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Acute effects of three different stretching techniques on hamstring flexibility in professional football players

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Abstract

Introduction: Hamstring injuries are common in physically active people and athletes. Lack of hamstring flexibility is the one of the most important characteristics of hamstring injuries in athletes. The aim of this study was to investigate effects of three different stretching techniques on hamstring flexibility in professional football players. Materials and Methods: Fifty-five male football players between the ages of 18–20 years old were involved in the study. The participants were divided into 3 groups: static stretching, neuromobilization and Mulligan traction straight leg raise (TSLR), respectively. Each participant's dominant lower extremity was assessed with a straight leg raise test (SLR) using a goniometer before and after the intervention. Results: There was a significant difference in the SLR range of motion before and after the intervention in all groups. There was no difference in the range of SLR between the groups at the beginning and at the end. However, the increase in the SLR range of motion was significantly higher in the Mulligan TSLR group. Conclusions: It was concluded that all 3 stretching techniques are effective in increasing hamstring flexibility in football players. However, the Mulligan TSLR technique could provide a greater increase in the range of motion than other techniques.

Keywords

football players, hamstring flexibility, stretching

Cover Page Footnote

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Article

Acute effects of three different stretching techniques on hamstring flexibility in professional football players

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1. Introduction

Hamstring injuries are common in physically active people and athletes participating in competitive sports such as sprinting, rugby and football [1]. Many factors, including insufficient warm-up, poor flexibility, muscle imbalance, neural tension and fatigue, predispose to hamstring injuries [1]. Lack of hamstring flexibility is the one of the most important characteristics of hamstring injuries in athletes [2].

Many procedures are used to increase hamstring flexibility. Static stretching is one of the safest and most commonly performed stretching methods used to increase muscle length. Due to the viscoelastic nature of the soft tissues, it has been reported that the static stretching provides an immediate increase in muscle flexibility [3,4]. However, this effect is transient and disappears rapidly [5].

The hamstrings serve as a mechanical interface surrounding the sciatic nerve. Nerve adhesions in the hamstrings can alter neurodynamics and cause abnormal mechanosensitivity in the sciatic nerve, which can affect hamstring flexibility. These changes in the mechanical sensitivity of the nerve tissue have been reported to limit hamstring flexibility in healthy people and those who have previously suffered from hamstring injuries [6–8]. Neuromobilization is thought to decrease neural mechanosensitivity and these interventions could be beneficial in the management of hamstring flexibility [9].

It has been suggested that the Mulligan traction straight leg raise (TSLR) can improve the range of the straight leg raise (SLR) in patients with low back pain or hamstring tightness [10]. According to the Mulligan Manual Therapy Concept, the reason for stretching/shortening in the hamstring muscles lies in stretching intolerance. Therefore, providing a pain-free range of motion under traction improves the muscle tolerance to stretch. The TSLR technique has advantages over other treatment options, as it is a single painless intervention that has immediate benefits [11].

There is no consensus on the appropriate dosage for neuromobilization; however, we chose 60 s based on previous studies [1,12]. Although it has been reported that static stretching of the hamstring muscles has a similar effect on flexibility in 30 and 60 seconds [13], we chose 60 seconds to last the same time as neuromobilization.

The aim of this study was to investigate the acute effects of static stretching, neuromobilization and TSLR on hamstring flexibility in professional football players.

2. Materials and Methods

2.1. Participants

This is a prospective randomized clinical study. Participants were informed about the aim and method of the study, which was approved by the local ethics committee of Gazi University. Fifty-five male football players between the ages of 18–20 years old were involved in this study. Potential subjects who had had hamstring injury within the past year, neurological or orthopedic impairments, and those with a surgical history for the lower extremity were not included in the study. Participants were randomly assigned into 3 groups using a randomized table of numbers. Opaque envelopes were used for the allocation of the individuals to the different groups as follows: static stretching (n = 18), neuromobilization (n = 19), and TSLR (n = 18).

2.2. Measurement of Hamstring Flexibility

Hamstring flexibility was assessed with SLR test before and after the intervention using a goniometer. The second assessment was conducted immediately after the intervention. Assessors and participants were not blinded to group assignment. While the participants were in the supine position, the axis of goniometer was placed on the trochanter major. One of the physiotherapists passively flexed the hip joint while the knee was fully extended to the end point where firm resistance was detected in the hamstring muscle group. The other physiotherapist measured the hip flexion angle with a goniometer. This assessment has been shown to have high reliability and validity in various studies. In a study examining handheld goniometer accuracy, Herrington et al. (2008) found the SLR test intra-tester reliability to be excellent (r = 0.93), with a standard error of measurement of 2.5° [14]. All interventions were performed before the football training, between 5:00 pm and 6:00 pm.

2.3. Interventions

Static Hamstring Stretching: Passive stretching of the hamstring muscles in the dominant leg was implemented. While the participant was lying supine, a physiotherapist passively positioned the participant into the SLR position (hip in flexion, knee in extension, and ankle in neutral). The physiotherapist made sure that the stretch did not cause any pain. The physiotherapist then stretched the hamstrings passively until the participant felt and reported a mild stretch sensation. The position was held for 60 seconds.

Neuromobilization: Each participant sat with their trunk in thoracic flexion (slump position), and while maintaining that posture, they performed alternating movements of knee extension/ankle dorsiflexion with cervical extension and knee flexion/ankle plantar flexion with cervical flexion. Participants performed these active movements for approximately 60 seconds.

Mulligan Traction Straight Leg Raise: A substantial traction force was applied along the long axis of the leg at the point of limitation while the knee was in a fully extended position. The traction was applied just proximal to the ankle joint. The traction was held until the leg was back in the neutral position. At any point when the participant reported any kind of stretching pain, the direction of the traction was changed to eliminate pain (slight rotation, abduction, and/or adduction of the leg under traction). As soon as the pain was eliminated, the physiotherapist continued to move the leg towards the range of SLR and then returned it to the resting position while carrying on the traction until the end position. There was not an additional holding time during this technique. It was ensured that there was no radiating back pain during the procedure. TSLR was administered in each participant 3 times in 3 repetitions. The interaction with the patient continued throughout the administration of the procedure.

2.4. Statistical Analysis

Statistical analyses were performed using the SPSS software version 23.0 (SPSS Inc., Chicago, IL, USA). Paired t-test was used to compare SLR ROM measurements at two time points (baseline and final assessments) in each group. Repeated measures ANOVA was used to compare the changes in SLR ROM among the groups. The significance level was set at 0.05. The results were statistically interpreted at 95% confidence level.

3. Results

Characteristics of the study sample are summarized in Table 1, demonstrating that there was no difference between groups at the beginning of the study.

Table 1. Sample characteristics.

	Static stretching		**Neuromobilization**		**Mulligan TSLR**		
	Mean	SD	Mean	SD	Mean	SD	**p**
Age (years)	18.11	0.47	18.53	0.70	18.56	0.78	0.140
Height (cm)	177.28	6.00	177.42	8.60	177.89	5.38	0.961
Weight (kg)	67.33	8.27	69.25	9.66	69.89	4.70	0.600
Training experience (years)	7.17	2.92	7.71	2.91	8.14	3.06	0.617
Training days/week	4.94	1.89	5.32	1.67	5.67	1.41	0.437
Training hours/day	100.00	14.55	99.47	24.60	105.00	36.01	0.787

SD: Standard deviation, TSLR: Traction straight leg raise.

There was a significant difference in the SLR ROM before and after intervention in all 3 groups. There was no difference in SLR ROM between the groups both at the beginning and at the end ($p > 0.05$) (Table 2). However, the increase in SLR ROM was significantly higher in the TSLR group ($p = 0.019$) (Table 2).

Table 2. SLR range of motion before and after intervention.

	Static stretching		Neuromobilization		Mulligan TSLR			
	Mean	SD	Mean	SD	Mean	SD	Test	**p2**
SLR before intervention	85.3	6.9	87.3	8.1	84.3	6.5	0.817	0.447
SLR after intervention	87.8	6.31	90.4	7.6	89.9	6.7	0.729	0.487
p1	**0.004**		**0.005**		**<0.001**			
p3: **0.019**								

p^1: in-group analysis, p^2: between groups analysis, p^3: group time interaction, SD: Standard deviation, SLR: Straight leg raise, TSLR: Traction straight leg raise.

4. Discussion

This study was planned to investigate the effects of static stretching, neuromobilization, and TSLR techniques on hamstring flexibility. It was observed that all 3 stretching techniques were effective in increasing hamstring flexibility in football players. However, the Mulligan TSLR technique was found to be more effective in increasing the SLR ROM compared to neuromobilization and static stretching.

Increasing the flexibility of the hamstring can be an important factor in preventing lower extremity strain injuries [1]. In a study conducted in military trainees, it was reported that lower extremity injuries reduced after the implementation of a stretching protocol that increased hamstring flexibility [15]. There are studies in the literature about proprioceptive neuromuscular facilitation (PNF) [16,17], static stretching [16,18], the Mulligan technique [11,17,19], neural sliding techniques [9,20], and ballistic stretching [21]. In this study, effects of static hamstring stretching, neuromobilization, and Mulligan TSLR techniques on hamstring flexibility were investigated.

It was observed that SLR ROM significantly increased after stretching in the static stretching and neuromobilization groups. The "sensory theory" proposed by Weppler and Magnusson suggests that muscle flexibility and the response to immediate tension are associated with the perception of tension and pain rather than the biomechanical effects on the muscle tissue [22]. Accordingly, the increase in hamstring flexibility after neuromobilization application is not a result of changes in the tissue, but it is due to changes in the patient's pain and tension perception. Castellote-Caballero et al. [1] completed a pilot study of 28 healthy football players assessing the effects of neurodynamic sliding. As a result of the study, a significant increase in hamstring flexibility was observed in the neurodynamic sliding technique group [1]. In another study, Castellote-Caballero et al. [9] divided 120 healthy subjects with short hamstring syndrome into neurodynamic sliding, static stretching, and placebo groups. They emphasized that hamstring flexibility increased most in the neurodynamic sliding group [9]. Mendez-Sanchez et al. [23] completed a pilot study of 8 football players. They applied only static hamstring stretch to the control group and applied the sciatic nerve sliding technique in addition to static hamstring stretch to the experimental group. They found that the increase in SLR range was greater in the experimental group [23]. Similarly, a significant increase in hamstring flexibility was observed in the present study following the administration of neurodynamic sliding exercises. The increase in flexibility was considered to be caused by altered tension and pain perception, as Weppler and Magnusson mentioned, regardless of the tissue lengthening. Therefore, it is considered that neurophysiologic factors are more dominant than biomechanical changes.

In the present study, the increase in SLR ROM was significantly higher in the Mulligan TSLR group. This may be due to an inhibitory effect on the lower limb alpha motor neuron activity of various receptors during TSLR. Golgi tendon organs around the knee, hip, and spine probably activate various segmental reflex pathways during the traction of the extremity. Likewise, Golgi tendon organs are activated during wide amplitude stretching movements such as SLR. This process in the nervous system may inhibit the activity of the stretched muscles during SLR by inhibiting type II muscle spindle afferent activity or reducing motor neuron excitability by 1-b fibers. Hence, improvements in the range of SLR may be directly related to the inhibition of the hamstring muscles rather than changes caused by stretch tolerance [19, 23]. Mazumdar et al. [2] applied the Mulligan TSLR and muscle energy techniques to asymptomatic men with hamstring tightness. They reported that both techniques decreased hamstring tightness; however, the muscle energy technique was more effective [2]. Hall et al. [19] studied the effects of the Mulligan TSLR technique on healthy subjects. They concluded that the Mulligan TSLR technique increased SLR range of motion by increasing hip flexion and pelvic rotation [19]. Yıldırım et al. [17] compared four groups of healthy subjects with bilateral hamstring tightness: 1. static stretching, 2. PNF stretching, 3. TSLR technique, and 4. no intervention. They reported that PNF stretching and Mulligan TSLR hip flexion range of motion were greater than those of the other groups [17]. We found that the Mulligan TSLR technique was more effective than the other techniques in this study. As mentioned above, alpha motor neurons may be inhibited and the Golgi tendon organs may be activated during the TSLR technique. This leads to an inhibition in the nervous system and, as a result, the tolerance to the stretch on the hamstring muscles increased.

To our knowledge, there are no studies comparing these 3 techniques together in the target population. This is the first study to compare the effects of static stretching, neuromobilization, and TSLR techniques on hamstring flexibility in professional football players. It was observed that these 3 stretching techniques may be effective in increasing hamstring flexibility in football players. However, it was seen that the Mulligan TSLR technique resulted in a greater increase than the other techniques. It was considered that the Mulligan TSLR technique may be applied before competition or training to increase hamstring flexibility in football players.

This study has some limitations. The sample of the study included only young males; thus, results cannot be generalized to other populations. Additionally, we only looked at acute effects of interventions and it is not possible to determine how long the observed increase in hamstring flexibility might have lasted. Future research should include different age groups and genders and examine long-term effects of the interventions.

5. Conclusions

It is concluded that all 3 stretching techniques were effective in increasing short-term hamstring flexibility in football players. However, the Mulligan TSLR technique was found to be more effective in increasing the SLR range of motion compared to neuromobilization and static stretching. It was considered that the Mulligan TSLR technique may be applied before competition or training to increase hamstring flexibility in football players.

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