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Injuries in the foot and ankle region in rugby players from the University of Malaga. Observational study

Lesiones en la región anatómica de pie y tobillo en jugadores/as de rugby de la Universidad de Málaga. Estudio observacional

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Keywords:

Rugby, first metatarsophalangeal joint, tibiofibular-talar joint, injury, foot, ankle.

Abstract

Introduction: Rugby is a contact team sport played worldwide. The primary physiological attributes required for rugby include strength, neuromuscular power, speed, repeated sprint ability, and agility. Foot and ankle injuries are the most common in rugby. Objectives: To determine the functional status of the foot and ankle complex in rugby players.

Patients and methods: An observational and cross-sectional study was conducted on the University of Málaga rugby team from february to april 2024.

Results: A statistically significant association was found between gender and dorsiflexion of the first metatarsophalangeal joint (p = 0.031), and between gender and the lunge test (p = 0.038). The Foot Posture Index (FPI) was predominantly neutral in the right foot (73.3 %) and in the left foot (53.4 %). Almost all players exhibited areas of hyperpressure (93.4 %). The most common injury among rugby players was lateral ankle sprain.

Conclusions: Lateral ankle sprain was the most common injury, with players exhibiting areas of hyperpressure in the foot, predominantly in the first toe pad and the head of the first metatarsal bilaterally. Regarding the functional status of the foot and ankle, notable variations were observed based on the characteristics of the players.

Palabras clave:

Rugby, primera articulación metatarsofalángica, articulación tibioperoneastragalina, lesiones, pie, tobillo.

Resumen

Introducción: El rugby es un deporte de equipo de contacto, practicado en todo el mundo. Las cualidades fisiológicas principales del rugby son la fuerza, la potencia neuromuscular, la velocidad, la capacidad de sprint repetido y la agilidad. Las lesiones a nivel de pie y tobillo son las más frecuentes en el rugby. El objetivo de este trabajo es determinar el estado funcional del complejo anatómico de pie y tobillo en jugadores de rugby.

Pacientes y métodos: Se realizó un estudio observacional y transversal, realizado en el equipo de rugby de la Universidad de Málaga desde febrero a abril de 2024.

Resultados: Se encontró asociación estadísticamente significativa entre el género y la flexión dorsal de la primera articulación metatarsofalángica (*p* = 0.031) y de género con el test de Lunge (*p* = 0.038). El FPI fue predominantemente neutro en el pie derecho (73.3 %) y en el pie izquierdo (53.4 %). Casi todos los jugadores presentaron zonas de hiperpresión (93.4 %). La lesión más frecuente en jugadores/as de rugby era el esguince lateral del tobillo.

Conclusiones: El esguince lateral de tobillo fue la lesión más frecuente. Los jugadores presentaron zonas de hiperpresión en el pie, prevaleciendo el primer pulpejo y cabeza del primer metatarsiano bilateral. En cuanto al estado funcional del pie y tobillo, se destacan variaciones atendiendo a las características del jugador.

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Introduction

Rugby is a contact team sport played by men, women, and children around the world. The wide variety of skills and physical requirements allows individuals with diverse constitutions and abilities to participate. It is considered an intermittent, high-intensity sport, as it involves activities requiring maximum strength and power interspersed with periods of lower-intensity aerobic activity and rest[1]. The result of these physical demands of the game leads to the development of high physiological qualities such as strength, neuromuscular power, speed, repeated sprint ability, and agility[2]. Additionally, it is a sport that encompasses a range of social and emotional concepts such as courage, loyalty, sportsmanship, discipline, and teamwork[3].

Considering this, despite rugby is a widely practiced contact sport globally and the scientific literature shows a trend in the occurrence of lower limb musculoskeletal injuries, there is insufficient evidence indicating the injury mechanisms for the most common conditions in this sport affects the anatomical region of the foot and ankle. We also found no evidence regarding the dominant leg's role in injury incidence. In the anatomical region studied, despite the exceptional function of the tibiofibular-talar joint and the first metatarsophalangeal joint in this sport, we found no evidence regarding their range of motion and whether it is altered with years of practice in rugby. Furthermore, how these injuries occur in relation to the player and how their occurrence affects the sporting context remains unknown, complicating the diagnostic and therapeutic approach from a clinical and multidisciplinary perspective.

Therefore, the main objective of this study was to determine the functional status of the anatomical region of the foot and ankle, specifically the tibiofibular-talar joint (TTJ) and the first metatarsophalangeal joint (1st MTPJ) in rugby players, and secondarily, to evaluate the injury mechanisms based on the characteristics of the player.

Patients and methods

Study design

We conducted an observational and cross-sectional study according to the STROBE statement criteria[4].

Population and study field

The study was conducted with a convenience sample. Data collection was carried out from February to April 2024 at the Sports Complex of the University of Málaga, Málaga, Spain.

Inclusion criteria were male and female players from the rugby team at the University of Málaga; players over 18 years of age. Exclusion criteria were: players suffering from any degenerative disease, surgical intervention at the level of the tibiofibular-talar joint or 1st metatarsophalangeal joint and orthopedic or extrapodal treatments.

Procedure

For each patient, specific data were collected from the medical history, including sociodemographic, anthropometric, and morphological data of the foot and ankle.

Regarding functional status, the range of motion of the TTJ was assessed using the Lunge test[5], positioning the subject standing 10 centimeters from the wall, aligning the first toe with the center of the heel. The participant's ability or inability to perform the test on each limb was rated as "fit" or "unfit."

The range of motion of the 1st MTPJ under unloaded conditions was evaluated using a two-arm goniometer[6]. The participant was positioned supine, with the center of the goniometer placed on the bisector of the first metatarsal, fixed by hand, and the movable arm aligned with the bisector of the proximal phalanx of the first toe. Additionally, the hallux limitus test[7] was performed with the participant in the supine position. The foot was placed in a neutral position while force was applied to the head of the first metatarsal and dorsiflexion of the toe was performed.

The Foot Posture Index (FPI)[8] was used to assess the foot in three spatial planes. Six elements were considered, each yielding a potential score from -2 to +2. Positive values were associated with pronation, negative values with supination, and a score of 0 represented neutrality.

To assess the perspective of the physical function of the anatomical complex of the foot and ankle, the Foot and Ankle Ability Measure (FAAM) questionnaire in its Spanish version was administered[9]. Finally, the International Physical Activity Questionnaire (IPAQ) in its short version[10], validated in Spanish, was administered to determine the amount of physical activity performed and whether this could be related to injuries at the foot and ankle level.

The collected variables are grouped in Table I.

Statistical analysis

Distinctions were made between categorical (ordinal or nominal) and numerical (continuous or discrete) variables. Jamovi version 2.3.28 was used for statistical analysis. Initially, a descriptive analysis of the study variables was conducted. Values corresponding to continuous variables were summarized in a table, describing means and standard deviations or percentiles and ranges of maximum and minimum values according to their symmetry.

To analyze the statistical significance ($p < 0.05$) of the differences observed in the frequencies of the variables of interest, the chi-squared test was used for independent samples in the case of qualitative variables.

Regarding the differences in quantitative variables between two independent groups, these were analyzed using the Student's t-test for independent samples. The normality condition in each group was checked with the Shapiro-Wilk test; if normality could not be assumed, the non-parametric Mann-Whitney U test was applied.

Results

A total of 15 subjects participated in the study, of which 12 were men and 3 were women, with a mean age of 25 (SD, 4.94) years for men and 21 (SD, 2.08) years for women. The mean height and weight for men was 181 (SD, 6.69) centimeters and 90.1 (SD, 15.8) kilograms. For women, it was 163 (SD, 10.8) centimeters and 74 (SD, 22.9) kilograms. Regarding shoe size, the mean was 43.8 (SD, 1.71) EU for men and 38.3 (SD, 3.21) EU for women. In

Table I. Study variables.

Data	Variables	
Sociodemographic data	Age (years)	
	Gender (Male/Female)	
Anthropometric data	Height (cm)	
	Weight (kg)	
	BMI (kg/m2)	
Morphological Data of the Foot	Shoe Size (number)	
	Dominant	Leg (Left/Right)
	Previous Pathologies at the Foot and Ankle Level	
	Areas of hyperpressure	
	Metatarsal Formula	Index Plus/Minus/PlusMinus
	Digital Formula	Egyptian/Greek/Square Type
	Range of Joint Mobility of 1st MTPJ (degrees)	
	Range of Joint Mobility of TTJ (Lunge Test)	
	Foot Posture Index (FPI) (between -12 and +12) (-2, -1, 0, +1, +2)	Palpation of the Head of the Talus Supra- and Inframalleolar Curvature Position of the Calcaneus in the Frontal Plane Astragalus-Scaphoid Prominence Longitudinal Arch Congruence Abduction/Adduction of the Forefoot Relative to the Hindfoot
Leve lof physical activity	Years playing rugby	
	Days of Training per Week	
	IPAQ Questionnaires (International Physical Activity Questionnaire) and FAAM (The Foot and Ankle Ability Measure)	

terms of BMI, it was found that 46.7% of the sample had overweight, with men representing 40% of the total. Finally, the right leg was dominant in 86.7% of the sample.

Regarding training time, it was found that most players trained more than 4 days a week, with this pattern being more common among men. In terms of years practicing rugby, most participants had more than two years of practice. No women were found to have been practicing this sport for more than 5 years. When associating years of practicing rugby with the presence of hyperpressure areas, it was noted that 93.4 % of players who had practiced for between 1 and 2 years or more than two years had hyperpressure areas in some part of the plantar surface of the foot. The most prevalent area was the first metatarsal head and first toe pulp bilaterally (46.7 %), followed by the first toe pulp bilaterally (40 %). Finally, to a lesser extent, hyperpressure areas were found in the first metatarsal head bilaterally (6.7 %).

Regarding playing position, it was shown that 80 % of men and all women played as forwards. Concerning the association of playing position with the presence of hyperpressure areas, it was found that most players in defensive positions were prone to experiencing hyperpressure areas in the first toe pulp bilaterally and the first metatarsal head bilaterally (66.7 %). Additionally, among forwards, most hyperpressure areas were found in the first toe pulp bilaterally (50 %). The 33.3% of defenders did not present hyperpressure areas.

Table II. Dorsal flexion of the first metatarsophalangeal joint.

	Statistic	*p*
Dorsiflexion of the 1st MTPJ right foot (degrees)	3.00	0.031
Dorsiflexion of the 1st MTPJ left foot (degrees)	9.00	0.210

Note: m: male; f: female

Regarding the functional status of the first metatarsophalangeal joint, the mean dorsal flexion of the right and left foot was acquired. In men, values of 50° (SD, 7.69) were obtained for the right foot and 54.6° (SD, 11) in the left one. For women, these values were 66.7° (SD, 11.5) bilaterally. A greater range of dorsal flexion of the metatarsophalangeal joint was found in women (Table II). No statistically significant association was found between the degrees of dorsal flexion of the 1st MTPJ and the years of sports practice. Regarding the functional hallux limitus test, the majority presence of bilateral functional hallux limitus was found in both men and women (66.7 %).

Regarding the functional status of the tibiofibular-talar joint through the Lunge test, a statistically significant association of the right lower limb with gender was found regarding the ability to per-

Table III. Dorsal flexion of the TTJ joint using the Lunge test.

Contingency tables			
	Genre		
Lunge test right foot	**Male**	**Female**	**Total**
Eligible	4	3	7
Ineligible	8	0	8
Total	12	3	15
Chi-square tests	**Value**	**gL**	***p***
Chi-square test	4.29	1	0.038
N	15		

Table IV. Dorsal flexion of the TTJ joint in relation to years of practice.

	Years playing rugby			
Lunge test right foot	**Between 1 and 2 years**	**> 2 years**	**> 5 years**	**Total**
Eligible	2	5	0	7
Ineligible	0	3	5	8
Total	2	8	5	15
Chi-square tests	**Value**	**gL**	***p***	
Chi-square test	7.47	2	0.024	
N	15			

form the test adequately (Table III). On the other hand, a significant association was found between the ability to perform the Lunge test in the right lower limb concerning the years of practice (Table IV).

Regarding the assessment of the lower limb using the FPI in the right and left foot, 73.3 % and 53.4 % overall had a neutral foot, respectively. In terms of gender, the FPI of the right foot in men was predominantly neutral (60 %), followed by pronated (20 %). In women, the predominant type was also neutral (13.3 %), followed by pronated (6.7 %). For the left lower limb, most men had a neutral foot (46.7 %), followed by pronated foot (26.7 %). In women, the FPI was pronated (13.3 %) followed by the neutral type (6.7 %).

Finally, no statistically significant associations were found between the presence of injuries at the foot and ankle level regarding the dominant leg or concerning the results obtained in the FAAM and IPAQ questionnaires. Regarding the IPAQ questionnaire, for this sample, lateral ankle sprain was found to be the most frequent injury among rugby players.

Discussion

The objective of this study was to determine the functional status of the anatomical region of the foot and ankle, specifically the tibiofibular-talar joint and the first metatarsophalangeal joint in rugby players, as well as to evaluate the injury mechanisms based on the characteristics of the player.

Our results demonstrated a greater range of dorsal flexion of the first metatarsophalangeal joint in female players, as well as a predominance of bilateral hallux limitus in both men and women.

Regarding the tibiofibular-talar joint, a significant association was found between the right lower limb and gender in terms of the ability to adequately perform the Lunge test. Finally, a significant association was found between the ability to perform the Lunge test in the right lower limb concerning the years of sports practice. Regarding the assessment of the lower limb using the FPI in the right and left foot, the majority presented a neutral foot bilaterally.

When associating years of practicing rugby with the presence of hyperpressure areas, it was noted that 93.4 % of players who had practiced this sport for between 1 and 2 years or more than 2 years exhibited hyperpressure areas in some part of the plantar surface of the foot, with the most prevalent areas being the first toe pulp and the head of the first metatarsal bilaterally. Regarding the association of playing position with the presence of hyperpressure areas, it was found that most players in defensive positions were prone to experiencing hyperpressure areas in the first toe pulp bilaterally and the head of the first metatarsal bilaterally. Additionally, among forwards, most hyperpressure areas were found in the first toe pulp bilaterally. Lastly, lateral ankle sprain was found to be the most frequent injury in rugby players.

Our results are consistent with the prospective study conducted by Sman et al.[11], which studied the FPI in Australian players of both football and rugby. It included a total of 202 men. The FPI results showed a score of 3.3 (SD, 2.5) for both sports. In a different study, Lopezosa-Reca et al.[12] conducted a cross-sectional study observing potential differences in foot posture and knee angle in football players and swimmers. They started from a sample of 68 football players and 72 swimmers. Football players presented a neutral foot position, whereas swimmers were found to have a pronated position. These sports may relate to rugby in terms of the explosiveness and significant muscle development required to exert the necessary forces during practice, as well as the presence of high-impact loads they experience during execution. Finally, they also resemble each other in the surface on which the sports practice is carried out, facilitating the alignment with our results. Regarding the discrepancies with swimmers, these may be due to the lesser relationship between the two sports.

Regarding the functional status of the TTJ, our results found an association with the cross-sectional study conducted by Clark and Campbell et al.[13] on ankle dorsiflexion through the Lunge test in 49 professional football players with and without a history of severe ankle injury. The measurement procedures carried out were identical to those used in our study. However, in this study, no fit or unfit ranges were stipulated. Instead, measures were taken based on each player's ability to perform the test correctly, and the mean was calculated. A mean of 9 centimeters was obtained for the right foot and 9.5 centimeters for the left one. The study by Langarika-Rocafort et al.[14] measured dorsiflexion in 25 female volleyball players using different methods. One of these was the Lunge test, which obtained results that were consistent with our measurements, although this was not stipulated in ranges but in centimeters. When comparing

the above-mentioned studies, we found a greater range of mobility in female vs male players. The results obtained are consitent with the findings of our study, indicating greater dorsal flexion in women than in men. These discrepancies may be associated with increased serum levels of estradiol and progesterone, as well as increased laxity in the ankle joint in women, as pointed out by Beynnon et al.[15] in their study, which found differences at the ankle level between men and women. Chino and Takahashi[16] found that dorsal flexion was more limited in men than in women. The decrease in joint range concerning years of rugby practice may be associated with the thickness of the gastrocnemius muscle, as ankle plantar flexion plays a very important role in rugby, along with propulsion and stability during the game.

Otter et al.[17] evaluated the functional status of the 1st MTPJ in rugby players. They conducted a study with a convenience sample of 15 men and 17 women, obtaining a mean of 82.8°, also measured using a universal goniometer. Our research disagrees with the mentioned article, as our mean values of dorsal flexion presented lower joint ranges in both men and women. However, unlike the population of this study, ours consisted of athletes.

In relation to the observational study conducted by Sockalingam et al.[18], the aim was to determine whether patients with functional hallux limitus presented a more or less voluminous muscle belly of the long flexor of the hallux. A total of 26 patients were evaluated using the functional hallux limitus test, following the same protocol as in our study. The results demonstrated the presence of a descended muscle belly due to a limitation in the retro-talar pulley, which is related to the presence of hallux limitus.

In conclusion, injury mechanisms were evaluated based on the characteristics of the player. Chow et al.[19] conducted a cross-sectional study on plantar pressures in elite and recreational rugby players with a sample of 51 elite rugby players and 57 recreational rugby players. Their results are in disparity with those presented in this study, as it was found that in a static position, the area with the most overload was that constituted by the lesser metatarsals, followed by overload in the hallux in both feet. On the other hand, plantar loads were analyzed using a software program. In contrast, in this study, overload areas were assessed based on the presence of hyperkeratosis.

A different study described by Ford et al.[20] compared the loading pressure patterns of the foot within sports footwear in 17 football players. It was found that the area of maximum hyperpressure was presented at the medial forefoot, followed by the pulp of the hallux. This study was conducted only on the right foot and demonstrated that the type of playing surface significantly affects plantar load.

Fuller and Taylor[21] conducted a cross-sectional study on injuries in international women's rugby involving 1562 female players. In line with our study, lateral ankle sprain was the most common injury. Similar results were obtained in the epidemiological study by Sankey et al.[22], which included a sample of 546 players. The previous studies proposed that injuries are due to player fatigue caused by the high workloads experienced in this sport.

Regarding the functional status of the foot and ankle, a greater range of dorsal flexion of the first metatarsophalangeal joint in female players is highlighted, as well as a predominance of bilateral functional hallux limitus in both men and women. Concerning the TTJ, there is an association between the range of dorsal flexion of the right lower limb and the gender of the player. On the other hand, the association between the range of dorsal flexion of the right lower limb in relation to the years of sports practice is noted. Both the FPI of the right and left foot predominantly indicate neutrality.

Regarding the injury mechanisms, the first toe pulp and the head of the first metatarsal bilaterally are the predominant hyperpressure areas in rugby players concerning years of sports practice. Regarding the association with playing position, most players in defensive positions are prone to experiencing hyperpressure areas in these same regions. Concerning forwards, most hyperpressure areas were found in the first toe pulp bilaterally. Finally, lateral ankle sprain is presented as the most frequent injury among rugby players.

Ethics declaration

This study has received favorable approval from CEUMA (CEUMA 146-2022-H), and each participant has signed informed consent to participate in the study.

Conflicts of interest

None declared.

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Authors' contributions

Study conception and design: VLG, ABOA.
Data mining: VLG, FDCI, MCCF.
Analysis and interpretation of results: VLG, SSM.
Creation, drafting, and preparation of the early draft: VLG, ABOA, Final Review: VLG, SSM, ABOA.

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