

Translated from the original in spanish

The proprioception, method of preventing ankle injuries in top-level athletes

La propiocepción, método de prevención de lesiones de tobillo, en deportistas de categoría superior

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Received: March 3rd, 2019.

Approved: April 4th, 2019.

ABSTRACT

The objective of this research is framed in analyzing the proprioception effect as a method of prevention of ankle injuries in athletes of the higher category. The longitudinal and explanatory study is carried out at the Olmedo Sports Center in the city of Riobamba, to a population of 30 players that represented 100 %. The methodology used is part of exploratory and bibliographic documentary field methods, techniques such as interview, physiotherapy assessment sheets and modified Romberg test. The effect of the method of proprioception provides as a result that 17 (57 %) players who presented ankle discomfort, is reduced to six (20 %) players to the physiotherapy intervention. For the analysis and processing of the data obtained in the application of the method, the statistical package SPSS version 22.0 IBM is used.

Keywords: proprioception; prevention; sports injury; sport.

RESUMEN

El objetivo de la investigación se enmarca en analizar el efecto propiocepción como método de prevención de lesiones de tobillo, en deportistas de la categoría superior. El estudio longitudinal y explicativo se realiza en el Centro Deportivo Olmedo de la ciudad de Riobamba, a una población de 30 jugadores que representó el 100 %. La metodología empleada se enmarca en métodos de campo exploratorio y documental bibliográfico, técnicas como la entrevista, fichas de evaluación fisioterapéuticas y test modificado de Romberg. El efecto del método de propiocepción proporciona como resultado que 17 (57 %) jugadores que presentaban molestias de tobillo, se logra disminuir a seis (20 %) jugadores, a la intervención fisioterapéutica. Para el análisis

y procesamiento de los datos obtenidos en la aplicación del método, se emplea el paquete estadístico SPSS, versión 22.0 IBM.

Palabras clave: propiocepción; prevención; lesión deportiva; deporte.

INTRODUCTION

The practice of sport is an activity where there is a risk of suffering a sports injury (Angamarca and Flores, 2012) where one of the problems that injuries cause is significant in the training-competition process, because it brings with it its modification or interruption. Any incident, injury, that occurs alters the training plans and is an important factor in the control of the training. Inadequate management of the injury can lead to a total impairment of their general physical capabilities and the major consequence will be total inactivity (García et al., 2013).

The most common intervention, within the sports field, focuses on the recovery of injuries to return to the previous level of sports performance and this is a costly process, from the economic and sports point of view (Casáis Martínez, L., 2008).

However, actions aimed at preventing injuries, despite having shown effectiveness, have not been implemented systematically in many sports modalities. Thus, it expresses the need that, from physical activity, methods can be integrated to minimize the impacts of sports injuries Traversi, M., Busico, N., and Caicedo Cavagnis, E. (2018).

All sports predispose, in one way or another, to different types of foot and ankle injuries (Ciro, J. A. O., Rodríguez, M. P. C., V. E. A., Giraldo, S. P., and Ching, I. C. G. 2007) conducted a nine-year study in a sports medicine center and observed that sprains constituted 50.4 % of ankle injuries and 6 % of foot injuries.

From the analysis of the epidemiology of sports injuries, despite the fact that these are frequently consulted, it is difficult to pinpoint their true incidences and prevalence due to variations in the definition of "sports injury" and the lack of standardized data collection methods that allow comparison and understanding of the multiple existing databases. Eighty per cent of sports injuries involve soft tissues such as muscles, tendons, ligaments and joints. Fractures or damage to internal organs are responsible for the remaining 20%. Studies found that the most frequently injured areas were: knee 45.5 %, ankle 9.8 % and shoulder 7.7 %. (Ciro, J. A. O., et al., 2007, p.172).

One of the results obtained in the investigation carried out by *Ciro, J. A. O., et al.,* in 2007 refers that,

"Among the factors that can affect sports injuries is the training regime: if the training plan is carried out inappropriately, it is a factor that can contribute to sports injuries. For that reason, uncontrolled athletic systems, such as free play, can increase the occurrence of acute sports injuries. In addition, training programs without an adequate correlation between intensity and duration of loads, accompanied by high levels of competition in long seasons, without adequate recovery periods, lead to a significant increase in injuries in

athletes. If one adds to the above inadequate physical and mental preparation of the individual, the risks are even greater" (p. 175).

In this sense, the physiotherapist, together with all the health team, will put all his knowledge and tools at the disposal of the treatment in order to benefit the patient (athlete) by reintegrating him in the shortest possible time, as well as taking into account that injured athletes have higher levels of tendency to risk (Traversi, M., Busico, N., and Caicedo Cavagnis, E. 2018).

In the sports environment, there is a marked tendency to intervene the injuries or pathologies once presented and that are disqualifying the patient, so that preventive actions are scarce, in addition, they are of great relevance in those who are initiating the sports process or are involved in sports all their lives or simply in the activities of their profession.

According to Dr. Horacio Hoyos, orthopedist, consulted by AS USA, in all physical activity in general, the knees and ankles are the most sensitive areas, being the main supports and axes of body movements (López, E., 2018, p.3).

In Ecuador, high-performance football clubs (Montealegre-Mesa, L. M., García-Solano, K. B., and Pérez-Parra, J. E. (2019) focus very little on injury prevention (Vera-García, F. J., Barbado, D., Moreno-Pérez, V.), Hernández-Sánchez, S., Juan-Recio, C., and Elvira, J. L. L. 2015) and as a result there is a significant number of injured athletes; only two clubs have physical therapy departments focused on preventing all kinds of injuries in athletes and are: Barcelona and Liga de Quito, the rest of the clubs only offer post-injury treatments. In the last three years, in Ecuador, the majority of injuries suffered by footballers involve the lower members in 90 %, which indicates the little information that citizens have about the care and prevention of injuries. The most common subtype of injury was ankle injuries, 80 %.

If there is a typical ankle injury, this is none other than the ankle sprain, especially the one that affects the ligament on the outside of the foot (external lateral ligament). This injury can occur in almost all physical actions (jumps, sprints, runs, etc.), hence its high incidence (Brines Gandía, J. 2012). Ankle sprains are one of the most frequently suffered injuries, both elite athletes and amateurs, as well as people who do not practice any type of sport.

Sprain is an injury to the capsule-ligament structures of a joint. It occurs when a joint is subjected to great forces of tension, unexpectedly; the ligaments elongate rapidly beyond their physiological limits. The result is an injury to the ligament fibres, which can range from distension to total rupture. In the case of an ankle sprain, the injury mechanism is a sudden and forced ankle gesture, most frequently in inversion (sprain of the ligament of the external part), but can also be in eversion (sprain of the ligaments of the internal part). Inversion and eversion: these are movements that take place in a frontal plane, anteroposterior axis. These movements basically originate in the subastragaline joint. The inversion has a range of motion of 35° to 45° and the eversion of 15° to 25°. (Kapandji, 2006).

One of the most damaging consequences of an ankle sprain is loss of proprioception, which occurs due to damage to the mechanoreceptors and decreased nerve conduction velocity. This proprioceptive impairment mainly affects postural control

and position sensation, drastically impairing ankle mobility. (Angamarca and Flores, 2012).

Consequently, the athlete must be aware of himself, his body and the state of it, so that is expressed in this research as a problem: What is the effect of proprioception as a method of preventing ankle injuries in the players of the top category of the Olmedo Sports Center in the city of Riobamba?

From there, it is declared as objective to determine the degree of effectiveness of proprioception as a method for the prevention of ankle injuries in sportsmen and women of the superior category of the Olmedo Sports Center, in the period September 2016 - February 2017.

MATERIALS AND METHODS

The research is carried out at the Olmedo Sports Centre, with a population of 30 players of the highest category. We worked with 100 %, in the ages between 15 and 40 years.

The study sample is characterized and the physiotherapeutic cards of each of the players were analyzed to determine the APPMAT value, determined as "Prophylactic assists for ankle joint discomfort", trying to quantify how many times the player attends these sessions during the course of a given time of two months (July 2016-August 2016). The above proposal applies for a period of 6 months: September 2016-February 2017.

Within the data collection instruments used, there is a physiotherapeutic observation card; through this instrument, it was possible to determine the amount of prophylactic assistance, for discomfort, of the ankle joint that could indicate a trauma among the players of the Olmedo Sports Center.

The ROMBERG equilibrium test, modified, is a basic test to evaluate the sense of equilibrium in an individual; in this test, the functioning of vestibular and proprioceptive receptors is evaluated. It is performed by placing the individual standing, with arms in front, head back and eyes closed; the individual has balance problems (positive to the test), when in the conditions described, presents a pendulum movement that may be slight, but perceptible or even fall.

The test integrates the evaluation of two primary afferent organs (vestibular receptors and the musculoskeletal system), the secondary afferent organs and the regulatory centers of the brain, as well as the effector organs (excepting the oculomotor system since vision is eliminated when the eyes are closed). Because of its ability to diagnose vestibular disorders, the test is reliable with respect to the sense of equilibrium; however, it does not provide quantitative results.

There are modifications to the ROMBERG test that include challenges (positions and movements); in the study, the vestibular disc with surface was used to perform the test. The evaluation of this test is defined on the basis of the time that the player can maintain the balance under the proposed limitations, without falling to the ground.

The ROMBERG test is applied to determine the equilibrium level of each of the players involved in the investigation and, in this way, to be able to obtain the initial data before the application of the proposal of proprioceptive exercises for the prevention of ankle injuries.

The physiotherapeutic records are evaluated again to analyze the APOMAT-POST value during the two-month period before the end of the intervention: January 2017-February 2017 and, in the same way, the application of the ROMBERG test to determine the values of the equilibrium maintenance time after the applied intervention.

It was proceeded to the statistical analysis of the results obtained, development of the corresponding discussion, conclusions and recommendations of the study. For statistical verification, the statistical package SPSS, version 22.0 IBM is used for quantitative samples, performing a descriptive analysis to determine the values of averages, error and standard deviation, a normality test that uses the criterion of Shapiro-Wilk for being a sample less than 60 data.

After the normality check, when obtaining normally distributed results, it determines the use of the parametric test for T-Student related samples, to check the level of significance, that is, the significant difference of the results before and after the intervention.

RESULTS AND DISCUSSION

The sample is made up of 30 players from the "Centro Deportivo Olmedo" aged between 16 and 42, with an average of $M=25.80 \pm 1.14$ with a standard deviation of 6.26 (Chart 1).

Chart 1. - Descriptive analysis of the study sample

	N	Mínimo	Máximo	Media	Desviación estándar
	Estadístico	Estadístico	Estadístico	Estadístico	Error estándar Estadístico
Edad	30	16	42	25,80	1,144
N válido (por la lista)	30				

Source: Statistical analysis of the SPSS program.

Determination of the ROMBERg and APPMAT test values in the period before the physiotherapeutic intervention

As a parameter in evaluation, which allows applying the proposal based on the use of proprioception exercises, the ROMBERG test was applied, modified, which determines the level of equilibrium presented by each of the players, showing an average of $M=13.43 \pm 0.30$ with a range of 10.3 - 15.0.

With the same procedure, the APPMAT value is determined (number of prophylactic attentions for ankle joint discomfort), in the period before the physiotherapeutic intervention, presenting an average of $M=2,70\pm 0,51$ attentions, with a range of 0-8 attentions, in a period of two months (Chart 2).

Chart 2. - Descriptive analysis of ROMBERG and APPMAT results prior to therapeutic intervention

	N	Mínimo	Máximo	Media	Desviación estándar
	Estadístico	Estadístico	Estadístico	Estadístico	Error estándar
ROMBERG pretest	30	10,3	15,0	13,433	,3037
APPMAT pretest	30	0	8	2,70	,510

Source: Statistical analysis of the SPSS program.

After the physiotherapeutic intervention, these variables are again evaluated to determine their values and means, showing that, for the modified ROMBERG test, the sample presented a mean of $M=14.23\pm 0.20$, with a range of 10.7-15-0. When analyzing the physiotherapeutic records, it is determined that the mean presented for the APPMAT value, in this period, decreases to $M=0.63\pm 0.22$ assists, with a range of 0-4, for the same period of time of two months as in the previous evaluation, which determines that there is, preliminarily, a difference between the means, both in the results of ROMBERG and APPMAT (Chart 3).

Chart 3. - Descriptive analysis of the ROMBERG and APPMAT variables of the sample under study, in the period after the intervention.

	N	Mínimo	Máximo	Media	Desviación estándar
	Estadístico	Estadístico	Estadístico	Estadístico	Error estándar
Romberg pretest	30	10,3	15,0	14,233	,2004
Appmat pretest	30	0	4	,63	,227

Source: Statistical analysis of the SPSS program.

Statistical verification of the results obtained in the variables ROMBERG and APPMAT before and after the therapeutic intervention

The data obtained both in the period before and after the therapeutic intervention were subjected to a normality test called (Shapiro-Wilk) for data less than or equal to 60 data. This test allowed us to determine which statistical method should be used to show whether there is a significant difference between the results of the different variables.

The evaluation of the normality of the results obtained by the sportsmen, in these periods of study, evidenced the existence of a normality with a P-value > 0,05, determined that the test for verification of the existence or not of a significant difference between the achieved results, from the parametric test, with this one, the T-Student test is used for related samples (Table 4). In this sense, it is determined that there is a significant difference between the results obtained between the period before the physiotherapeutic intervention and the period after the physiotherapeutic intervention, both for the ROMBERG variable, which makes it possible to determine the level of equilibrium, and the APPMAT variable, which makes it possible to prescribe the number of prophylactic assists for ankle joint discomfort, in a given period of time.

The level of significance is in a P-value < 0.001, which is taken as a decision to accept the alternative hypothesis for this study, indicating that exercises based on proprioception help to improve the statistically proven level of equilibrium. In addition, by obtaining this improvement there is a strengthening in this joint, which allows the reduction of prophylactic assistance for discomfort in the ankle joint which, likewise, was statistically proven and it can be said that proprioception, as a method of prevention of ankle injuries, in top athletes, is effective.

Chart 4. - Statistical analysis of the determination of significant differences in the different APPMAT periods

Diferencias emparejadas						Sig. (bilateral)		
Media	Desviación estándar	Media de error estándar	95 % de intervalo de confianza de la diferencia		t	gl		
			Inferior	Superior				
Romberg_pre_test-	-	,8604	,1571	-	-,4787	5,0093	29	,000
Romberg_post_test	,8000		1,1213					
Appmat_pre_test	2,067	2,116	,386	1,276	2,857	5,349	29	,000
Appmat_post_test								

P-value < 0,001

Source: Statistical analysis of the SPSS programme.

Several authors such as Montealegre-Mesa, García-Solano and Pérez-Parra, (2019), refer to the importance of proprioceptive exercises that should be worked on in the sports field, as the lack of these are influencing the performance of athletes as well as the vulnerability of manifesting a sports injury and, as a consequence, have times of low in their sporting activity.

The increase in the times of sick leave (or absence from sporting activity), both in training (Vera-García, and others, 2015) and in competition, brings with it significant consequences for the athlete in physical deconditioning, change in sports routines and lifestyles, anxieties about possible economic losses and sporting results, which leads to multiple effects for their activity.

The most frequent injuries in football correspond to ankle sprains (p.9). The sprain is like a partial structural damage in the fibers that form a ligament, but without reaching its breaking point (Martin, R. D. 2018). Therein lies the difference with other medical conditions, it is a damage, but not a total rupture. These results make it even more interesting to investigate which factors make the athlete more vulnerable to injury and to know which variables are associated with the possibility of producing a sports injury.

Comparing the research conducted with a similar "Use of proprioceptive ankle exercises to prevent more frequent sports injuries in football players" (F.J. Vera-García, D. Barbado, V. Moreno-Pérez, S. Hernández-Sánchez and C. Juan-Recio, J.L.L. Elvira 2015) determine proprioception as a method of injury prevention (Martínez, L. C. 2008) causes positive effects, decreasing the rate of discomfort and, therefore, of injuries.

It is important for the physiotherapist, who is part of a high performance team, to know the injuries that occur most frequently, the risk factors, although some injuries are unpredictable, but with the proper application of proprioceptive exercises can prevent and improve the performance of players.

In the projects, the beneficial results decreased a high percentage of the discomfort of the players. Thus, it is determined that there is a significant difference between the results obtained between the period before the physiotherapy intervention and the period after the physiotherapy intervention, both for the ROMBERG variable, which allows to determine the level of balance, and the APPMAT variable, which allows to determine the number of prophylactic assists for ankle joint discomfort, in a given period of time.

The level of significance was found in a P-value < 0.001, which determines that the alternative hypothesis for this study should be accepted. This indicates that exercises based on proprioception help to improve the level of balance statistically proven and, in turn, to obtain this improvement, there is a strengthening in this joint which allows the reduction of prophylactic assistance by discomfort in the ankle joint, which, with a level of significance of 0.05, with a reliability of 95%, it can be said that the method analyzed can prevent injuries in this joint.

In conclusion, it is stated that the proprioception exercises, in this research, allow to regulate the direction and range of movement, admitting reactions and automatic responses, intervening in the development of the body schema and its relationship

with space, sustaining the planned motor action. In such a way, it is possible to improve the statesthesia, cenesthesia and effector activities in the players of the Sport Center Olmedo.

It is corroborated that exercises based on proprioception help to improve the level of balance; in addition, there are differences between the means in the periods before $M=13,43\pm 0,30$ and after $M=14,23\pm 0,20$ of the intervention; statistically, verified in a level of P-value $< 0,001$ and, at the same time, when obtaining this improvement, there is a strengthening in this joint which allows the decrease of the prophylactic assists due to discomfort in the ankle joint which, in the same way, was statistically verified. And it can be stated that this proposal recognizes the prevention of injuries in this joint.

During the research and training process, proprioception exercises, as a method of injury prevention, allow the APPMAT study parameter to be improved, since when analyzing the physiotherapeutic records, it was determined that the mean presented before $M=2.70\pm 0.51$ decreases in the period after the intervention to $M=0.63\pm 0.22$ assists, for the same period of time of two months, as in the previous evaluation. The statistical verification, at a level of P-value < 0.001 , corroborates the alternative hypothesis put forward in relation to this proposal presented to prevent the existence of injuries in this joint.

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