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Original Article

Clinical predictors for ankle sprain recurrence of amateur volleyball athletes

Preditores clínicos para recorrência de entorse de tornozelo em atletas amadores de voleibol

Predictores clínicos de la recurrencia del esguince de tobillo en atletas aficionados de voleibol

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Keywords:
Sports' lesions; Rehabilitation; Lesion recurrence; Orthopedics.

ABSTRACT
To evaluate the risk factors and complications in the recurrence of ankle sprains in amateur volleyball athletes. 22 male amateur volleyball athletes, divided into groups with sprains (n=11) and a control (n=11) were evaluated using the Foot and Ankle Outcome Score questionnaire, Visual Analogue Scale (VAS), Y Balance Test, Dorsiflexion Lunge. Our results indicate a direct correlation between the middle blocker and ankle sprains. A significant difference was observed between the groups on the VAS. The present study shows that reduced ankle range of motion, pain, athlete position are possible predictors for the recurrence of ankle sprains.

Palavras-chave:
Lesões esportivas; Reabilitação; Recorrência de lesões; Ortopedia.

RESUMO
Avaliar os fatores de risco e complicações na recorrência de entorse de tornozelo em atletas amadores de voleibol. 22 atletas amadores de voleibol do sexo masculino divididos em grupo entorse (n=11) e grupo controle (n=11) foram avaliados por meio do questionário Foot and Ankle Outcome Score, Escala Visual Analógica (VAS), Teste de Equilíbrio em Y, Dorsiflexão Lunge. Nossos resultados mostram correlação direta entre a posição de central e as entorses de tornozelo. Foi observada diferença significativa entre os grupos na EVA. O presente estudo mostra que a redução da amplitude de movimento, dor e posição do atleta são possíveis preditores para a recorrência de entorses de tornozelo.

Palabras-clave:
Lesiones deportivas; Rehabilitación; Recurrencia de lesiones; Ortopedía.

RESUMEN
Evaluar factores de riesgo y complicaciones en la recurrencia de esguinces de tobillo en deportistas aficionados de voleibol. 22 atletas aficionados masculinos de voleibol, divididos en un grupo con esguinces (n=11) y control (n=11), fueron evaluados utilizando el cuestionario Foot and Ankle Outcome Score, Escala Visual Analógica (EVA), pruebas de Equilibrio en Y, Dorsiflexión en Estocada. Nuestros resultados muestran correlación directa entre la posición de central y los esguinces de tobillo. Se observó una diferencia significativa entre los grupos en la EVA. Este estudio indica que la reducción del rango de movimiento, el dolor y la posición del atleta son posibles predictores de la recurrencia de los esguinces de tobillo.

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INTRODUÇÃO

Ankle sprains are a very common musculoskeletal injury (50 to 70%), among physically active populations (Gribble, 2019) and are associated with long-term pain or even physical and functional disability. The most common acute incidence is the lateral inversion sprain of the ankle, which consists of a mechanical lateral torsion, affecting the talocrural and subtalar joints, which can cause laxity and ligament damage to the structures that stabilize the joint, generating pain, incapacity, or even dynamic instability (Ivins, 2006). Ankle sprains can be classified into three degrees by considering the structures involved. A grade I "mild" sprain that can lead to loss of functional capacity, pain, and edema. Grade II "moderate" sprain with partial ligament injury, difficulty tolerating weight and presence of edema. Grade III "severe" sprain with ligament rupture, bruising and severe pain.

In sports, ankle sprains are directly linked to sporting movements that lead to greater absorption of loads in the ankle joint (Gribble, 2019). Fong et al. (2007) described that the segments most affected by injuries in volleyball athletes are the ankle (45.6%) and knee (11.4%), mostly during the contact between athletes in the blocking movement and attack. Watkins and Green (1992) carried out a study with 86 male athletes from the Scottish volleyball league to investigate injuries suffered during the championship. The authors described a total of 46 injuries, 30% in the knees, 26% in the ankles, 22% in the fingers and 20% in the spine. The activities observed with the highest occurrence of sprain injuries were blocking (41%) and attacking (30%), mainly during training. Similarly, Solgård et al. (1995) analyzed 5222 individuals treated in a traumatology emergency using a questionnaire on the occurrence of injuries. A total of 278 injuries were recorded in 269 volleyball players, with the most affected areas being the hands/fingers (25%) and ankle (20%) during jumps and contact with the ball. In Volleyball, the demand for jumping favors ankle sprains, being responsible for 54% of inversion injuries (Fong et al., 2007).

For this reason, the use of prophylactic measures such as orthoses, ankle braces and bandages to prevent injuries during impact is constantly observed in the case of volleyball athletes (Ruiz-Sánchez et al., 2022). Treatment can be carried out conservatively using the PRICE method (protection, rest, ice, compression, and elevation) and kinesiotherapy and manual therapy approaches to reduce pain and edema, associated with pharmacological treatment, or in more severe cases the treatment can be surgery aimed at ligament reconstruction and recovery of joint functionality (Ruiz-Sánchez et al., 2022).

Regardless of the form of treatment, conservative or surgical, the presence of a history of sprain with structural injuries linked to the sensorimotor system are described as risk factors for injury recurrence, especially in athletes (Alghadir et al., 2020). Ankle stability is important for volleyball athletes, as dorsiflexion plays a significant role in activities such as jumping and landing (Xixirry et al., 2019). After an ankle sprain, there are limitations in joint mobility that may favor the recurrence of the sprain during sports. The assessment of range of motion, stability, and function of the ankle of athletes with a history of sprains is fundamental for the selection of physiotherapeutic approaches aimed at performance associated with functionality. Therefore, the objective of the present study was to analyze the risk factors and complications for the recurrence of ankle sprains in amateur volleyball athletes. Our hypothesis is that the affected limb and the athlete's position may contribute to deficits in range of motion, stability, and function of the ankle, ultimately providing a greater risk of recurrence of the sprain injury (Alghadir et al., 2020).

METHODS

STUDY DESIGN

Cross-sectional study with single arm analysis following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement (von Elm et al., 2007).

SAMPLE

The convenience sample consisted of 22 male amateur volleyball athletes (11 with a history of ankle sprains and 11 controls). The athletes were evaluated at the Health Care and Professional Practices Center – NASPP of the Centro Universitário FIPMoc (UNIFIPMoc), Montes Claros, Minas Gerais, Brazil. Inclusion criteria for individuals in the group with sprains were a) Age between 18 and 40 years old; b) ankle sprain suffered in the last 2 years; c) Recurrence of traumatic episodes of lateral ankle sprains; and d) Early return to sporting activities. To control group, the following inclusion criteria were used: a) Age from 18 to 40 years; and b) No ankle sprains in the last 2 years. Athletes who met the following criteria were excluded from the study: a) Musculoskeletal injury that makes it impossible to carry out tests and intervention; b) History of pre-existing rheumatological diseases; c) Grade 3 sprain requiring surgical intervention; and d) Inadequate lower limb strength or any vestibular or balance disorder that may confound test performance.

All participants were duly informed about the research objectives and the procedures carried out through a Free and Informed Consent Form approved by the Research Ethics Committee of the Centro Universitário FIPMoc (n°6.333.617/2023).

INSTRUMENTS AND PROCEDURES

Data collection was conducted in person and individually, in the NASPP physiotherapy department at a previously scheduled time, depending on the availability of the athletes. The collection process involved two stages: First, the athletes answered a questionnaire to investigate personal and sports training characteristics. In the second stage, specific tests were applied to identify restrictions

and function of the knee joint. A physiotherapist evaluator was present at each stage. The evaluator of the second test stage participated in prior in-person training lasting two hours, when he received theoretical and practical instructions on the tests. The evaluator was aware of the presence of a history of injuries during data collection.

The questionnaire consisted of questions regarding lifestyle habits, presence of comorbidities, presence of musculoskeletal disorders, length of time practicing the sport, weekly frequency of sports practice, performance of other physical activities and sports, occurrence of surgical treatment and/or conservative with physiotherapy.

To assess range of ankle motion, the goniometry was used. The dorsiflexion, plantarflexion eversion and inversion were collected.

Ankle function was assessed using the Foot and Ankle Outcome Score (FAOS) questionnaire. FAOS is a questionnaire that assesses the incapacity of ankle and foot injuries in activities of daily living (ADLs) and performance in sports. It consists of 42 questions distributed across 5 domains: symptoms (7 questions), pain (9 questions), ADLs (17 questions), functional recreations (5 questions) and quality of life (4 questions) in relation to the injured structure. Athletes were instructed to recall their experiences from the past week when completing the questionnaire. Each question is scored from 0 to 4, based on the response provided. The questionnaire is calculated by adding up the points obtained in each domain, totaling a maximum value of 100 points. A result of 0 points indicates extreme symptoms, and 100 points indicates no symptoms (Tapaninaho et al., 2022).

To assess pain intensity, the Visual Analogue Scale (VAS) was used. The individual is asked about the degree of pain and must classify it according to the scale of 0, which means total absence of pain and 10 the maximum pain level (Bernardelli et al., 2021). Three data collection were carried out: current VAS "at the time of the evaluation", 2-day VAS "two days before the evaluation" and 7-day VAS "seven days before the evaluation". The three data collection allowed us to verify whether the observed pain remains constant, improving or worsening over the period studied.

The Y Balance test was used to evaluate dynamic balance by measuring the reaching distance of the lower limb in the anterior, posteromedial, and posterolateral directions (Chimera et al., 2015). The test was carried out with adhesive tape in the shape of the letter Y on the floor so that the angle formed by the lateral lines corresponds to 90° degrees and the two lateral angles correspond to 135° degrees in relation to the previous line. Before starting data collection, measurements were taken of the length of the athlete's lower limbs (anterior superior iliac spine to the medial malleolus). The athletes were familiarized with the test (Alghadir et al., 2020). The athletes were barefoot, with their support feet at the intersection of the lines and with their hands on their waists. Afterwards, the athlete was instructed to use the rocking foot to touch the lines of the anterior, posteromedial, and posterolateral region with the hallux. with the greatest possible reach. The athletes informed they could not put their bodyweight on the rocking foot once it touched the ground. The measurement was taken after each direction was performed, bilaterally. The attempt was discarded when the athlete was unable to return to the starting position with balance. Three trials were recorded in each direction in random order and the average was used for data analysis. The reaching distance was normalized by dividing by the limb length and multiplying by 100 (Alghadir et al., 2020; Gribble and Hertel, 2003).

Dorsiflexion Lunge Test was used to evaluate the range of motion (ROM) of ankle dorsiflexion with the knee to the wall (Xixirry et al., 2019; Gomes et al., 2023). The test is conducted using a 1-meter tape drawn perpendicular to the wall on the floor. The athletes were positioned with the heel and second toe aligned on the line in contact with the wall. After positioning, the athlete was instructed to bring their knee to the vertical line of the wall while maintaining foot alignment and heel contact with the floor. The evaluated foot was gradually moved away from the wall until the athlete was able to make only slight contact with the knee in the vertical line. Results smaller than 9-10 cm suggest ankle dorsiflexion restrictions.

STATISTICAL ANALYSIS

The data were analyzed in Statistical. Package for the Social. Sciences – SPSS, version 26.0. Initially, a descriptive analysis of the data was carried out, with mean values, standard deviation, relative and absolute frequency. Pearson's Chi-square test was performed to compare the variables between the sprain and control groups. The significance level adopted was 5%.

RESULTS

The characterization of male volleyball athletes in the sprain and control groups is presented in Table 1. The sample demonstrates homogeneity in terms of average age, mass weight, height, and duration of practice in the sport. A difference was observed in relation to the position played by the athletes, with greater frequency in the middle blocker in the sprain group (36.4%) and opposite in the control group (17.3%).

Regarding specific information on the group with sprains, a recurrence prevalence of two sprains per athlete was observed, considering the number of traumatic episodes per position. All athletes reported no need for surgical procedures (100%) due degree 3 sprains were excluded and 63.4% reported having undergone physiotherapeutic treatment.

Table 2 shows information on the range of motion, stability, and pain in the ankle that suffered the sprain and control groups of amateur volleyball athletes. There was no difference between the ROM values obtained by the groups in both the dominant and supporting limbs ($p>0.05$). The values found in both groups are within the

reference values for dorsiflexion (0-20°), plantar flexion (0-45°), eversion (0-20°) and inversion (0-40°). However, in the group with sprains, lower values of range of motion were noted in the supporting limb related to the sprained region compared to the dominant limb.

In the assessment of dynamic balance, there was no difference in the anterior, posteromedial, and posterolateral directions between groups in both the injured and healthy limbs (p>0.05). When evaluating pain intensity, a significant difference was observed only in the 2-day VAS (referring to 48 hours before the evaluation), with the sprain group reporting mild pain (p=0.034).

Table 3 shows information about the Foot and Ankle Outcome Score (FAOS) questionnaire applied to evaluate the function and symptoms of the ankle and foot of male volleyball athletes. No difference was observed between

Table 1. Characterization of male volleyball athletes.

Variables		Sprain (n=11)	Control (n=11)	p-value
Age (years)		25.27 (±1.19)	20.91 (±0.5)	0.41
Mass weight (Kg)		86.65 (±4.03)	79.27 (±4.72)	0.50
Height (m)		1.84 (±0.02)	1.81 (±0.01)	0.54
Time practicing the sport (years)		8.05 (±1.69)	6.09 (±0.69)	0.68
Volleyball position	Middle Blocker	4 (36.4%)	2 (18.2%)	0.00*
	Setter	2 (18.2%)	2 (18.2%)	
	Libero	0 (0.0%)	2 (18.2%)	
	Opposite	3 (27.3%)	3 (27.3%)	
	Outside Hitter	2 (18.2%)	2 (18.2%)	

Note: Mean (± standard deviation). *significant difference (p<0.05).

Table 2. Mean (± standard deviation) assessment of dynamic balance, stability and ankle pain of the 22 male volleyball athletes.

Variables		Sprain (n=11)		Control (n=11)		p-value
		RLL - healthy	LLL – sprained	RLL	LLL	
ROMs (degrees)	Dorsiflexion	19.64 (± 1.31)	16.73 (± 1.24)	19.91 (± 0.48)	20.82 (± 0.52)	R: 0.25; L: 0.07
	Plantar flexion	40.91 (± 1.48)	39.27 (± 1.30)	41.36 (± 0.98)	39.73 (± 0.95)	R: 0.68; L: 0.70
	Eversion	19.91 (± 1.58)	18.82 (± 1.48)	24.18 (± 1.88)	24.73 (± 1.74)	R: 0.40; L:0.09
	Inversion	35.91 (± 1.78)	31.64 (± 2.00)	37.55 (± 2.08)	36.00 (± 2.13)	R: 0.33; L: 0.16
Y Balance Test (cm)	Anterior	67.55 (±3.01)	66.36 (±4.14)	64.18 (±1.95)	65.45 (±2.32)	R: 0.46; L: 0.34
	Posterolateral	105.45 (±2.67)	104.73 (±2.27)	95.18 (±2.67)	97.55 (±2.13)	R: 0.40; L:0.40
	Posteromedial	102.18 (±2.58)	97.64 (±2.45)	94.27 (±3.30)	95.27 (±3.28)	R: 0.40; L: 0.40
Lunge Test (cm)		37.91 (±1.88)	33.18 (±2.49)	37.09 (±1.17)	36.00 (±1.43)	R: 0.14; L: 0.07
VAS	current	2.27 (±0.80)		0.27 (±0.20)		0.28
	2 days before	2.82 (±0.77)		0 (±0.0)		0.034*
	7 days before	2.91 (±0.93)		0.36 (±0.36)		0.13

Note: ROM = range of motion; VAS = Visual Analogic scale; RLL = Right lower limb; RLL = Left lower limb. *significant difference (p<0.05).

Table 3. Mean (± standard deviation) of the Foot and Ankle Outcome Score (FAOS) questionnaire domains of the 22 male volleyball athletes.

FAOS domains	Sprain (n=11)	Control (n=11)	p-value
Symptoms	17.18 (±1.14)	21.64 (±0.56)	0.05
Pain	25.27 (±1.87)	30.82 (±0.75)	0.41
Activity of daily living	60.91 (±2.91)	66.45 (±1.36)	0.28
Sport and functional recreations	10.82 (±1.26)	14.27 (±0.80)	0.44
Quality of life in relation to the foot and ankle	11.00 (±1.39)	14.82 (±0.52)	0.15
Normalized total score	74.51 (±4.51)	88.09 (±2.09)	0.32

the groups in any of the domains (p>0.05). However, it is observed that the sprain group presents lower scores in all domains compared to the control group.

DISCUSSION

The present study was designed with the purpose of evaluating the risk factors and complications of ankle sprains in amateur volleyball athletes that may contribute to a possible recurrence of the sprain. Our results indicate that individuals with sprains have a reduced range of motion in active dorsiflexion, and eversion. The reduction in ankle range of motion may be attributed to mobility deficits, joint stiffness, long-term pain, and decreased stability and proprioception. However, this smaller range of motion did not result in changes in functionality during activities of daily living.

According to Terada et al. (2013), the quality of ankle range of motion, especially in dorsiflexion, plays a fundamental role in the predisposition of new ankle injuries and lower limb fractures. It is noteworthy in our study that athletes in the group with sprains had a smaller range of dorsiflexion movement in both the open and closed kinematic chain. In the control group, an equivalence of range of movement was found in all physiological movements of the ankle. An important point regarding the recurrence of sprains according to Alghadir et al. (2020), are the anatomical changes and ligament laxity that compromise biomechanical movements, synovial changes, and degenerative diseases, resulting in ankle instabilities, losing the dynamic support of the joint, proprioceptive impairments, and deficits. However, in the present study the athletes showed a decrease in ankle mobility, without demonstrating the presence ligament laxity.

For the most part, athletes who have suffered an ankle sprain do not seek medical help and, after the symptomatology ends, they do not undergo adequate rehabilitation. Hübscher et al. (2010), report that athletes who suffered an ankle sprain, when their pain improves, return to their normal activities without continuing any rehabilitation program, thus making them more prone to the recurrence of the sprain, in addition to limiting their functional activities. Our results show a prevalence of recurrence of two sprains per athlete even when reporting physiotherapy treatment. According to Terada et al. (2013), following rehabilitation guidelines after a sprain, especially for complete recovery of dorsiflexion movement, is vital to returning to quality activities.

The ankle recovers from an injury after a period of 6 to 12 weeks and most patients continue to experience ligament laxity, instability, decreased strength and long-term pain. In the present study, when evaluating the function and symptoms of the ankle and foot using the FAOS, the group with sprains presented symptoms of pain during activities and complaints of pain in relation to the foot and ankle in the long term. According to Alghadir et al. (2020), as pain and swelling decrease, the athlete is now ready for therapeutic intervention aimed at progressive improvement with a focus on improving function, ROM, and proprioception, resulting in long-term pain relief.

When analyzing the group with sprains, considering that all participants were right-handed, and that approximately 64% of the injuries were affected on the left foot, the biomechanics of the jump contributes to the injury mechanism, since the Right-handed athlete uses the contralateral lower limb as support for both the approach phase and the impulse phase when performing the attack. Furthermore, contralateral lower limb also usually lands first after the attack motion. At the same time, excessive exposure to numerous landing movements and changes in direction also contributes to the incidence of injuries (Ardakani et al., 2019). According to Hübscher et al. (2010), in addition to the ligament structure suffering instability, several mechanoreceptors in the joint undergo changes, interfering with the processing of information in the vestibular and visual systems, with the development of joint instability and functional impairments, increasing the chances of recurrence of sprain.

Therefore, the present study shows that it is possible to find a decrease in ankle range of motion, the presence of pain and changes in function after the sprain, factors that may allow the injury to reoccur, especially without carrying out an adequate rehabilitation program. The limitations of the present study refer to the small sample size due to the scarcity of volleyball players in the region, requiring caution when interpreting and extrapolating the research results. Future studies with an increased sample size associated with kinematic and dynamic assessment of the ankle may contribute to a better understanding of the risk factors involved in the recurrence of ankle sprains.

CONCLUSION

The present study shows that reduced range of ankle motion, pain, athlete position and inaccuracy in treatment are possible predictors for the recurrence of ankle sprains, which can lead to disability and functional limitations in sports performance.

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

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