the assessment: i) questionnaires, ii) static postural control and then iii)

functional performance. Measurements of static postural control and functional performance were performed again at T1 and T2 using the same procedures as for T0. Assessment procedures are described in detail in the following sections and were performed by researchers that were blind to participants' group allocation. The researchers had a training session of an hour one day before starting the intervention.

Demographic, anthropometric and clinical data

Demographic, anthropometric and clinical data and the sport practice habits were assessed by a questionnaire (Appendix 3). Participants were asked about their dominant limb, defined as the limb used to kick the ball (Alonso, Brech, Bourquin, & Greve, 2011; Shigaki et al., 2017). Weight and height were measured using a stadiometer-balance.

Static postural control assessment

Single leg static postural control was assessed using an AMTI MASS-6 force platform. Participants were asked to stay in one-legged support with the dominant limb for 30 seconds, with the hands on the hips and the non-dominant heel superior to the contralateral patella. They were instructed to remain as still as possible while focusing on a visual target at eye level two meters away. When participants were unable to maintain test position for 30 seconds, touching the floor with the foot or changing the position of the arms, the test was repeated. Three repetitions were recorded for each limb. Measurements were taken first with eyes opened and then with eyes closed. This test has been found to be reliable (Intraclass correlation coefficient – ICC = 0.87-0.97) (Ponce-Gonzalez et al., 2014). The force platform measures the displacement of the centre of pressure (COP) and is considered the gold standard for postural control assessment (Lin, Seol, Nussbaum, & Madigan, 2008; Ruhe, Fejer, & Walker, 2013). The COP was characterised in terms of: anterior-posterior displacement (COPy), mid-lateral displacement (COPx), total displacement, mean velocity and total area of displacement. These data were recorded using Nexus 1.8 software (Vicon, Oxford), treated using Excel 2016 and processed using Matlab R2011a (MathWorks, Natick).

Lower limb functional performance

Lower limb functional performance was assessed through the single leg hop test (SLHT), the 6 meters timed hop (6MTH) and the crossover hop test (COHT). For the 3 tests, a path of 6 meters in length and 15 cm in width was marked on the floor with adhesive tape measure. Before each test, participants performed a training test with each leg. Then, each test was repeated 3 times alternately with each leg.

In SLHT each participant was asked to perform a unipedal jump trying to reach as far as possible while keeping the hands on the hips. No secondary adjustments were allowed to correct balance (extra jumps) (Daniel, Stone, & Riehl, 1988). The reliability of the test has been reported to be excellent (ICC = 0.95-0.98) (Ageberg, Zatterstrom, & Moritz, 1998; Daniel et al., 1988; Kockum & Heijne, 2015).

For the 6MTH, participants were asked to jump as quick as possible along a path of 6 meters. The time taken to perform the test, from the beginning of the test to the moment that the heel crossed the final line was measured with a manual chronometer. The reliability of the test was found to be good to excellent (ICC = 0.88-0.97) (Brosky, Nitz, Malone, Caborn, & Rayens, 1999)

For the COHT participants started the test on the right side of the path in unipedal support with the dominant limb. Then, they were instructed to jump with the same limb 3 consecutive times crossing the line between each jump without stepping on it. The score is the total distance from the starting line to the heel mark after the third jump. The reliability of this test was found to be excellent (ICC 0.96) (Bolgla & Keskula, 1997; Noyes, Barber, & Mangine, 1991). A schematic diagram of the three hop tests is in Figure 2.

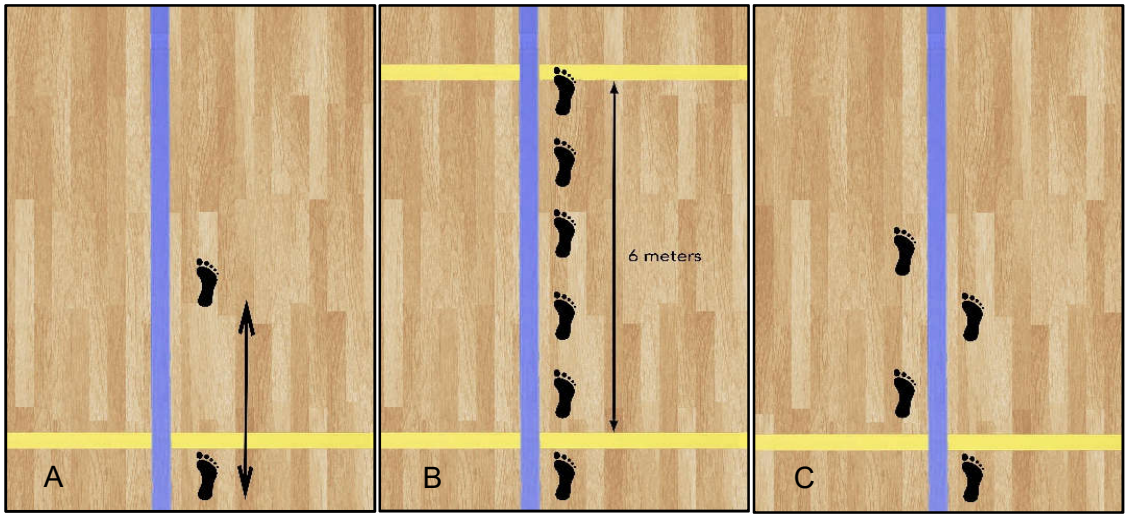

Figure 2. Single leg hop test (A), 6 meters timed hop (B) and crossover hop test (C) schematic diagram.

Hip range of motion and symptomatology during the straight leg raise

Hip flexion range of motion during the straight leg raise (SLR) was measured with a universal goniometer. Maximum hip flexion till first symptoms appear was performed with the ankle at maximum dorsal flexion and the knee at 0º of extension (Castellote-Caballero et al., 2014; Urban, 1981). Then, participants were asked to report on the symptoms felt during the test (e.g. pain, tingling, heat), and to register their intensity and location using a 10 cm visual analogue scale and a body chart, respectively (Walsh, Flatley, Johnston, & Bennett, 2007) (Appendix 4) .

Intervention

One group received neural sliding mobilization (group 1) and the other neural tensioning mobilization (group 2). The combination of joint movements targeted the tibial nerve. This nerve was chosen because it innervates the muscles that have greater activity during the jump and landing (Hobara, Kanosue, & Suzuki, 2007).

Sliding mobilization was performed with the subject lying in supine, while the investigator passive and simultaneously performed a mobilization going from maximum ankle plantar flexion and knee and hip extension to ankle dorsiflexion, total knee flexion and 90º hip flexion. Four sets of 10 movements were completed with an approximate rhythm of 6 seconds per cycle and with an interval of 1 to 2 minutes between sets.

Tensioning mobilization was performed using the neurodynamic test SLR as described by Butler (Butler, 1989). The subject was placed in supine. The test started with ankle dorsiflexion and knee extension. From this position, the investigator passively performed maximal hip flexion (till first symptoms appear). When symptoms first arose, the investigator reduced the hip flexion in 5 or 10 degrees (so that neural mobilization was asymptomatic) and while holding this position performed repeated movements going from maximum dorsiflexion to maximum plantar flexion. Four sets of 10 ankle movements were completed with an approximate rhythm of 6 seconds per cycle and with an interval of 1 to 2 minutes between sets. After each cycle of 10 repetitions, the position was held for 10 seconds (Beneciuk et al., 2009; Butler, 1989; Dilley, Lynn, Greening, & DeLeon, 2003). The techniques are shown in Figure 3.

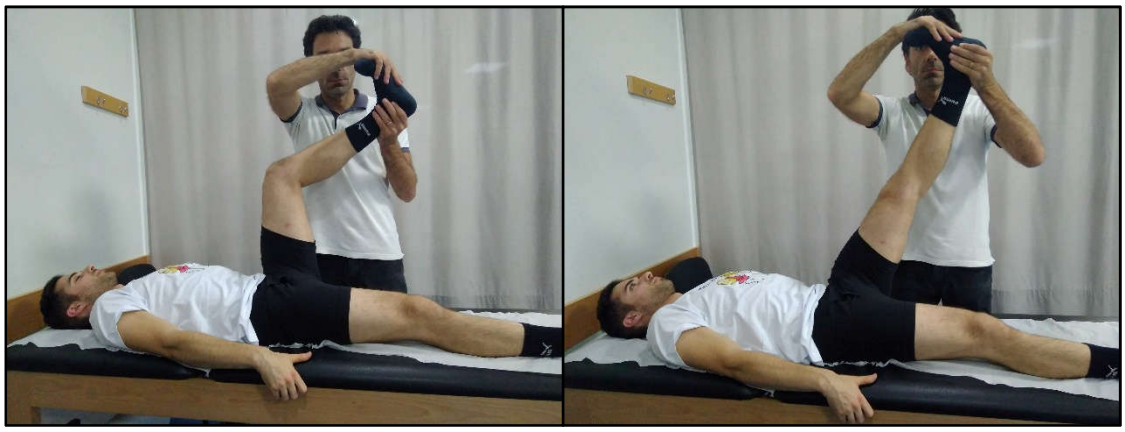

Figure 3. Sliding and tensioning neural mobilization.

Data Analysis

All data analyses were performed using SPSS 24.0 for Windows (SPSS Inc, Chicago, IL). Mean and standard deviation and count and proportion were used to describe continuous and ordinal and categorical variables, respectively. The Shapiro-Wilk test was used to determine if the sample had a normal distribution. Between group differences for baseline characteristics were explored using a Student's t test (continuous variables) or a Chi-square (categorical variables). A general linear model of repeated measures using time (T0, T1 and T2), intervention (sliding vs. tensioning) and limb (dominant vs. non-dominant) as the factors was used to compare the effects of the interventions. Post hoc comparisons (Bonferroni) were used when a significant main effect was found for time. A significant level was set at $p<0.05$.

3. Results

This section presents the results of this dissertation.

3.1. Sample's sociodemographic characteristics

The sample included 37 participants, distributed into two groups: the sliding technique group (n=18) and the tensioning technique group (n=19). In the sliding technique group (ST), 4 participants (22,2%) were female and 14 (77,8%) were male, while in the tensioning technique group (TT), 3 participants (15,8%) were female and 16 (84,2%) were male. The mean (± SD) age in ST group is 23,4 ± 3,8 years old and in TT group is 24,2 ± 5,9 years old. No significant differences (p>0,05) were found between groups regarding sociodemographic data (Table 1).

Table 1. Sample characteristics.

Variables		Sliding (n=18)	Tensioning (n=19)	p
Sex	Female n (%)	4 (22,2%)	3 (15,8%)	0,618
	Male n (%)	14 (77,8%)	16 (84,2%)	
Age (years)	Mean ± SD	23,4 ± 3,8	24,2 ± 5,9	0,614
Weight (kg)	Mean ± SSD	67,2 ± 7,4	69,1 ± 8,9	0,496
Height (cm)	Mean ± SD	172,7 ± 6,6	175,6 ± 7,8	0,247
Dominant limb	Right n (%)	14 (77,8%)	17 (89,5%)	0,335
	Left n (%)	4 (22,2%)	2 (10,5%)	
Field position	Goalkeeper n (%)	1 (5,6%)	3 (15,8%)	0,098
	Defender n (%)	1 (5,6%)	5 (26,3%)	
	Midfielder n (%)	5 (27,8%)	6 (31,6%)	
	Forward n (%)	10 (55,6%)	3 (15,8%)	
	Missing n (%)	1 (5,6%)	2 (10,5%)	
Formal Education	9th grade n (%)	2 (11,1%)	2 (10,5%)	0,403
	12th grade n (%)	12 (66,7%)	11 (57,9%)	
	Bachelor degree n (%)	2 (11,1%)	6 (31,6%)	
	Master degree n (%)	1 (5,6%)	0 (0%)	
	Missing n (%)	1(5,6%)	0 (0%)	

3.2. Baseline assessment

At baseline mean (±SD) SLR scores were 86,1 ± 15,2 in the ST and 84,3 ± 15,7 in the TT groups. Of the 18 participants in ST, 4 felt pain during the SLR (6,4 ± 1,2 of intensity). In the TT, 8 of the 19 participants felt pain (4,8 ± 1,7 of intensity). No significant between group differences were found for hip flexion during SLR (p=0,734), frequency of symptoms (p=0,413) and pain intensity (p=0,228) during SLR. In addition, no between group difference was found for number of previous injuries (Table 2).

Table 2. Sample's history of injuries, hip range of motion and symptoms during SLR at baseline.

Variables		Sliding (n=18)	Tensioning (n=19)	p
SLR (º)	Mean ± SD	86,1º ± 15,2º	84,3º ± 15,7º	0,734
Symptoms	No symptom n (%)	3 (16,7%)	1 (5,3%)	0,413
	Pain n (%)	4 (22,2%)	8 (33,3%)	
	Other symptoms n (%)	10 (55,6%)	8 (42,1%)	
	Both n (%)	1 (5,6%)	2 (10,5%)	
Pain intensity	Mean ± SD	6,4 ± 1,2	4,8 ± 1,7	0,228
Previous Injuries[1]	No injuries n (%)	5	7	----
	Muscle injury n (%)	5 (1 year)	4 (2 years)	
	Ankle/knee sprain n (%)	8 (2 years)	4 (2 years)	
	Trunk/upper limb injury	0	5 (2 years)	

[1]One participant on Tensioning Technique group referred more than 1 previous injury.

3.2.1. Postural sway

No significant differences were found between groups at baseline for postural sway, except for anterior-posterior displacement (COPy) in the non-dominant limb with eyes opened (ST: 3,35 ± 0,41 cm; TT: 4,05 ± 1,33 cm; p = 0,043). The results are shown in Table *3*.

Table 3. Postural sway's baseline assessment.

Variables			Sliding (n=18)	Tensioning (n=19)	P
Eyes opened	Dominant	COPx (cm)	4,68 ± 1,43	4,54 ± 1,19	0,784
		COPy (cm)	3,56 ± 0,80	3,64 ± 0,66	0,781
		Velocity (cm/s)	5,01 ± 1,03	5,18 ± 1,23	0,813
		TCOP (cm)	150,35 ± 30,80	155,37 ± 36,86	0,808
		Area (cm^2)	10 ± 4	11 ± 4	0,613
	Non dominant	COPx (cm)	4,57 ± 0,94	5,08 ± 1,85	0,309
		COPy (cm)	3,35 ± 0,41	4,05 ± 1,33	0,043
		Velocity (cm/s)	4,72 ± 0,69	5,15 ± 0,96	0,265
		TCOP (cm)	139,96 ± 23,46	153,90 ± 28,35	0,229
		Area (cm^2)	10 ± 3	14 ± 12	0,239
Eyes closed	Dominant	COPx (cm)	7,50 ± 2,08	7,89 ± 2,66	0,285
		COPy (cm)	6,58 ± 4,31	5,88 ± 1,62	0,466
		Velocity (cm/s)	10,65 ± 3,00	11,25 ± 2,33	0,588
		TCOP (cm)	145,41 ± 35,85	165,68 ± 36,76	0,124
		Area (cm^2)	38 ± 30	35 ± 16	0,602
	Non dominant	COPx (cm)	7,00 ± 2,44	6,74 ± 1,48	0,624
		COPy (cm)	6,07 ± 5,05	5,15 ± 1,46	0,426
		Velocity (cm/s)	10,21 ± 2,23	10,97 ± 2,71	0,449
		TCOP (cm)	145,60 ± 33,45	157,19 ± 37,97	0,404
		Area (cm^2)	35 ± 36	32 ± 18	0,711

COPx – mid-lateral displacement; COPy – antero-posterior displacement; TCOP – total displacement.

3.2.2. Hop tests

No significant differences were found between groups at baseline for SLHT, 6MTH and COHT (p>0.05).

Table 4. Hop tests' baseline assessment.

Variables		Sliding	Tensioning	p
Dominant	SLHT (cm)	150,4 ± 25,7	160,5 ± 23,1	0,220
	6MTH (s)	2,02 ± 0,26	1,97 ± 0,26	0,502
	COHT (cm)	424,5 ± 77,4	446,6 ± 71,8	0,375
Non dominant	SLHT (cm)	153,1 ± 25,0	166,8 ± 18,4	0,066
	6MTH (s)	2,06 ± 0,27	2,00 ± 0,21	0,466
	COHT (cm)	424,7 ± 83,0	447,7 ± 68,7	0,365

3.3. Effect of interventions on postural sway

Table 5 presents mean values (± SD) for all postural sway variables in the three moments of assessment (T0, T1, T2). There was a significant effect of time for the total displacement of COP (Wilk's Lambda = 0,62; F(2,68)=8,70; p<0,001) and for velocity (Wilk's Lambda = 0,56; F(2;61)=7,69; p=0,002) when measurements were taken with eyes opened. Pairwise comparisons revealed a decrease in total displacement from T0 to T1 and from T0 to T2 (p<0,05), but not from T1 to T2 (p =0,768), and in velocity from T0 to T1 (p<0,001), but not between the other measurement moments (p>0,05). No significant main effect for intervention or for limb were found (p>0,05).

Similarly, when measurements were taken with eyes closed, there was a significant effect of time for COP total displacement (Wilk's Lambda = 0,78; F(2;60=6,84; p=0,003) and for velocity (Wilk's Lambda = 0,78; F(2;52)=7,61; p=0,003). Pairwise comparisons showed a decrease from T0 to T1 and from T0 to T2 (p<0,05) but not from T1 to T2 (p=1) for both variables.

No significant main effect for intervention or for limb were found (p>0,05).

Table 5. Effect of interventions on postural sway.

			Eyes opened			Eyes closed		
			T0	**T1**	**T2**	**T0**	**T1**	**T2**
			Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Sliding	Dominant	COPx (cm)	4,68 ± 1,43	4,43 ± 0,90	4,25 ± 0,84	7,50 ± 2,08	7,15 ± 2,30	6,85 ± 2,67
		COPy (cm)	3,56 ± 0,80	3,36 ± 0,56	3,41 ± 0,57	6,58 ± 4,31	5,37 ± 1,99	4,59 ± 0,94
		Velocity (cm/s)	5,01 ± 1,03	4,59 ± 0,84	4,75 ± 0,99	10,65 ± 3,00	9,86 ± 2,35	9,43 ± 2,56
		TCOP (cm)	150,35 ± 30,80	137,58 ± 25,16	142,51 ± 29,85	145,41 ± 35,85	142,16 ± 34,15	137,50 ± 31,51
		Area (cm^2)	10 ± 4	10 ± 3	9 ± 3	38 ± 30	28 ± 14	26 ± 16
	Non dominant	COPx (cm)	4,57 ± 0,94	4,51 ± 0,87	4,58 ± 0,87	7,00 ± 2,44	6,65 ± 2,06	6,20 ± 1,46
		COPy (cm)	3,35 ± 0,41	3,33 ± 0,33	3,36 ± 0,55	6,07 ± 5,05	7,32 ± 8,73	7,31 ± 7,52
		Velocity (cm/s)	4,72 ± 0,69	4,36 ± 0,58	4,51 ± 0,65	10,21 ± 2,23	9,77 ± 3,09	9,26 ± 2,05
		TCOP (cm)	139,96 ± 23,46	130,66 ± 17,26	135,21 ± 19,43	145,60 ± 33,45	134,20 ± 30,24	128,74 ± 23,65
		Area (cm^2)	10 ± 3	10 ± 3	10 ± 3	35 ± 36	41 ± 67	38 ± 41
Tensioning	Dominant	COPx (cm)	4,54 ± 1,19	4,57 ± 0,88	4,68 ± 1,51	7,89 ± 2,66	6,52 ± 1,69	6,91 ± 1,95
		COPy (cm)	3,64 ± 0,66	3,59 ± 0,61	3,58 ± 0,63	5,88 ± 1,62	5,12 ± 2,21	5,20 ± 2,34
		Velocity (cm/s)	5,18 ± 1,23	4,84 ± 1,12	5,04 ± 1,98	11,25 ± 2,33	9,68 ± 2,21	9,79 ± 2,56
		TCOP (cm)	155,37 ± 36,86	141,69 ± 26,06	146,84 ± 44,06	165,68 ± 36,76	145,25 ± 24,57	146,46 ± 36,97
		Area (cm^2)	11 ± 4	11 ± 4	12 ± 8	35 ± 16	26 ± 13	28 ± 12
	Non dominant	COPx (cm)	5,08 ± 1,85	4,44 ± 0,71	4,51 ± 1,05	6,74 ± 1,48	7,24 ± 2,39	7,10 ± 2,17
		COPy (cm)	4,05 ± 1,33	3,56 ± 0,41	3,60 ± 0,58	5,15 ± 1,46	5,25 ± 2,22	5,08 ± 1,27
		Velocity (cm/s)	5,15 ± 0,96	4,68 ± 1,01	4,67 ± 0,93	10,97 ± 2,71	10,21 ± 2,71	10,29 ± 2,63
		TCOP (cm)	153,90 ± 28,35	140,40 ± 30,42	140,17 ± 28,00	157,19 ± 37,97	146,24 ± 34,60	146,87 ± 28,02
		Area (cm^2)	14 ± 12	11 ± 3	11 ± 4	32 ± 18	32 ± 20	29 ± 12

3.4. Effect of intervention on hop tests

Table 6 presents mean values (± SD) for all hop tests in the three moments of assessment. There was a significant main effect of time for the SLHT (Wilk's Lambda = 0,649; F(2,70)=11,204; p<0,001), 6MTH (Wilk's Lambda = 0,607; F(2,70)=12,424; p<0,001) and COHT (Wilk's Lambda = 0,564; F(2;58)=14,823; p<0,001). Pairwise comparisons showed differences from T0 to T1 and from T0 to T2 (p<0,05), but not from T1 to T2 in both SLHT (p=0,637) and 6MTH (p=0,1). In the COHT, pairwise comparisons revealed an increase from T0 to T2 and T1 to T2 (p<0,001), but not from T0 to T1 (p=0,104).

There was, also, a significant interaction between time and dominant limb in SLHT (Wilk's Lambda = 0,80; F(2,70)=5,03; p=0,009), but no significant interaction between time and intervention (p>0,05).

Table 6. Effect of intervention on hop tests.

			T0	T1	T2
		Hop Test	Mean ± SD	Mean ± SD	Mean ± SD
Sliding	Dominant	SLHT (cm)	150,4 ± 25,7	159,3 ± 27,6	167,2 ± 23,6
		6MTH (s)	2,02 ± 0,26	2,00 ±0,2	1,95 ±0,30
		COHT (cm)	424,5 ± 77,4	430,5 ± 80,6	453,9 ± 86,5
	Non Dominant	SLHT (cm)	153,1 ± 25,0	164,7 ± 23,8	162,0 ± 25,2
		6MTH (s)	2,06 ± 0,27	1,98 ± 0,26	1,96 ± 0,28
		COHT (cm)	424,7 ± 83,0	443,8 ± 86,3	463,3 ± 82,9
Tensioning	Dominant	SLHT (cm)	160,5 ± 23,1	167,1 ± 21,2	170,7 ± 18,4
		6MTH (s)	1,97 ± 0,26	1,94 ± 0,24	1,94 ± 0,26
		COHT (cm)	446,6 ± 71,8	456,0 ± 72,8	458,4 ± 71,1
	Non Dominant	SLHT (cm)	166,8 ± 18,4	165,7 ± 22,8	166,2 ± 21,2
		6MTH (s)	2,00 ± 0,21	1,94 ± 0,24	1,88 ± 0,26
		COHT (cm)	447,7 ± 68,7	454,0 ± 60,8	464,9 ± 63,9

4. Discussion

This study aimed to compare the effects of sliding and tensioning neural mobilization in postural sway and lower limb performance in football players, both in the mobilized (dominant) and non-mobilized limb. The results revealed that both neural mobilization techniques have a positive and similar effect on the variables studied.

Decreases in COP measures are considered good indicators of postural control improvement (Low, Walsh, & Arkesteijn, 2017). COP displacement and COP velocity decreased in both groups suggesting that postural control improved with both interventions from baseline to immediately after the intervention and from baseline to 30 minutes after the interventions. Both variables were referred on literature as the most reliable indicators of postural sway changes (Li, Liang, Wang, Sheng, & Ma, 2016; Low et al., 2017; Ruhe, Fejer, & Walker, 2011). Nevertheless, no significant effects were found for COP area and lateral and anteroposterior displacement. COP displacement and COP velocity measures represent a combination of anteroposterior and medial-lateral COP movement, reflecting the results of both variable changes (Palmieri, Ingersoll, Stone, & Krause, 2002). This may explain the lack of significant results in COP area and lateral and anteroposterior displacement.

Both techniques of neural mobilization had a similar positive effect on the performance of the 3 hop tests, which consisted of an increase in the distance jumped (SLHT and COHT) and a decrease in the time needed to jump the 6MTH. These improvements were from T0 to T1 and from T0 to T2, but not from T1 to T2 in SLHT and 6MTH, suggesting an immediate effect of the neural mobilization which was maintained at 30 minutes post intervention. For the COHT, a significant improvement was also present from T0 to T2 and from T1 to T2, but not from T0 to T1, suggesting that improvements progressed with time. The results of our study are in line with those reported by Park *et al* (2014) who assessed postural sway in healthy participants immediately after sliding neural mobilization targeting the sciatic nerve. They reported significant improvements both for balance and hip joint flexion range of motion (Park et al., 2014). However, both our study and Park *et al* (2014) findings contrast with those reported by Nunes *et al* (2017). These authors compared the effects of sliding and tensioning neural mobilization to static stretch in vertical jump and dynamic balance (star excursion balance test) immediately after the interventions and reported no effect in both measures (Nunes et al., 2017). The discrepancy in the results may be related to differences in the methods. The range of motion used by Nunes *et al* (2017) for neural mobilization was smaller (movements of 10º range) than the one used in the present

study and in the study by Park *et al* (2014) (total range of motion). As nerve excursion depends on the range of joint motion and, conceivably, different excursions might have different impact on nerve function, it might help explain the differences in the results.

In addition, several studies referred positive effects immediately after neural mobilization in pain, thermal pain sensitivity, flexibility and mobility (Ballestero-Pérez et al., 2017; Beneciuk et al., 2009; Castellote-Caballero et al., 2014; Mendez-Sanchez et al., 2010; Neto et al., 2017). Other studies mentioned improvements after a short intervention of two to three weeks (Cleland, Childs, Palmer, & Eberhart, 2006; Dwornik, Kujawa, Bialoszewski, Slupik, & Kiebzak, 2009; Nagrale, Patil, Gandhi, & Learman, 2012). However, to the best of our knowledge no study assessed the medium or long-term effect of neural mobilization.

There was a significant interaction between time and limb for the SLHT. Despite improvements in both limbs, the SLHT showed a greater increase in distance in the dominant than in the non-dominant limb. For the remaining hop tests and for the COP measurements no significant differences were found between the limb that received neural mobilization (the dominant limb) and the limb that did not receive neural mobilization. This suggests that neural mobilization has positive effects on both limbs. Also Sharma *et al* (2016) assessed the effect of neural mobilization on both lower limb that received neural mobilization and the contralateral limb that did not receive mobilization. They reported that neural mobilization has the potential to increase flexibility also in the limb in which neural mobilization was not performed (Sharma & Cleland, 2016). Villafañe *et al* evaluated pressure pain threshold on 30 patients with thumb carpometacarpal osteoarthritis that received radial nerve sliding mobilization and 30 patients that did not receive neural mobilization and found improvements in the contralateral side only in the intervention group (Villafañe, Bishop, Fernández-de-las-Peñas, & Langford, 2013). These results are in line with our findings and have very important clinical implications, especially in cases of a lower limb injury or surgery where movement is contraindicated.

As previously stated, there were no significant differences between neural mobilization techniques for both postural sway and functional performance, which means that both techniques have positive and similar effects on lower limb performance and static postural sway. Literature have been reporting differences between sliding and tensioning mobilization for other variables. Coppieters *et al* (2008) reported that longitudinal excursion of the median nerve at the wrist was approximately twice as large for the sliding technique (12.6mm) than for the tensioning technique

(6.1mm). In addition, the author realized that strain in the median nerve at the wrist remained relatively constant during the sliding technique (variation of 0.8%) whereas it varied strongly during the tensioning technique (6.8%). Another study on sciatic nerve had similar results, reporting that different neurodynamic techniques combining hip and knee movements result in markedly different sciatic nerve excursions (Coppieters et al., 2015). One study of the immediate hypoalgesic effects of neural mobilization in healthy subjects showed that ST and TT elicited an immediate increase in PPT, although there was a greater neurophysiological effect in the ST group compared with the TT group (Beltran-Alacreu et al., 2015). Conceivably, neural sliding and neural tensioning effects might be equivalent for some variables and different for others. Data on these similarities and differences is crucial to inform the selection of one technique of neural mobilization in detriment of the other for specific patients and conditions.

4.1. Clinical implications

These findings suggest a positive and similar immediate effect for static postural control and functional performance that remains at least for 30 minutes of both 4 sets of 10 neural glidings and 4 sets of 10 neural tensioning mobilizations with 1 minute interval between sets, directed at the tibial nerve and performed at a rate of approximately 6 seconds per cycle. These findings suggest that when aiming to improve static postural control and lower limb performance both types of neural mobilization could be used with this specific dosage. Even during the recovery in a post-surgery or another immobilization condition, these techniques can be helpful in an early intervention on contralateral limb. It can be useful, too, if implemented in general training to improve physical skills.

4.2. Study limitations and future research

The limitations of this study should be considered, namely the fact that the sample only included young trained athletes, so the findings cannot be generalized to other samples of athletes or patients with specific clinical conditions.

The follow-up assessment was only 30 minutes after the intervention. We can considerer this time lapse as acute, so our findings only report acute effects. A follow-up of 24h or more is needed to inform on the stability of improvements for longer periods. Future studies could also consider studying the effect of different dosages of neural mobilization.

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5. Conclusion

Results of this study suggest that sliding and tensioning neural mobilization may have immediate improvements in postural control and functional performance in football players, independently of the chosen technique, and these improvements remain 30 minutes after the intervention. They also suggest that the mobilization of one limb can produce effects on the other. These findings may support the use of neural mobilization as a current training method to improve static postural control and lower limb performance or as early intervention in the contralateral limb in immobilization or acute pain situations. Although, more studies are needed to confirm these suggestions.

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APPENDIX 1. Information document

Documento Informativo ao Participante

"Efeito da mobilização neural do membro inferior no controlo postural e performance do membro inferior em atletas"

1. Apresentação do estudo

O meu nome é Jessica Ferreira, sou Fisioterapeuta e aluna do 2º ano do Mestrado em Fisioterapia da Escola Superior de Saúde da Universidade de Aveiro. Em conjunto com um grupo de alunos do 4º ano da Licenciatura em Fisioterapia da mesma escola (André Bebiano, Daniel Raro, João Martins), estamos a realizar um projeto de investigação que culminará na minha dissertação de Mestrado e no projeto de final de curso dos colegas, sob a orientação da Prof.ª Drª Anabela Silva. Gostaríamos de o/a convidar a participar no estudo que estamos a realizar. Para participar, importa tomar conhecimento de algumas informações importantes, nomeadamente os objetivos do estudo e os procedimentos envolvidos, por forma a conhecer o que o estudo implica. Estamos disponíveis para prestar qualquer esclarecimento (os contactos estão no final da folha de informação).

2. Quais os objetivos principais deste estudo?

A mobilização neural é usada com o objetivo de melhorar a função do sistema nervoso periférico e consiste em usar movimentos dos segmentos do corpo para facilitar o deslize dos nervos em relação às estruturas que os circundam ou para aumentar a tensão na estrutura nervosa. Recentemente, tem sido muita usada no desporto para promover a recuperação funcional dos atletas. Contudo, os estudos que caracterizam os efeitos da mobilização neural e que comparam diferentes formas de mobilizar são escassos. Assim, este estudo tem como objetivo principal perceber se existem diferenças no controlo postural (i.e. na facilidade com que mantemos a posição), na função do membro inferior e no limiar de dor à pressão mecânica entre duas formas distintas de aplicar a mobilização neural.

3. Sou obrigado a participar no estudo?

Não, a decisão de participar ou não do estudo é exclusivamente sua. Depois de informado e esclarecido, caso pretenda participar terá de assinar a folha do consentimento informado que garante que participa de livre vontade. Mesmo depois de assinado este consentimento, pode em qualquer momento abandonar o estudo sem prestar qualquer tipo de justificação.

4. O que irá acontecer se eu decidir participar?

Iniciará o estudo com o i) preenchimento de questionários com objetivo de recolher informação sobre a idade, o sexo, lesões anteriores e prática desportiva e medição da altura e peso; ii) depois será avaliado o controlo postural e a função de ambas as pernas. A avaliação do controlo postural consiste em estar o mais imóvel possível e apoiado só num pé em cima de uma plataforma que vai medir as oscilações do corpo. A função do membro inferior será avaliada através de 3 testes em que se mede o tamanho máximo de um salto, de 3 saltos para a direita e para a esquerda e o tempo necessário para completar um percurso de 6m a saltar. Depois desta avaliação inicial, será aplicada a mobilização que consistirá em fazer um conjunto de movimentos com a perna dominante. Os procedimentos de avaliação do controlo postural, da função das pernas e do limiar de dor serão repetidos imediatamente após a mobilização e 30/45 minutos após o término da mobilização. Todos estes procedimentos decorrerão na Escola Superior de Saúde da Universidade de Aveiro. De forma a facilitar as medições e a intervenção pedimos que traga calções (poderá mudar de roupa nos vestiários da Escola). O agendamento das sessões será de acordo com a sua disponibilidade.

5. Sou a pessoa indicada para participar neste estudo?

Para este estudo procuramos pessoas com 18 ou mais anos que joguem futebol na 1ª e 2ª divisão da distrital de Aveiro ou que joguem noutras distritais mas estudem na Universidade de Aveiro. A mobilização do sistema nervoso é um procedimento que não é, normalmente, utilizado em pessoas com algumas lesões nervosas, artrite, tumores, problemas de circulação ou lesões medulares. Assim, se tiver algum destes problemas, se tiver sido submetido a cirurgia nos últimos 6 meses ou sofrido uma lesão nos últimos 3 meses pedimos-lhe que não participe.

6. Quanto tempo demorará a sessão de recolha de dados?

As sessões demorarão entre cerca de 1h a 1h30min.

7. O que irá acontecer aos dados recolhidos?

Os dados recolhidos serão tratados apenas pela equipa de investigação, estando a confidencialidade assegurada. É do conhecimento de todos os investigadores envolvidos que não se pode divulgar qualquer identidade dos participantes ou informação relacionada que remetam a estes. Mesmo quando descritos na dissertação,

apresentações ou eventualmente num artigo publicado, todos os dados serão codificados por forma a manter esse sigilo.

8. O que tenho de fazer?
Apenas apareça no dia e hora previamente agendado (de acordo com a sua disponibilidade), e com roupa adequada (calções).

9. Quais são os possíveis benefícios de participar neste estudo?
Este é um estudo de investigação que visa perceber melhor uma forma de tratamento usada em fisioterapia. É pouco provável que tenha benefícios imediatos para si. Contudo, poderá ajudar a compreender melhor esta forma de tratamento e a longo prazo contribuir para a sua melhor e mais eficaz utilização.

10. Quais são os possíveis malefícios de participar neste estudo?
Os procedimentos de avaliação e intervenção utilizados são idênticos aos usados na prática clínica e em muitos estudos anteriores, pelo que não se prevê que algo corra mal.

11. A quem devo contactar em caso de ter alguma dúvida?
Se tiver alguma dúvida ou queixa e/ou quiser falar sobre algum aspeto da investigação, por favor contate:

Investigador Responsável
Prof. Drª Anabela G Silva
Morada: Universidade de Aveiro, Edf. 30 Agras do Castro, Escola Superior de Saúde,
Telefone: 234 370 200; Extensão: 23899 E-mail: asilva@ua.pt

Investigador co-responsável
Jessica Ferreira, Email: jessicaferreira@ua.pt

Alunos do 4º ano da Licenciatura em Fisioterapia
André Bebiano (andrebebiano@ua.pt)
Daniel Raro (danielraro@ua.pt)
João Martins (joaoncmartins@ua.pt)

APPENDIX 2. Written consent

Consentimento Informado

Título do Estudo “Efeito da mobilização neural do membro inferior no controlo postural e performance do membro inferior em atletas”

	Sim	Não
1. Li o documento informativo sobre este estudo?		
2. Recebi informação suficiente e detalhada sobre este estudo?		
3. Percebi o que o estudo implica e o que me vai ser pedido?		
4. Percebi que posso fazer as perguntas que quiser e as minhas dúvidas foram todas esclarecidas.		
5. Compreendi que posso abandonar este estudo em qualquer altura, sem dar qualquer explicação e sem que resultar qualquer penalização para mim.		
6. Concordo em participar voluntariamente neste estudo que avalia o efeito da mobilização do sistema nervoso no controlo postural, performance e limiar de dor nos membros inferiores?		

Nome do Participante:_____

Assinatura do Participante:_____

Data:___/___/_____

Nome do Investigador:_____

Assinatura do Investigador:_____

Data:___/___/_____

APPENDIX 3. Demographic, anthropometric and clinical data

CARACTERIZAÇÃO DO PARTICIPANTE

1. Informação demográfica e de saúde

1.1. SEXO

(1) [ ] Feminino (2) [ ] Masculino

1.2. DATA DE NASCIMENTO ___/___/___ *(dia/mês/ano)*

1.3. EDUCAÇÃO FORMAL

(1) 4ºano de escolaridade [ ]

(2) 6ºano de escolaridade [ ]

(3) 9ºano de escolaridade [ ]

(4) 12ºano de escolaridade [ ]

(5) Bacharelato/Licenciatura [ ]

(6) Outro [ ] *(por favor especifique)* _____

1.4. Posição em campo: _____

1.5. Número de treinos semanais:_____

1.6. Duração média de cada treino: _____

1.7. Membro dominante:_____

1.8. Lesões anteriores:

(1) [ ] Não
(2) [ ] Sim. Indique quais e há quanto tempo ocorreram.
Lesão_____Tempo_____
Lesão_____Tempo_____
Lesão_____Tempo_____
Lesão_____Tempo_____
Lesão_____Tempo_____
Lesão_____Tempo_____

APPENDIX 4. Symptoms registration

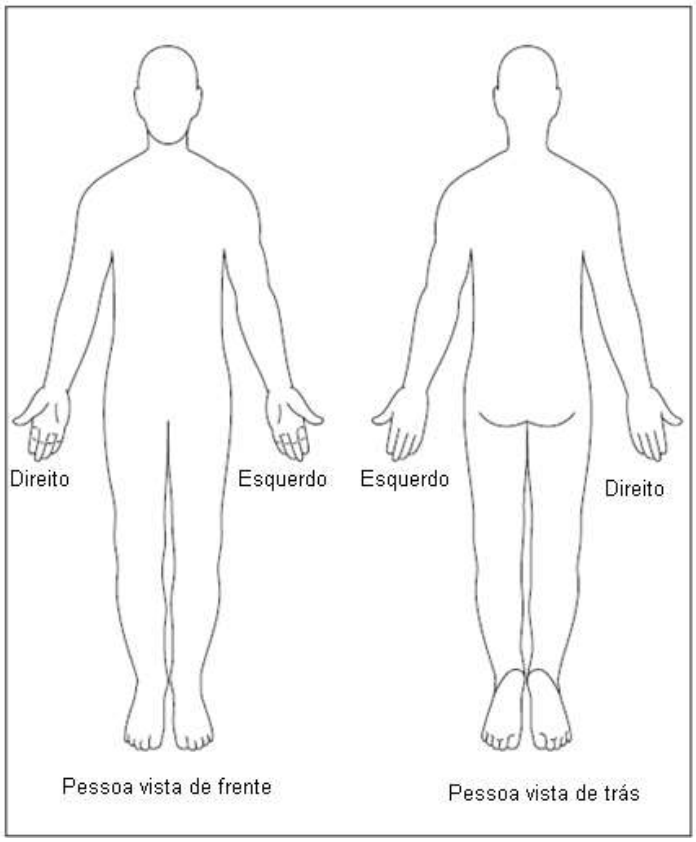
Caracterização de eventuais sintomas durante o teste Straight Leg Raise

1.1. Durante o teste sentiu dor, calor, formigueiros ou outro sintoma:

(1) [ ] Não
(2) [ ] Sim, indique quais:
(2.1) [ ] Dor
(2.2) [ ] Formigueiros
(2.3) [ ] Calor
(2.4) [ ] Sensação de repuxar
(2.4) [ ] Outro. Indique qual(ais)_____

1.2. Se respondeu que sim à pergunta anterior, indique na figura que se segue onde se localizavam os sintomas usando a descrição que se segue

Dor: ////; Formigueiros ….; Calor****, Repuxar; ####; Outro xxxx



1.3. Se respondeu que sim à pergunta 1.1, indique a intensidade dos sintomas utilizando a escala que se segue. Nesta escala o zero (0) indica a ausência de dor e 10 a pior dor imaginável.

_____

ANNEX 1. Ethical commission approval

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Conselho de Ética

Conselho de Ética e Deontologia

Parecer nº: 2/2016.
Requerente: Doutora Anabela Silva.
Título do Projeto: "Efeito da mobilização neural do membro inferior no controlo postural, limiar de dor e performance do membro inferior em atletas".
Orientadora: Doutora Anabela Silva - Professora Adjunta (ESSUA).
Equipa de Investigação: Doutora Anabela Silva - Investigadora responsável (ESSUA), Fisioterapeuta Jéssica Ferreira – Investigadora co-responsável-Aluna de Mestrado (ESSUA).
Relator: Doutor António Rocha Andrade.
Relatores Adjuntos: Doutora Paula Cristina M. S. Pereira, Doutor António J. A. Nogueira, Doutor Armando J. Formoso de Pinho e Doutor Jorge Carvalho Arroteia.

I. Relatório

O processo encontra-se devidamente instruído contendo elementos fundamentais relativos a:
- caraterização do projeto;
- equipa de investigação;
- bibliografia de referência;
- apêndices:
  1 – documento informativo sobre critérios de exclusão;
  2 – consentimento informado;
  3 – documento informativo ao participante;
  4 – caraterização do participante;
  5 – caraterização de eventuais sintomas durante o teste *Staight Leg Raise;*
  6 - questionário de avaliação inicial.

II. Parecer

A. Fundamentação:

1. A proposta relativa ao projecto está devidamente fundamentada, sendo inteligível e exaustiva no que respeita aos seus objectivos, metodologia, indicação de estudos semelhantes e bibliografia.
2. A amostra está bem definida e os procedimentos a seguir no decurso da recolha de dados – no laboratório de Estudo do Movimento Humano da ESSUA – estão devidamente descritos.
3. Os riscos associados ao desenvolvimento do Projecto estão considerados.

De acordo com referido a proposta respeita os princípios de ética neste tipo de investigação na medida em que:

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Conselho de Ética

1. O estudo salvaguarda o consentimento informado dos participantes, com pelo menos 18 anos de idade sendo feito anteriormente à recolha de dados;
2. O estudo salvaguarda a participação voluntária da participação;
3. O estudo é devidamente acompanhado pela equipa de investigação;
4. Os riscos associados à participação no estudo não são superiores aos riscos associados ao dia-a-dia do participante;
5. Os dados recolhidos no projecto são analisados pela equipa de investigação, mantendo-se confidencias e anónimos, sob a responsabilidade da Coordenadora e do estudo;
6. Os dados são armazenados por um período de três anos e depois destruídos.

B. Sugestões de aperfeiçoamento:

Não há.

C. Conclusão:

De acordo com o anteriormente assinalado e os princípios seguidos por este Conselho é emitido o seguinte parecer:

1. A Comissão Permanente do Conselho de Ética, constituída pelos ora Relatores, após apreciação conjunta da documentação recebida e atendendo a que os procedimentos descritos no estudo de investigação apresentada asseguram a não utilização de qualquer método invasivo e asseguram que os participantes, com 18 ou mais anos, atletas de futebol, serão oportunamente informados e esclarecidos sobre as condições em que vão decorrer as observações e recolha de dados, de modo a ser obtido o consentimento informado, e garantem que os dados recolhidos serão tratados de maneira a permanecerem confidenciais e anónimos considera que **merece parecer favorável** a realização do projecto em análise.
2. Submetido ao CED o parecer da sua Comissão Permanente, este Conselho, em sua reunião plenária de 13 de Janeiro de 2016, por entender que ficam salvaguardadas as exigências éticas e os princípios da justiça e da autonomia e bem-estar dos participantes, concorda por unanimidade com o mesmo, em razão do que o ratifica e **dá parecer favorável** à realização do projecto intitulado: "Efeito da mobilização neural do membro inferior no controlo postural, limiar de dor e performance do membro inferior em atletas".

Aveiro, 13 de Janeiro de 2016.

O Relator Principal:

Doutor António Rocha Andrade.