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Research Article / Araştırma Makalesi

The effects of knee brace use on landing error, balance, and crossover hop test in healthy athletes

Sağlıklı sporcularda dizlik kullanımının sıçramadan sonra yere iniş hatasına, dengeye ve hoplama testine etkisi

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ABSTRACT

Objective: In this study, it was aimed to examine the effects of knee brace use on landing error after jumping, balance and crossover hop test (CHT) in healthy athletes.

Methods: After recording the descriptive information of the healthy volunteer athletes and measuring the lower extremity joint range of motion, and the Q angle at the knee, participants were randomized. During the study, randomization was carried out as follows: those who did not use knee braces ($Group_{Non}$), those who used simple knee braces ($Group_{Basic}$) and those who used ligament-supported knee braces ($Group_{Lig}$). Y-balance test of lower extremity (YBTL), CHT, and landing error scoring after jumping were applied to the participants.

Results: A total of 56 professional athletes ($Group_{Non}$, n=19; $Group_{Basic}$, n=19; $Group_{Lig}$, n=18) participated in the study. Characteristics of the participants did not reveal any difference (p>0.05). Compared with the other two groups, lower hip extension range of motion was observed in $Group_{Non}$ (p<0.05), and no difference was observed in other lower extremity descriptive data (p>0.05). Furthermore, comparing to the other two groups, a significant (p=0.014) increase was observed only in the velocity of CHT applied to the non-dominant extremity of $Group_{Basic}$. No significant difference was observed in the other evaluated parameters (p>0.05). As a result of intra-group correlation analyses, different levels of relationship were determined between the landing results after the jumping and various biomechanical properties according to the choice of knee brace (p<0.05).

Conclusion: It would be appropriate to choose the knee brace to be used in healthy athletes by taking into account the biomechanical defining characteristics of the athlete.

Keywords: *Knee, braces, physical fitness, biomechanics, athlete*

ÖZ

Amaç: Bu çalışmada; sağlıklı sporcularda dizlik kullanımının sıçramadan sonra yere iniş hatasına, dengeye ve çapraz hoplama testi sonuçlarına etkisini incelemek amaçlandı.

Gereç ve Yöntem: Gönüllü sağlıklı sporcuların tanımlayıcı bilgileri kaydedilip alt ekstremite eklem hareket açıklıkları ve diz Q açısı ölçümleri yapıldıktan sonra katılımcılar rastgele gruplandı. Araştırma sırasında dizlik kullanmayan ($Grup_{Non}$), basit dizlik kullanan ($Grup_{Basic}$) ve ligament destekli dizlik kullanan ($Grup_{Lig}$) olacak şekilde randomizasyon gerçekleştirildi. Katılımcılara Y denge testi, çapraz hoplama testi ve sıçramadan sonra yere iniş hatası puanlaması uygulandı.

Bulgular: Çalışmaya 56 profesyonel sporcu ($Grup_{Non}$, n=19; $Grup_{Basic}$, n=19; $Grup_{Lig}$, n=18) katıldı. Katılımcıların özellikleri farklı değildi (p>0.05). $Grup_{Non}$'in diğer iki gruba kıyasla kalça ekstansiyonu eklem hareket açıklığı ölçüm değerleri (p<0.05) düşüktü; diğer alt ekstremite verilerinde fark yoktu (p>0.05). $Grup_{Basic}$'in diğer iki gruba kıyasla non-dominant ekstremiteye uygulanan çapraz hoplama testinin sadece hız değerinde (p=0.014) anlamlı bir yükseklik gözlendi. Diğer parametrelerde anlamlı fark bulunmadı (p>0.05). Grup içi korrelasyon analizleri sonucunda sıçramadan sonra yere iniş sonuçları ile çeşitli biyomekanik özellikler arasında dizlik seçimine göre farklı düzeylerde ilişki belirlendi (p<0.05).

Sonuç: Sağlıklı sporcularda kullanılacak dizliklerin sporcunun biyomekanik yönden tanımlayıcı özellikleri dikkate alınarak seçilmesi uygun olacaktır.

Anahtar Sözcükler: *Diz, dizlik, fiziksel uygunluk, biyomekanik, sporcu*

INTRODUCTION

Practicing sports is recommended for the protection and promotion of lifelong mental and physical health for everybody. However, sports injuries stand out as a major problem that arises depending on the sports discipline (1). The rate of participation in sports in young and adult age groups is higher than in other age groups, and the most common cause of trauma in young age groups is sports (2).

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Sports injuries are costly due to the athlete's medical care needs and absence from sports, and it is a difficult process for the athlete, both physically and psychologically (3). Regarding the difficulty of the treatment process after sports injury, it is much more economical and easy to prevent injuries to athletes (4). The high cost, physical and psychological difficulties of sports injuries emphasize the prevention of sports injuries and the necessity of different practices in this regard, based on evidence (3,4).

Various injury prevention programs have been developed by sports professionals to protect against sports injuries. It is stressed that the most suitable injury prevention program is the one that is easiest to implement and maintain by the athlete and the coach. Another method used to prevent sports injuries is protective equipment usage by the athletes during training or competition. In this respect, the use of helmets, mouth guards, and tapes or braces for different body parts is frequent among athletes in different sports disciplines (1).

As a result of the developing orthotic technology, the advance in the quality of orthoses' material, and the increase in the number of studies on orthoses' biomechanics, orthoses usage frequency in athletes is increasing (1). Ankle braces used to prevent ankle instability, lumbar supports used for low back health, and knee braces used to prevent knee injuries are examples of commonly used orthoses (5).

Considering all sports injuries, it has been reported that the most common injury concerns lower extremities, and knee injuries are the first among them (6). For this reason, knee braces are one of the most frequently used orthoses by athletes to protect them from sports injuries (1). It is noteworthy that the use of knee braces as protective equipment is especially used by athletes competing in sports that include jumping, cutting and pivot movements (7). For this reason, it is of great importance to examine the effects of knee brace use on sports performance and conditions that predispose to lower extremity injuries.

When the literature is examined, there is absolute consensus on the importance of balance in preventing sports injuries (8,9). Therefore, Y balance test of lower extremity (YBTL) was used in the study to investigate whether the use of knee braces affects balance. On the other hand, CHT is one of the functional tests used to evaluate lower extremity functionality, predict post-injury return to sports, and reinjury (7). Landing Error Scoring System (LESS) is a movement analysis method (10) developed to detect and prevent risk factors of anterior cruciate ligament injury. For these reasons, existing tests were preferred as functional tests.

It has been emphasized in the literature that descriptive measurements such as lower extremity length, knee Q angle and lower extremity joint range of motion should be made in order to interpret functional measurement parameters of the lower extremity properly (10-12). For this reason, these measurements were made at the beginning of the study to obtain lower extremity status information. The aim of the present study is to observe the effect of the use of a simple and ligament-supported knee brace on LESS (13), YBTL and CHT results (7).

MATERIAL and METHODS

The sample of the study consisted of healthy athletes who applied to our clinic to participate in sports or to receive a general health examination.

Inclusion-Exclusion Criteria

Participants who were professional athletes between the ages of 18-30, and had a normal lower extremity musculoskeletal system examination, had no musculoskeletal injuries that would preclude them from performing the functional test, were included in the study. Those who had a disease that prevented them from doing sports, lower extremity injury in the last six months, a history of lower extremity fracture or surgery were excluded from the study.

Study Design

The study was approved by the Süleyman Demirel University Clinical Research Ethics Board of Medical Faculty (Date: 23/7/2020, No. 192). All of the athletes who did not have any health problems were informed about the purpose of the research. Descriptive data were recorded by a researcher after taking verbal and written consent of the athletes who conformed to the inclusion criteria, and agreed to participate voluntarily in the study. After measuring the range of motion of the lower extremity and the Q angle of the knee, the participants were randomized and divided into three groups as: $Group_{Non}$: participants who did not wear any knee braces during the study; $Group_{Basic}$: participants who wore a closed patella neoprene knee brace (Genucare Basic, Orthocare, Ankara/Türkiye) on both knees during the study (Figure 1); Group $_{Lig}$:participants who wore a neoprene knee brace, which was a knee support with patella pad and spring ribs (Genucare Air-X Ligament, Orthocare, Ankara, Türkiye) on both knees, during the study (Figure 2).

Figure 1. Closed patella neoprene knee brace

Before functional tests were performed, participants were allowed a 5-min warm-up exercise and a 3-min lower extremity stretching exercise. Existing warm-up and stretching exercises were carried out without adhering to any protocol, in order to protect the athlete from any injuries. Afterwards, YBTL, CHT, and LESS were applied to all participants. After the tests were demonstrated to the participants, and were allowed three trials, they were started.

Y Balance Test of Lower Extremity (YBTL)

The YBTL was used to measure lower extremity balance of the athletes (14). During the test, the participant was asked to stand motionless with his/her hands on his/her waist, on his/her right and left lower extremities separately, and to extend his/her other foot 135° posteromedially and 135° posterolaterally, and as far forward as he/she could. In order for the individual to understand the test, he/she was made to warm up for six times in three directions. The test was performed three times in each direction and the highest value was recorded in cm. The following formula was used to determine the difference between the first and last measurement total scores: (Anterior + Posteromedial + Posterolateral) / (3 x lower limb length) x100. While performing the tests, care was taken not to take the sole of the foot off the ground, not to take support from any object, and ensure that the participant could return to the starting point. Measurements in which any of these steps could not be performed were not evaluated and the test was repeated.

Crossover Hop Test (CHT)

In the CHT, two 6-m-long lines 15 cm apart were used. Participants began the test on one foot on the outside of the line on the same side of the leg to be tested. After that, the participants zigzagged on one leg to fall on the outside of the lines, and kept their balance forward, making three consecutive jumps. The participant was instructed to balance on the jump leg for two seconds after three consecutive jumps. The participant's time to complete the test and total distance were recorded. All measurements were made separately for the dominant and non-dominant side (7).

Figure 2. Neoprene knee brace with patella pad and spring ribs

Landing Error Scoring System (LESS)

Landing error after jumping was evaluated with the scoring system whose Turkish validity and reliability was provided by Ercan et al. Participants were subjected to a jump test. A wooden box with a height of 30 cm and a non-slippery floor was prepared for the jump. Participants followed the jumping protocol wearing rubber sneakers and shorts. A jumping mat was placed for each subject at a distance half the subject's height from the box. The jump was shown individually by the researchers. Subjects were allowed to experiment. No commands were given during the application, and participants were allowed to make free landings and rebound jumps. The landing protocol was repeated three consecutive times. Cameras were placed opposite the participant and on the dominant extremity side. The distance of the cameras from the jumping mat was set at 345 cm, and the distance of the camera lens from the ground was set at 122 cm. A smartphone (LG G3 D855 model, 16/32 GB internal memory, 13 MP camera resolution, V21a-AME-XX) was used for video recording. The recorded videos were scored with the help of the Kinovea v.0.8.15 (Free software under GPL v2 license, https://www.kinovea.org) programme (13).

Statistical Analysis

Sample size was calculated taking into account the pilot data of the study. Considering the Type I error as 0.05 and the Type II error as 0.20, it was calculated that there should be at least 17 athletes in each group. One-way ANOVA test was used in the post hoc power analysis using the G*Power 3.1.9.7 package program, with the CHT velocity data obtained from the CHT. According to the power analysis, the power (1-β) value at alpha 0.05 level was calculated as 0.85. SPSS v23 package program was used in data analysis. The conformity of quantitative data to normal distribution was determined by the Shapiro-Wilk test. After analyzing the descriptive data of the groups, differences between groups were tested. Differences between categorical variables were evaluated with the Chi-Square test with Monte Carlo correction, and the differences between quantitative variables were evaluated with the Kruskal-Wallis test. Spearman correlation analysis was used accordingly. Data are presented as frequency (n), rate (%), and mean ± standard error. The $p<0.05$ level was considered significant. The rho value was interpreted as: <0.2 very low correlation, 0.2-0.4 low correlation, 0.4-0.6 moderate correlation, 0.6-0.8 high correlation, and >0.8 very high correlation.

RESULTS

The study included 56 healthy professional athletes. Athletes were randomized and divided into three groups (Group $_{Non}$, n=19; Group$_{Basic}$, n=19; Group $_{Lig}$, n=18) according to the use of knee braces. While there were 9 (47%) football players and 10 (53%) volleyball players in Group $_{Non}$, there were 9 (47%) football players, and 10 (53%) volleyball players in Group$_{Basic}$, and 7 (39%) football players and 11 (61%) volleyball players in Group $_{Lig}$. The sports discipline distributions of the athletes in our study were similar according to groups (p=0.743). The right side dominant participants were 17 (89%) in Group $_{Non}$, 15 (79%) in Group$_{Basic}$, and 15 (83%) in Group $_{Lig}$ (p=0.741). There were no significant differences between the groups in other descriptive data of the participants (p>0.05), (Table 1).

Table 1. Descriptive data of participants

Parameter	Group $_{Non}$ (n=19)	Group $_{Basic}$ (n=19)	Group $_{Lig}$ (n=18)	p
Gender (female/male)	9 (%47)/10 (%53)	9 (%47)/10 (%53)	10 (%56)/8 (%44)	0.891
Age (yr)	20.3±0.5	21.1±0.6	22.1±0.9	0.430
Height (cm)	176.8±1.9	178.8±1.3	180.1±1.6	0.155
Body weight (kg)	67.3±3.1	69.8±2.2	70.5±2.1	0.539
Body Mass Index (kg/m²)	21.4±0.7	21.8±0.6	21.7±0.4	0.940
Continuity in sports (yr)	8.9±0.9	10.5±0.8	10.7±1.0	0.511
Training time (hr/wk)	11.5±0.6	13.8±1.3	12.2±1.5	0.503

Participants' lower extremity length, knee Q angle, and trunk, hip, knee, ankle range of motion measurements were evaluated separately for the dominant and non-dominant side. There were no significant differences between the descriptive data of the lower extremities of the athletes included in the study (p>0.05); however, the range of motion values in the extension direction of the hip joint differed between Group$_{Basic}$ and the other groups (p<0.05), (Table 2).

The YBTL test results of the participants did not reveal a significant difference (p>0.05), (Table 3). A significant difference was found between Group $_{Basic}$ and other groups for the non-dominant side in the CHT velocity of the participants (p=0.014). There was no significant difference between the groups in the LESS score (p>0.05), (Table 4).

Correlation analysis was performed to examine the factors associated with the participants' LESS score. LESS score in Group $_{Non}$ revealed only moderate negative correlation with weekly training time (r=-0.49, p=0.032). LESS score was found to be moderately positively correlated with dominant and non-dominant extremity ankle eversion (r=0.62, p=0.005; r=0.53, p=0.019, respectively), and moderately positively correlated with non-dominant extremity hip flexion (r=0.48, p=0.037) in Group$_{Basic}$.

Table 2. Descriptive data of participants' lower extremities

		Group $_{Non}$(n=19)	Group$_{Basic}$(n=19)	Group $_{Lig}$(n=18)	p
Lower limb length (cm)	D	91.0±1.1	92.3±0.7	93.2±1.0	0.408
	ND	90.9±1.1	92.3±0.6	93.2±1.0	0.354
Knee Q angle (°)	D	10.7±0.5	11.6±0.9	11.9±0.8	0.698
	ND	10.6±0.5	11.6±0.9	11.8±0.8	0.622
Ankle PF (°)	D	42.6±1.5	45.5±0.9	46.7±1.0	0.116
	ND	43.2±1.2	45.3±0.8	46.1±0.9	0.198
Ankle DF (°)	D	20.3±0.9	23.2±0.9	23.3±1.0	0.081
	ND	20.5±0.9	22.6±0.6	22.4±0.9	0.237
Ankle inversion (°)	D	29.7±1.1	30.3±1.2	30.0±1.1	0.897
	ND	30.3±1.1	30.3±1.3	30.6±1.1	0.980
Ankle eversion (°)	D	16.8±1.0	16.1±1.0	16.4±0.9	0.676
	ND	16.3±1.0	16.6±0.9	17.8±0.8	0.613
Knee flexion (°)	D	143.7±1.5	146.6±0.9	146.1±1.0	0.355
	ND	143.4±1.6	146.3±0.9	146.4±1.1	0.346
Knee extension (°)	D	0±0	0±0	0±0	1.000
	ND	0±0	0±0	0±0	1.000
Hip flexion (°)	D	121.6±1.9	122.1±1.8	125.8±1.8	0.242
	ND	121.3±1.9	123.4±1.6	125.8±1.9	0.221
Hip extension (°)	D	21.6±1.7^{a}	26.8±0.9^{b}	26.4±1.1^{b}	**0.024***
	ND	21.8±1.6^{a}	26.6±0.9^{b}	26.7±1.0^{b}	**0.034***
Hip abduction (°)	D	41.6±1.3	42.4±1.1	41.9±1.6	0.917
	ND	41.1±1.7	41.3±1.4	41.1±1.9	0.972
Hip adduction (°)	D	29.7±0.7	29.7±1.0	27.5±1.1	0.167
	ND	29.7±0.7	29.0±1.1	27.8±1.1	0.361
Trunk flexion (°)		79.2±2.6	83.4±1.7	83.1±2.1	0.519
Trunk extension (°)		29.0±1.6	30.0±1.2	30.3±1.2	0.593
Average trunk lateral flexion(°)		33.4±1.3	33.4±1.5	34.4±1.3	0.823

D: dominant, ND: non-dominant; *: $p<0.05$; ^{a,b}: difference among groups with different exponential letters; PF: plantar flexion, DF: dorsiflexion.

Table 3. Participants' lower extremity Y-balance test results

Parameter	Group $_{Non}$(n=19)	Group$_{Basic}$(n=19)	Group $_{Lig}$(n=18)	p
Dominant side				
YBT-Anterior	72.3±2.6	70.0±3.4	79.9±4.3	0.116
YBT-Posteromedial	115.3±3.7	118.7±3.9	113.6±4.6	0.846
YBT-Posterolateral	109.1±3.3	110.8±2.7	107.7±2.9	0.985
YBT-Total	108.8±2.8	108.3±3.3	108.1±3.8	0.851
Non-dominant side				
YBT-Anterior	72.2±2.8	71.2±3.8	79.8±4.0	0.150
YBT-Posteromedial	114.7±3.5	118.4±4.1	114.9±4.2	0.907
YBT-Posterolateral	110.6±3.0	109.2±2.6	109.7±3.5	0.924
YBT-Total	109.2±2.8	108.1±3.7	109.2±3.8	0.964

YBT: Y-balance test

Table 4. Crossover hop test and LESS results of participants

Parameter	Group $_{Non}$(n=19)	Group$_{Basic}$(n=19)	Group $_{Lig}$(n=18)	p
Dominant				
Crossover hop-distance (cm)	565.5±42.2	657.0±31.1	582.8±46.1	0.207
Crossover hop-time (s)	2.42±0.10	2.44±0.08	2.51±0.14	0.722
Crossover hop-velocity (m/s)	2.41±0.21	2.71±0.12	2.36±0.17	0.260
Non-dominant				
Crossover hop-distance (cm)	552.3±41.4	646.1±37.4	571.8±43.7	0.246
Crossover hop-time (s)	2.57±0.08	2.25±0.08	2.49±0.14	0.050
Crossover hop-velocity (m/s)	2.22±0.21 ^{b}	2.86±0.13 ^{a}	2.30±0.14 ^{b}	**0.014***
LESS score	4.21±0.46	4.26±0.58	3.94±0.42	0.833

*: $p<0.05$ level; ^{a,b}: difference among groups with different exponential letters.

It was observed that the LESS score value in Group $_{Lig}$ was highly negatively correlated with the posteromedial value of the dominant YBTL (r=-0.68, p=0.002). In the same group, it was displayed that the LESS score was highly negatively correlated with the posteromedial value of the non-dominant YBTL (r=-0.65, p=0.004), and moderately negatively correlated with the posterolateral (r=-0.51, p=0.030) and total scores (r=-0.52, p=0.029). It was observed that the LESS score was moderately negatively correlated with the distance reached in both CHTs (r=-0.52, p=0.027; r=-0.51, p=0.032, respectively). In the same group, LESS scores were highly positively correlated with the Q angle of both knees (r=0.64, p=0.004; r=0.64, p=0.004, respectively). In the same group, it was determined that LESS score was moderately positivelycorrelated with dominant ankle eversion (r=0.51, p=0.033), dominant and non-dominant hip abduction (r=0.59, p=0.010; r=0.49, p=0.039, respectively) and trunk extension (r=0.48, p=0.045). Dominant ankle dorsiflexion was negatively correlated with the LESS score (r=-0.65, p=0.003) at a high level.

DISCUSSION

The main aim in the current study was to investigate the effect of knee braces on different parameters that have been shown to affect the risk of lower extremity injury in professional athletes (7-10). In this context, no difference was detected between the groups whose descriptive information was homogeneous, except for the velocity value in the CHT of the non-dominant extremity in $\text{Group}_{\text{Basic}}$. On the other hand, according to the predictive values in Padua et al.'s original article (10), it was observed that the parameters associated with the LESS score were classified as 'excellent' in landing when using a knee brace ($\text{Group}_{\text{Lig}}$) that provides knee stabilization.

It has been emphasized in the literature that descriptive measurements such as lower extremity length, knee Q angle and lower extremity joint range of motion should be made in order to interpret the functional measurement parameters of the lower extremity properly (10-12). As a result of the goniometric measurements made in the current study, there was no significant difference between the groups in lower extremity length, knee Q angle and lower extremity range of motion, except that the dominant and non-dominant hip extension was lower in $\text{Group}_{\text{Non}}$ compared with the other two groups. It has been reported that statistically significant or insignificant differences were observed in different hip joint range of motion measurements in elite hockey players (15). For these reasons, it is considered that this difference in $\text{Group}_{\text{Non}}$ did not have a significant effect on the parameters measured.

In Brunner et al.'s review (8), 33 injury prevention programs applied in the prevention of lower extremity injuries were evaluated. Some of these programs focus on all lower extremity injuries, some on groin injuries only, some on knee injuries only, some on ACL injuries only, and some on ankle injuries only. Despite this diversity, balance training was a component of the program in 29 of the 33 programs examined. When this study and other studies in the literature are examined, there is absolute consensus on the importance of balance in the prevention of sports injuries (8,9,16). In the current study, the YBTL was used to investigate whether the use of knee braces affects balance. As a result of our evaluation, it was observed that the use of knee braces did not make a difference in the results of the YBTL.

However, in Grup_{Lig}, which uses a knee brace that provides better knee stability, dominant and non-dominant Y Balance-Anterior scores increased, although it was not statistically significant. In a study by Baltacı et al., the effects of using five different prophylactic knee braces on performance were examined, and it was reported that the hinged 'H' buttress knee brace was more effective in the YBTL compared with other knee braces (17). We think that the difference between the study evaluating the effects of different knee braces on balance and our current study is due to study methodology, the structure and model differences of the knee braces used. In another study by Ochi et al., the balance of participants was evaluated with a device (Biodex Balance System), and it was shown that four different knee braces did not have an effect on balance in parallel with our study (18). In the light of current study and other studies in the literature, no effect of knee brace use on balance parameter is observed.

CHT is one of the functional tests used to evaluate lower extremity functionality, return to sports after injury, and predict re-injury (7). As a result of our study, it was determined that $\text{Group}_{\text{Basic}}$ was faster than the other groups in the velocity parameter of the non-dominant extremity CHT (p=0.014). In a study by Mortaza et al. examining the effect of three different knee braces on performance parameters, it was shown that there was no statistically significant differences in the use of knee braces on CHT and other evaluated parameters, in parallel with our study (19). In another study by Mortaza et al., the effects of knee brace use on individuals with ACL insufficiency were investigated, and the results were in line with their previous studies (20). Sole et al., examining the chronic effect of knee brace use, could not describe an effect of 6-wk knee brace use on CHT (21). Contrary to these studies, Peebles et al. revealed that the use of knee braces in individuals who had ACL surgery increased the CHT jump distance symmetry over time (22). In this study, similar results were obtained in different groups and with different knee braces, supporting the results in the literature, and it was concluded that the use of knee braces in healthy individuals does not make a difference in terms of CHT results.

LESS is a motion analysis method developed by Padua et al. in order to detect and prevent risk factors for ACL injury, especially (10). Therefore, in the present study, this scoring system was used to examine the effect of knee brace use on the biomechanics of landing after jumping. Padua et al. defined the effect limit of error score on risk as ≤4 excellent, 4-5 good, 5-6 moderate, and >6 poor landing (10). As a result of our analysis, although there were no statistically significant differences in the error scores between the groups, the fact that the average score of the $\text{Group}_{\text{Lig}}$ was 3.94 displays that the LESS score average of those using ligament-supported knee braces is in the excellent category, accor–

ding to the risk effect limit developed by Padua et al. As far as we can review the literature, there are no studies on the effect of LESS on knee brace use.

On the other hand, according to the correlation analysis, there are different parameters such as range of motion, knee Q angle, functional test results, which correlate with the LESS score during the use of the knee brace. Since the knee joint will remain relatively stable during knee brace use, it is a natural result that the kinetic chain mechanism and hip, ankle and even trunk range of motion values are correlated with the LESS score, when the LESS scoring criteria are examined. In this context, while preferring knee brace types that provide knee stability more effectively, we think that it is important to know the descriptive characteristics of the lower extremities of healthy athletes, and to choose knee brace types by considering the anthropometric characteristics of the individuals.

The limitations of our study include the fact that it was conducted on professional athletes in only two sports, that athletes in a similar age group were included in the study, that recreational athletes were not evaluated, and that the study was not designed as crossover randomization.

CONCLUSION

In the light of current study, it is observed that the use of prophylactic knee brace does not have a negative effect on performance. On the other hand, various personal characteristics of individuals should be considered in the selection of knee brace type. For example, according to the correlation results, in order to reduce the LESS score, someone with low hip flexion should use a basic knee brace, while someone with low hip abduction should use a ligament-supported knee brace. Especially during the use of knee brace types with effective knee stabilization, the biomechanics of landing after jumping can be related to many factors.

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Ethics Committee Approval / Etik Komite Onayı

The study was approved by the Süleyman Demirel University Clinical Research Ethics Board of Medical Faculty's decision no. 192, dated 23/07/2020.

Conflict of Interest / Çıkar Çatışması

The authors declared no conflicts of interest with respect to authorship and/or publication of the article.

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Author Contributions / Yazar Katkıları

Concept: SE, CÇ; design: SE, CÇ; materials: SE, CÇ; data collection and processing: EA, HTA, GK, ASU; analysis and interpretation: ASU, SE; literature review: SE, EA, HTA, GK, ASU; writing manuscript: EA, HTA, GK; critical reviews: SE, CÇ.

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