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# Postural stability and knee proprioception in football players: The role of self-myofascial release with a foam roller

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**Abstract**

The aim of this study was to determine the acute effects of self-myofascial release exercises performed on the lower extremity and trunk muscles of amateur football players using foam rollers on postural sway and knee joint position sense. A total of 20 healthy amateur football players volunteered to participate in the study. In a crossover experimental design, participants underwent postural sway and knee joint position sensation measurements twice on different days in both the self-myofascial release (SMR-FR) condition and the control condition using foam rollers. SMR-FR exercises were performed on the lower extremity and trunk muscles for 60 seconds for each muscle group. Postural sway was measured with the Biodex Balance System in the eyes open (EO) and eyes closed (EC) conditions, and knee joint position sense (KJPS) was measured with an isokinetic dynamometer at 30°, 45° and 60° in the dominant leg. No significant difference was found between the foam roller group and the control group in the EO condition ($p > 0.05$). While there was a significant decrease in postural sway scores in the foam roller group after SMR-FR in the EC condition ($t=3.021$; $p<0.05$), no difference was found in the control group ($p>0.05$). Pre-post differences in postural sway scores were higher in the foam roller group ($U=84.500$; $p<0.05$). Pre-test EPS did not differ between groups ($p>0.05$). At post-test, 30° and 60° KJPS were not different between groups ($p>0.05$), but the control group had a higher KJPS at 45° ($U=120.500$; $p<0.05$). After FR-MFG, there was a significant decrease in KJPS values in the foam roller group at 30° and 60° ($p<0.05$), while KJPS did not change at 45° ($p>0.05$). There was no statistically significant difference between the pre- and post-test KJPS values of the foam roller and control groups ($p>0.05$). In conclusion, after foam roller myofascial release exercises, it was observed that the postural sway performance of amateur football players was not affected in the EO condition, but increased in the EC condition. In addition, it was found that after foam roller myofascial release there was an improvement in knee joint position sense at 30° and 60°, but no effect at 45°.

## Introduction

In order to achieve a high level of performance, dynamic, static, proprioceptive neuromuscular facilitation and ballistic stretching exercises play a significant role in addition to moderate intensity activities for training and pre-competition preparation (Jones et al., 2015). Van Den Tillaar (2019) reported the effectiveness of general and special warm-up methods applied actively and/or passively in team sports, and stated that special warm-up protocols are more effective than long warm-up protocols in short-term activities such as sprinting. Different warm-up exercises are used according to training types and branches. Several researchers have examined myofascial release as a component of these warm-up regimes (see MacDonald et al., 2013; Torun et al., 2021; David et al., 2019). Myofascial release warm-up exercises, a prominent example of this approach, have gained popularity due to their positive impact on athletes' performance levels (Pagaduan et al., 2012). Among the various tools employed in myofascial release exercises, the foam roller stands out as a particularly effective implement (Pagaduan et al., 2012). The primary advantage of foam rollers lies in their ability to facilitate self-myofascial release through the application of body weight, whereby the foam roller is maneuvered in a back-and-forth motion between the initial and final muscle points (MacDonald et al., 2013). This characteristic has

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facilitated the exploration of postural control and joint position sense in research studies (Melton et al., 2024; Junker & Stöggl, 2019; David et al., 2019; Zeeshan et al., 2020).

Balance is defined as the ability to maintain equilibrium in response to changes in the body's centre of gravity. This capacity is facilitated by neuromuscular stimulation, which is influenced by visual, vestibular, and somatic senses (Boccolini et al., 2013).The maintenance of balance and postural control is influenced by internal and environmental factors (Chander & Dabbs, 2016). Balance is the ability controlled through coordinated movements on the kinetic chain, which includes the movements of the hip, knee, and ankle joints (Michell et al., 2006; Barabas et al., 1996; Panjan & Sarabon, 2012). These movements significantly affect the fluidity and ability of sport-related movements. Handrakis et al. (2010) determined that static stretching exercises improve dynamic balance. Lewis et al. (2009) observed that acute stretching exercises applied before physical activities positively improved postural sway. However, contrary to these studies, Behm et al. (2004) and Nagano et al. (2006) found that stretching exercises impair balance performance.

Joint position sense is defined as the awareness of a joint's position in space (Grob, 2002). The term 'joint position sense capability' is used to denote the ability to actively or passively reproduce a position that has been applied by a person. The evaluation of open kinetic chain or closed kinetic chain positions can be conducted through direct measurement with an electrogoniometer utilising video or a potentiometer, or alternatively through indirect measurement with a Visual Analog Scale (Kaya et al., 2012). The integration of afferent stimuli from proprioceptive receptors in various structures and conditions of the knee contributes to the development of knee proprioception. Additionally, external feedback from the knee exerts a significant influence on this process (Bircan & Fidan, 2000). Warm-up activities have been shown to enhance muscle elasticity, muscle temperature, muscle contraction speed, joint range of motion, the amount of oxygen reaching the muscle, and nerve conduction speed (Kuter et al., 1990). Consequently, it is hypothesized that warm-up exercises have a positive effect on proprioception (Kuter et al., 1990). The findings of numerous studies have demonstrated that varying durations of warm-up exercises can enhance joint position sense (Magalhaes et al., 2010; Bartlett & Warren, 2002; Salgado et al., 2015).

It is reasonable to hypothesize that self-myofascial release exercises, which are frequently employed as a component of warm-up procedures, have the potential to enhance the performance of football players, particularly in terms of postural stability and joint position sense. The objective of this study was to ascertain the acute effects of self-myofascial release exercises, implemented on the lower extremity and trunk muscles of amateur football players using foam rollers, on postural sway and knee joint position sense.

## Method

### Participants

The present study comprised 20 healthy male football players (mean age: 22.60 ± 2.951 years, mean height: 177.10 ± 5.60 cm, mean weight: 72.85 ± 7.59 kg; mean ± SD) who had not sustained any injuries, motor control problems, neurological disorders, or vestibular disorders in the preceding six months, and who participated on a voluntary basis. The participants from local amateur league were athletes who attended football training a minimum of three days per week, and the measurements were taken during the competitive season. The participants were informed about all risks and potential harms prior to the study, and informed consent forms were signed. Prior to the study, ethical approval was obtained from the Non-Interventional Ethics Committee of the Faculty of Sports Sciences, Selçuk University (Date: 30.09.2021, Number: 124). The study was conducted in accordance with the Helsinki Declaration. Participants were advised not to consume alcohol or caffeine and not to engage in strenuous exercise for 48 hours prior to the measurements.

### Procedure

The study used a crossover design. Participants entered the study in both experimental conditions at different times and returned to the laboratory a total of 6 times for measurement. In order to eliminate the learning and practice effect, half of the participants were first measured in the condition without FR (control group) and the other half were first measured in the FR condition (foam roller group), and they were measured in the other condition at least 3 days apart. Participants in the research group first had their postural sway measured, and then did self-myofascial release exercises, and then had their postural sway measured again. Participants in the control group had postural sway measurements taken without the application of

self-myofascial release exercises. On another day, participants in the research group were first measured for knee joint position sense, then FR was applied, and then knee joint position sense was measured again. Participants in the control group had their knee joint position sense measured without FR application.

### Self-Myofascial Release with Foam Roller

Prior to the commencement of the measurements, the participants were introduced to the concept of myofascial release with FR exercises and were permitted to practice the exercises until they were able to perform them independently. On each measurement day, the participants underwent a standardized warm-up protocol, which lasted approximately 10 minutes (comprising 5 minutes of low-intensity jogging and 5 minutes of dynamic stretching). Self-myofascial release exercises with foam rollers (SMR-FR) were applied to the lower extremity and trunk muscles with the body parallel to the floor (Figure 1). SMR-FR was applied for 60 sec for each muscle (Okamato et al., 2013). Participants performed FR rolling movements within the start and end points of the muscles (Beardsley & Skarabot, 2015). Immediately following the SMR-FR, knee joint position sense and postural sway were measured.

### Postural Sway Measurement

The Biodex Balance System (BBS) was utilized to evaluate postural sway performance. The BBS has a 360-degree range of motion and a 55 cm diameter movable platform with adjustable difficulty levels. Participants' postural sway performance was assessed in open-eye and closed-eye conditions while standing on their dominant leg. Postural sway tests were conducted under eyes-open (EO) and eyes-closed (EC) conditions. Participants were instructed to move the platform freely while observing the device screen, adjusting their foot position until a stable stance was achieved. The platform was then fixed according to the participant's foot position, and the corresponding foot coordinates were recorded in the system. To avoid the stabilizing effect of arms, participants were instructed to cross their arms over their chest with their hands touching their shoulders. All participants performed the tests barefoot and in appropriate sports clothing, with sufficient practice allowed to ensure adaptation to the instrument.

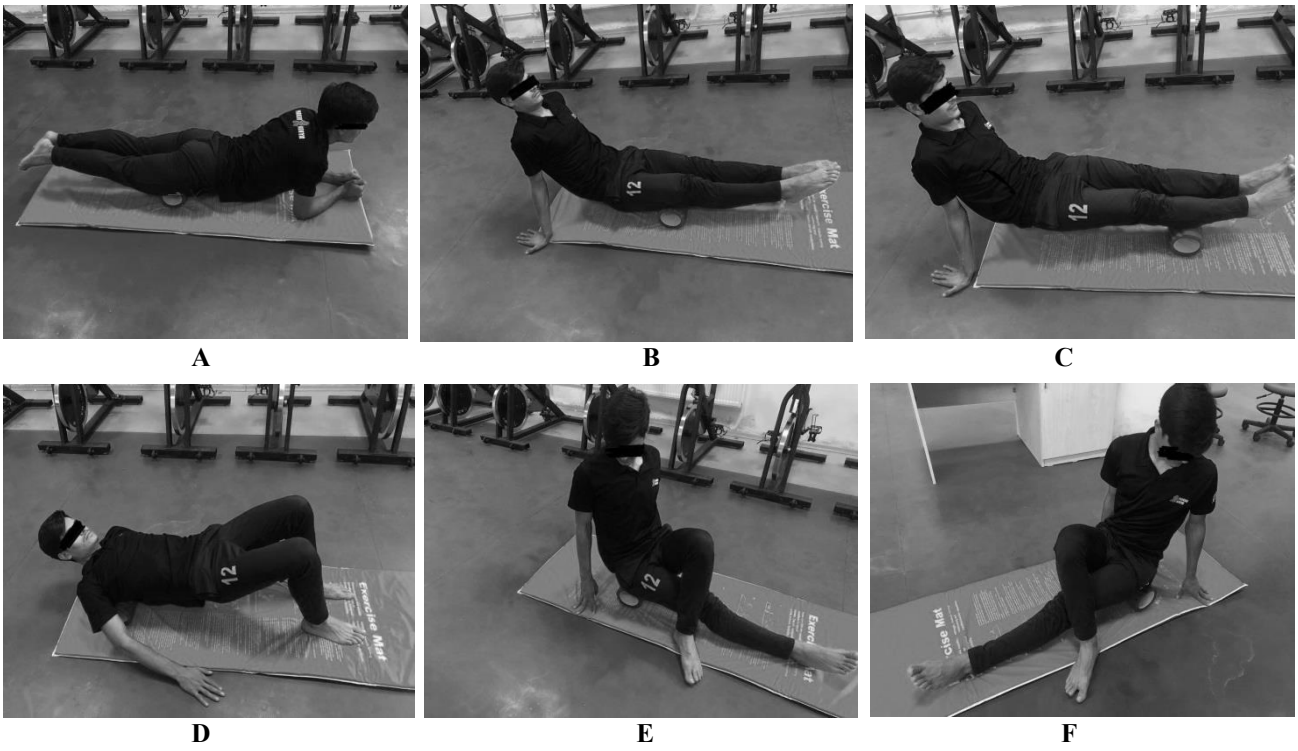


**Figure 1.** Self-myofascial release with foam roller (SMR-FR), **A:** For quadriceps muscle, **B:** For hamstring muscles, **C:** For calf muscles, **D:** For back muscles, **E:** For gluteal muscles-right, **F:** For gluteal muscles-left.

The EO and EC balance tests were performed for 20 sec each, with participants adjusting their center of gravity using visual feedback. The EO condition had the device screen turned off to prevent feedback, while the EC condition had closed eyes. Postural sway tests were performed twice, with a 2 minute rest period between trials (Erkmen et al. 2010; Kocaoğlu et al., 2023; Salavati et al., 2007; Testerman et al., 1999).

### Knee Joint Position Sense Measurements

Knee joint position sense measurements were taken using an isokinetic dynamometer (HUMAC NORM, Lumex Inc, Ronkonkoma, NY, USA). Before use, the angles of the device were adjusted according to the individual body measurements of each participant. Measurements were taken on the dominant leg. Participants were given 3 practice trials prior to measurement to familiarise themselves with the device. The knee was brought to maximum flexion and these angles were taught to the participants by stopping for 10 seconds at 30°, 45° and finally 60° flexion angles, while slowly moving from maximum flexion to extension. The knee was then returned to maximum flexion and participants were asked to try to find these angles by actively moving their knee towards the previously learnt flexion angles of 30°, 45° and 60°, respectively, while moving from maximum flexion to extension. The measurements were repeated 3 times for all angles. Each measurement was followed by a 2-minute rest period. The average of participants' deviations from each angle in the dominant leg was recorded as the knee joint position sense (Négyesi et al., 2019; Zhang et al., 2019).

### Data Analysis

Statistical analysis of the data was performed using the SPSS 26.0 statistical software package. The variables obtained from the participants' measurements were summarised as means and standard deviations. The Shapiro-Wilk test was used to assess the normality of the data distribution. Based on the results of the normality analysis, parametric (paired t-test and unpaired t-test) or non-parametric (Mann-Whitney U test, Wilcoxon test) tests were used for pairwise comparisons of dependent and independent groups. The statistical significance level for the study was set at 0.05.

## Results

Table 1 shows descriptive characteristics of participants.

**Table 1**
Descriptive characteristics of participants (n=20).

| Variables | Mean | SD | Minimum | Maximum |
|---|---|---|---|---|
| Age (year) | 22.60 | 2.951 | 18.00 | 28.00 |
| Height (cm) | 177.10 | 5.60 | 169.00 | 190.00 |
| Body mass (kg) | 72.85 | 7.59 | 58.00 | 92.00 |

### *Postural Sway*

Postural sway scores in eyes open condition is presented in Figure 1. There was no significant difference between the EO postural sway scores of the foam roller and control groups in both pre-test and post-test (U= 196.500; $p$ = 0.924 for pre-test; U= 189.000; $p$ = 0.766 for post-test). Compared to the pre-test, the EO postural sway scores of the Foam roller group did not change in the post-test (Z=0.503; $p$ = 0.615). The same result was found in the control group (t=0.615; p = 0.546). The EO postural sway score differences were not significantly different between the foam roller and control group (U= 186.000; $p$ = 0.704).


**Figure 1.** Postural sway scores in the eyes open condition.

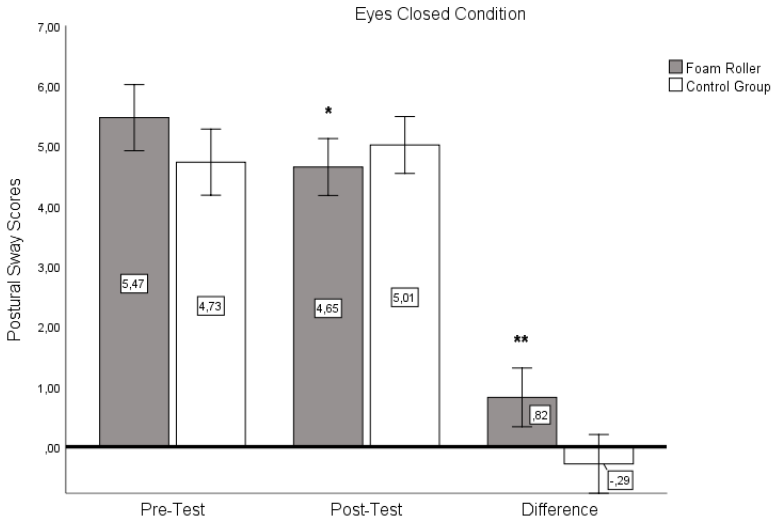


**Figure 2.** Postural sway scores in eyes closed condition.

** Lower than the pre-test (p<0.05). ** Higher than the control group (p<0.05).*

Figure 2 shows the postural sway scores in eyes closed condition according to the experimental conditions. In EC condition, postural sway scores between the foam roller and control group did not found significant (t= 1.906; $p$ = 0.064). In the post-test, postural sway scores were not different between foam rollers and control group (t= -1.091; $p$ = 0.238). In the foam roller group, EC postural sway scores was lower in post-test than pre-test (t= 3.021; $p$ = 0.007), but there was no difference in the control group (t=-1.334; $p$ = 0.198). The difference between pre-test and post-test postural sway scores in the eyes closed condition was higher in the foam roller group compared to the control group (U= 84.500; $p$ = 0.002).

### *Knee joint position sense*

Figure 3 shows knee joint position senses at 30°, 45° and 60°. The 30° knee joint position sense was not different between the foam roller and control groups in both pre-test (U= 138.000; $p$ = 0.096) and post-test (U=176.000; $p$ = 0.529). Compared with the pre-test, there was a decrease in knee joint position sense in the post-test of the foam roller group at 30° (Z= 2.593; $p$ = 0.010), but there was no significant difference in the control group (Z= - 0.284; $p$ = 0.776). The pre-test and post-test difference scores were not different between the foam roller and control groups (t=1.981; $p$ = 0.055).

In the pre-test, knee joint position sense at 45° degrees was not different between the foam roller and control groups (U= 151.500 $p$ = 0.192), but in the post-test, the foam roller group was higher than the control group (U= 120.500; $p$ = 0.030). The pre-test and post-test difference scores at 45° did not different between pre-test and post-test in both the foam roller group (Z= 1.138 $p$ = 0.255) and control group (Z= 1.114; $p$ = 0.265). There was no significant difference between the foam roller and control groups in the knee joint sense at 45° (U = 193.500; $p$ = 0.862).

Knee joint position sense at 60° was not different between the foam roller and control groups in the pretest (U=142.500 p = 0.121) and posttest (U=183.000; p = 0.659). In the control group, knee joint position sense at 60° was not different between the pre-test and post-test (Z= -0.196; p = 0.844), but it decreased significantly in the post-test compared to the pre-test (t= 2.426; p = 0.025). There was no difference between the foam roller and control groups in the pre-test - post-test difference scores (U=146.000; p = 0.149).

## Discussion

The aim of the study was to investigate the acute effects of foam roller myofascial release exercises applied to the lower extremity and trunk muscles of amateur football players on postural sway and knee joint position sensation. It was found that foam roller myofascial release exercises caused changes in postural sway and 30° to 60° knee joint position sensation in the EO condition. In this section, the effects of foam roller myofascial release on each of the measured parameters are discussed separately.

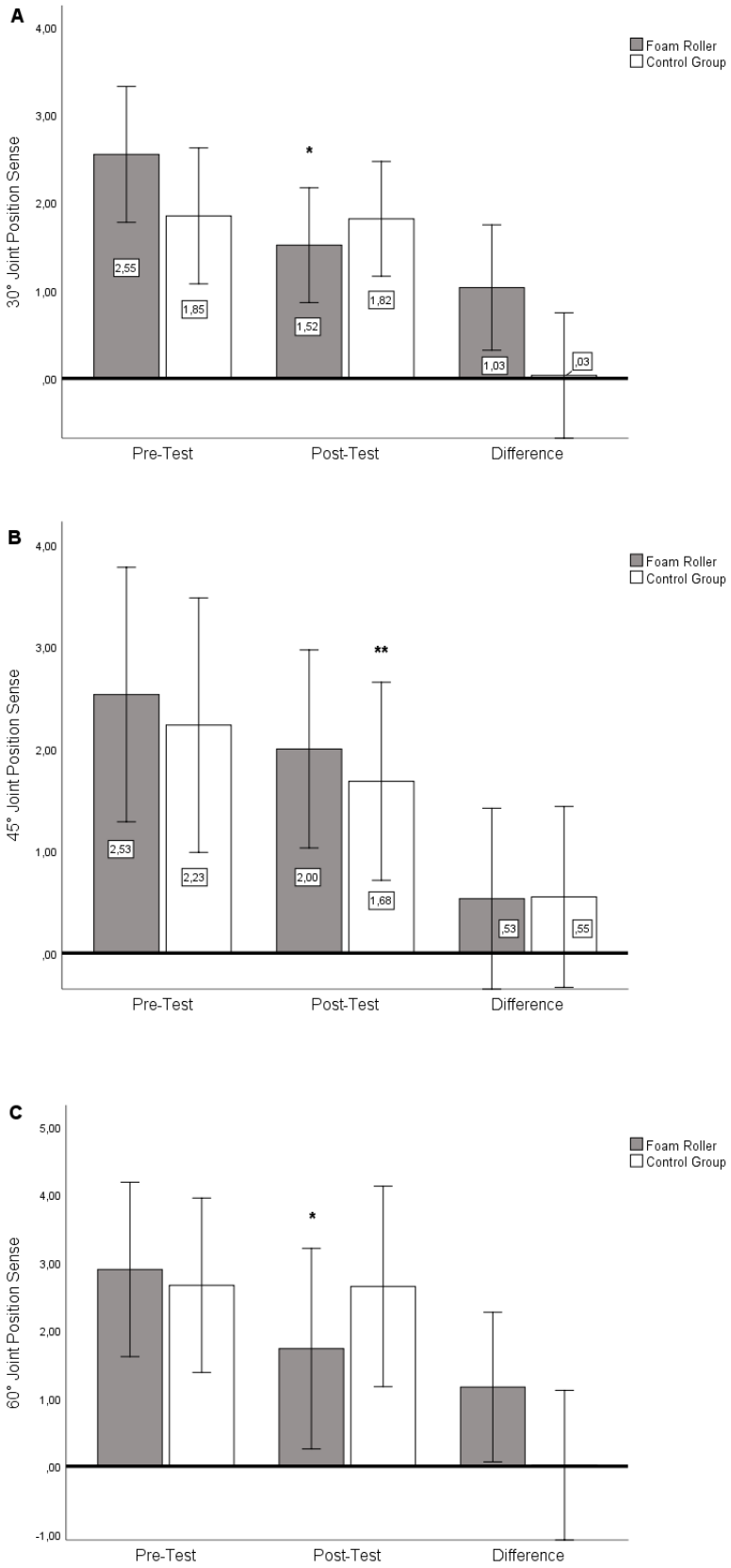


**Figure 3.** The knee joint position senses according to the experimental conditions. A: at 30°, B: at 45°, C: at 60°.

** Lower than the pre-test (p<0.05). ** Lower than the foam roller (p<0.05).*

## Postural Sway

The results of the study showed that foam roller myofascial release did not change the EO postural sway scores of the research group, in other words, foam roller myofascial release did not affect postural sway performance in the GA condition. However, in the EC condition, the postural sway scores of the research group decreased after the foam roller myofascial release exercises, which mean that the postural sway performance improved.

Supporting our research, De Benito et al. (2019), in their study investigating the effects of vibrating and non-vibrating foam roller exercises on dynamic balance, found that both vibrating and non-vibrating foam roller methods, applied for 60 seconds and two repetitions, and improved dynamic balance performance. Again, in the study by Torvinen et al. (2002), they included 14 participants aged 24-33 years, with no health problems and no active sports participation, in a 4-minute whole-body vibration application. They reported statistically significant differences in the postural sway test performed 2 minutes after the 4-minute whole-body vibration session. They also added that this difference disappeared after 1 hour. There are studies suggesting that postural correction exercises, including foam roller exercises, have an effect on balance and performance (Karakuş & Kılıç, 2006).

In contrast to our study, Grabow et al. (2017) reported that foam roller exercises applied for 60 seconds and three sets did not have a positive effect on dynamic balance performance in their study investigating the effects of foam roller exercises on balance.

In a study, they applied FR twice a week for a total of 8 weeks to the muscles in the leg part of the foam roller application. As a result of the study, no significant difference was found in terms of postural sway and performance in participants treated with FR (Junker & Stöggl 2019). In another study, FR application had no effect on dynamic balance (Halperin et al., 2014).

## Knee Joint Position Sense

When examining the effects of foam roller myofascial release exercises on knee joint proprioception, it was found that there was a decrease in proprioception values after application at 30° and 60°, in other words, foam roller myofascial release exercises increased knee joint proprioception at 30° and 60°. However, it was found that there was no change after the foam roller myofascial release exercises at 45°. Based on this, it can be said that foam roller myofascial release exercises can improve joint proprioception at both narrow and wide joint angles.

David et al. (2019) reported that myofascial release using a foam roller resulted in statistically significant improvements in hip and knee joint position sense immediately after the intervention, as well as 10 and 20 minutes after the intervention. Similarly, a study by Cho & Kim (2016) found that a one-week daily myofascial release intervention using a foam roller significantly improved hip joint position sense. Another study showed that a one-week application of kinesiotape, one of the fascial treatment methods, led to improvements in cervical joint position sense (Zeeshan et al., 2020). Furthermore, a six-week kinesthetic training intervention resulted in statistically significant differences in cervical joint position sense (Reddy et al., 2019). Koumantakis et al. (2020) found that vibration therapy and light manual massage led to improvements in proprioception of the hamstring region. This research partially supports our study.

Contrary to the findings of this study, a study evaluating specific subcomponents of proprioception following vibration-assisted myofascial release exercises reported no statistically significant differences between pre- and post-intervention measurements (Güzel, 2020). Similarly, a study by Trans et al. (2009) found that vibration-assisted myofascial release combined with postural sway exercises had a positive effect on proprioception, whereas vibration therapy alone had no effect on proprioceptive sensation.

## Conclusion

In conclusion, after foam roller myofascial release exercises, it was observed that the postural sway performance of amateur football players was not affected in the EO condition, but increased in the EC condition. In addition, it was found that after foam roller myofascial release there was an improvement in knee joint position sense at 30° and 60°, but no effect at 45°.

### Acknowledgement

This study, summarized from F. Korkusuz's master's thesis, was presented at the VII. INCES, International Science, Culture and Education Congress (INCES, April 28- May 1, 2024).

### Authors' Contribution

Study Design: FK, NE; Data Collection: FK, AA; Statistical Analysis: NE, AA; Manuscript Preparation: FK, NE, AA.

### Ethical Approval

The ethical approval was obtained from the Non-Interventional Ethics Committee of the Faculty of Sports Sciences, Selçuk University (Date: 30.09.2021, Number: 124). The study was conducted in accordance with the Helsinki Declaration.

### Funding

The authors declare that the study received no funding.

### Conflict of Interest

The authors hereby declare that there was no conflict of interest in conducting this research.

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