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ANTERIOR CROSS LIGAMENT INJURY (ACL) IN CANTABRIAN FOOTBALL PLAYERS. DESCRIPTIVE ANALYSIS OF RISK FACTORS

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Abstract. Introduction: The rupture of the Anterior Cruciate Ligament (ACL) is one of the most problematic injuries in the world of football, not only because of the period that it will keep the subject inactive, but also because of the consequences that it can produce in the athlete. Objectives: To know some of the risk factors, as well as the mechanism of ACL injuries in the last three seasons in Cantabrian football. Material and methods: Data was collected on different risk factors of all ACL injured Cantabrian soccer players in the last 3 seasons (2016 to 2019). These data were recorded through an interview conducted by the Cantabrian Football Federation. The initial sample was 93 people, 84 being men (H) and 9 women (M). Results: The competition turned out to be more harmful than the training (H: 88.5%; M: 77.8%), being the first part of the match where there were more injuries (H: 47.8%; M: 66.7 %). Defenders in men (50.7%) and midfielders in women (55.6%) were the most affected positions. With 87% in men and 100% in women, the injuries occurred on artificial grass with the use of Artificial Grass (AG) studs (H: 46.4%; M: 77.8%) and during the month of April (H: 4.5%; M: 33.3%). In addition, the injuries occurred without contact (H: 73.9%; M: 77.8%) and 66.7% in both groups did not perform preventive work. Conclusions: ACL injury occurs mainly without contact, with the use of AG cleats on artificial turf, during the first part of the game and in April. Defenders in men and midfielders in women were the most affected positions.

Keywords: Epidemiology, soccer, causes, anterior cruciate ligament, incidence, risk factors.

LESIÓN DE LIGAMENTO CRUZADO ANTERIOR (LCA) EN FUTBOLISTAS CÁNTABROS. ANÁLISIS DESCRIPTIVO DE LOS FACTORES DE RIESGO

Resumen. Introducción: La rotura de Ligamento Cruzado Anterior (LCA) es una de las lesiones más problemáticas dentro del mundo del fútbol, no solo por el periodo que mantendrá inactivo al sujeto, sino también por las secuelas que puede producir en el deportista. Objetivos: Conocer algunos de los factores de riesgo y mecanismos de lesión de LCA en futbolistas cántabros de las temporadas 2016 a 2019. Material y métodos: Se recogieron datos sobre diferentes factores de riesgo de todos los jugadores/as del fútbol cántabro lesionados de LCA en las últimas 3 temporadas (2016 al 2019). Estos datos se registraron mediante una entrevista realizada por la Federación Cántabra de Fútbol. La muestra inicial fue de 93 personas, siendo 84 hombres (H) y 9 mujeres (M). Resultados: La competición resultó ser más lesiva que el entrenamiento (H: 88,5%; M: 77,8%), siendo la primera parte del partido donde más lesiones hubo (H: 47,8%; M: 66,7%). Los defensas en los hombres (50,7%) y los mediocentros en mujeres (55,6%) fueron las posiciones más afectadas. Con un 87% en hombres y 100% en mujeres, las lesiones se produjeron sobre hierba artificial con el uso de tacos Artificial Grass (AG) (H: 46,4%; M: 77,8%) y durante el mes de abril (H: 4,5%; M: 33,3%) . Además, las lesiones se produjeron sin contacto (H: 73,9%; M:77,8%) y el 66,7% en ambos grupos no realizaba trabajo preventivo. Conclusiones: La lesión de LCA se produce principalmente sin contacto, con el uso de tacos AG sobre césped artificial, durante la primera parte del partido y en abril. Los defensas en hombres y los mediocentros en mujeres fueron las posiciones más afectadas.

Palabras clave: Epidemiología, fútbol, causas, ligamento cruzado anterior, incidencia, factores de riesgo.

Introduction

Soccer is one of the most played sports worldwide. According to data from the Fédération Internationale de Football Association (FIFA), it has 270 million participants (Noya and Sillero, 2012). In Spain there are 92.3805 licenses, of which 12.891 are in Cantabria, where the data for the present analysis come from (RFEF, 2017).

Due to the characteristics of this sport and the high number of people who practice it, a large number of injuries occur, specifically between 6 and 9 per 1000 hours (h) of exposure (Noya and Sillero, 2012).

Establishing a universal definition of "sports injury" is really complicated. We can find an infinite number of meanings depending on the author and different criteria such as loss of playing or training time, need for medical assistance, injured tissue (Salces, 2015), severity of the injury or location of the injury (Pujals et al, 2016).

FIFA adopted the proposal of Ekstrand, Waldén, and Hägglund (2004), who consider a sports injury as "an injury occurring during the training session or match schedule that causes absence for the next training session or match."

To group these injuries, we will follow the classification used by Romero and Tous (2010) and from which institutions such as the UEFA have benefited to carry out different investigations (Cos, Cos, Buenaventura, Pruna and Ekstrand, 2010). There are two main categories: acute or traumatic and chronic or overuse. Within the first group, we distinguish between sprains, contusions, fractures, dislocations, and others (not included in previous points).

In addition, taking into account the period of sick leave, we found minor (1-7 days), moderate (8-21 days), and severe (more than 21 days) injuries (Tegnander et al, 2007).

One of the most problematic injuries in the world of soccer is the anterior cruciate ligament (ACL) injury. We understand this as the partial or complete rupture of this ligament, incapacitating the athlete for sports practice for a period of time of approximately 6 to 9 months (Leyes, Pérez and de Olano, 2011). As Paredes, Martos, and Romero (2011) point out, "it can mean for some athletes the end of their career, or produce sequelae that can remain for the rest of their sporting life or, on the other hand, the partial deterioration of sporting practice and its consequence on physical fitness for their performance." Furthermore, only 63% manage to recover their pre-injury level (Ardern, Webster, Taylor and Feller, 2011).

Another important element that increases the need to reduce the number of injuries is the high cost of ACL surgery, amounting to between 17,000 and 25,000 euros (Hewett, Ford, Hoogenboom, and Myer, 2010).

Looking at the number of injuries that occur per season and the average time off work, Waldén, Hägglund, Magnusson, and Ekstrand (2011) found that, in different professional soccer teams in Sweden, 0.4 ACL injuries occurred per team and season, with an average time off work of 237.5 days. These same authors, in another study (2016) where they analyzed different teams from various European leagues, observed that the ratio of ACL injuries was 0.066 per 1000 h of exposure and that, per season, there were 0.43 such injuries with an estimated sick leave period of 225 days.

Schiffner et al (2018), saw that the ratio of ACL injuries, in professional Bundesliga players, was 0.040 per 1000 h of exposure and that, per team, over the course of the season, 0.53 injuries occurred. In this case, the average downtime was about 244 days.

Thus, although the ratio of ACL injuries produced per 1000 h of exposure is not high, or even the number of them per team and season either, we note that the time that the injured athlete will have to remain inactive is remarkable, so knowing the factors or characteristics that can enhance it, as well as trying to correct those that are modifiable (Price, Tuca, Cordasco and Green, 2017) becomes extremely important.

Regarding the ACL injury, we can find both intrinsic factors (inherent to the subject) and extrinsic factors (independent of the athlete) and it is the sum of both and their interaction that increase the probability of suffering an injury during sports practice (Cos et al, 2010).

Female gender, high joint laxity (Price et al, 2017; Leyes et al, 2011), age, muscle fatigue (Alentorn-Geli et al, 2009; Garin, Reyes, & Penagos, 2016), excessive genu recurvatum, small intercondylar notch size (Price et al, 2017), body mass index (BMI), family history (Griffin et al, 2006), previous injuries (McCall et al, 2014) or improper movement patterns such as dynamic valgus (Acevedo, Rivera-Vega, Miranda, & Micheo, 2014; Griffin et al, 2006), in addition to alterations in the quadriceps-ischial relationship (Barber-Westin, Noyes, Smith, & Campbell, 2009; Alanís-Blancas, Zamora-Muñoz, and Cruz-Miranda, 2012) are some of the factors inherent to the athlete.

On the other hand, as extrinsic factors we have the playing field that increases the friction between the ground and the foot or the type of footwear and the frictional resistance it offers (Acevedo et al, 2014; Alentorn-Geli et al, 2009), the weather conditions or the characteristics of the sport itself (Griffin et al, 2006), as well as whether we are in competition or in training (Acevedo et al, 2014).

Another important aspect is the mechanism of ACL injury. The most common injuries are associated with changes of direction combined with deceleration, turns, and

jump receptions, although they can occur in actions such as internal-external rotation of the tibia, varus-valgus in the last degrees of extension (20-30º), a load in flexion, or an anterior translation of the tibia generated by an excess of tension in the quadriceps (Hewett et al, 2010).

As mentioned above, this type of injury is usually of considerable severity, not only because it keeps the athlete out of the field for a long period of time, but also because of the possible consequences of the injury. That is why the proposed objectives are to know some of the risk factors and ACL injury mechanisms from the 2016 to 2019 seasons in Cantabrian soccer players.

Material and Method

In the present descriptive analysis, data were collected retrospectively from the last 3 consecutive seasons (2016-2017, 2017-2018, and 2018-2019) in which all male and female soccer players in Cantabria from base to 3rd division categories, who suffered an ACL rupture, were included together.

Information was obtained on different risk factors for each subject at the time of injury (sex, age, type of turf, dominant leg/leg injured, injury mechanism, type of studs, whether it was in a match or in training, minute, month of injury, position, and whether or not he/she was doing preventive work) in addition to the type of injury suffered.

The sample included in the study was 93 persons, of whom 84 were men and 9 women. The exclusion criterion used was not having all the data analyzed in full.

The recording of the data was carried out by the Cantabrian Football Federation by means of an oral interview carried out on the first day the subject arrived at the sports readaptation area, in which different items were indicated according to the data provided by the patient.

The classification used for the type of studs used by the injured subjects was the one proposed by Thomson, Whiteley, Wilson, and Bleakley (2019), where it divides these into: Artificial Grass (AG), Firm Ground (FG), and Soft Ground (SG). In addition, two more types were added: Turf and Hard Ground (HG) (Queen, Charnock, Garrett, Hardaker, Sims, and Moorman et al, 2008).

Results

After applying the exclusion criteria, the sample selected for the study was 78 players, of whom 69 were male (19.1 ±4.0 years) and 9 female (19.7 ±4.8 years).

In the group of women, the most recorded injury was the ACL, exclusively, with 8 cases (88.9%). In the case of men, a total of 42 ACL injuries (60.9%) were recorded, this being the most representative. The rest, in addition to ACL, also presented other associated structures. Among them we found 8 ACL with internal meniscus (IM), 9 with external meniscus (EM), and 5 in which both menisci were affected. The remaining 5 injuries were classified as "other" and included, in addition to ACL rupture, involvement of the internal lateral ligament (ILL) or posterior cruciate ligament (PCL).

The results obtained for the different factors analyzed are as follows (table 1):

	MEN		WOMEN	
FACTORS ANALYZED	**Sample**	**Percentage**	**Sample**	**Percentage**
TYPE OF INJURY	**n**	**%**	**n**	**%**
ACL	42	60,9	8	88,9
ACL + IM	8	11,6	1	11,1
ACL + EM	9	13,0	-	-
ACL + BOTH MENISCI	5	7,2	-	-
ACL + OTHERS	5	7,2	-	-
TIME OF OCCURRENCE	**n**	**%**	**n**	**%**
Competition	59	85,5	8	88,9
Training	10	14,5	1	11,1
MINUTE OF INJURY	**n**	**%**	**n**	**%**
From min 1 to 22	10	14,5	5	55,6
From min 22 to halftime	23	33,3	1	11,1
From halftime to min 67	12	17,4	1	11,1
From min 68 to the end	14	20,3	1	11,1
POSITION	**n**	**%**	**n**	**%**
Goalkeeper	3	4,3	-	-
Defender	35	50,7		33,3
Midfielder	26	37,7	5	55,6
Striker	5	7,2	1	11,1
PLAYING FIELD	**n**	**%**	**n**	**%**
Artificial	60	87,0	9	100
Natural	9	13,0	-	-
TYPE OF STUDS	**n**	**%**	**n**	**%**
FG	19	27,5	1	11,1

SG	4	5,8	-	-
AG	32	46,4	7	7,77
HG	11	15,9	1	11,1
TURF	3	4,3	-	-
MECHANISM OF INJURY	**n**	**%**	**n**	**%**
Contact	18	26,1	2	22,2
No contact	51	73,9	7	77,8
DOMINANCE	**n**	**%**	**n**	**%**
Injury to dominant leg	34	49,3	5	55,6
Non-dominant leg injury	35	50,7	4	44,4
PREVENTIVE WORK	**n**	**%**	**n**	**%**
They did perform preventive work	23	33,3	3	33,3
They did not perform preventive work	46	66,7	6	66,7
MONTH	**n**	**%**	**n**	**%**
January	9	13,0	-	-
February	9	13,0	-	-
March	6	8,7	1	11,1
April	10	14,5	3	33,3
May	6	8,7	2	22,2
June	7	10,1	-	-
July	1	1,4	-	-
August	3	4,3	1	11,1
September	4	5,8	-	-
October	2	2,9	-	-
November	6	8,7	2	22,2

December	6	8,7	-	-

*Table 1*Summary of the results obtained. *Min: minute; FG: Firm Ground; SG: Soft Ground; AG: Artificial Grass, HG: Hard Ground.*

Time of onset of injury

In competition, a greater number of injuries were recorded in both men (59 cases, 88.5%) and women (8 cases, 88.9%) as opposed to training injuries (men: 10 cases, 14.5%; women: 1 case, 11.1%), with the first half being the period with the highest number of injuries for both groups (men: 33 cases, 47.8%; women: 6 cases, 66.7%). Analyzing this first period in men, we saw that from the 23rd minute until halftime most injuries occurred (23 cases), while the first few minutes presented fewer cases (10). On the other hand, women suffered 55.5% of the injuries (5 cases) in the first 22 minutes, the rest being distributed evenly throughout the match.

Position

In men, the most affected field position was defense, with a total of 35 cases (50.7%), followed by midfielders (26 injuries; 37.7%), forwards (5 injuries; 7.2%) and finally, with only 3 records (4.3%), the goalkeeper.

In the case of women, the most injured position was midfielder, with 5 incidents (55.6%). This was followed by defenders (3 cases, 33.3%) and forwards (1 case, 11.1%).

Playing field and type of studs

Regarding the playing surface, 87% of the men (60 cases) and 100% of the women (total cases) were injured on artificial turf, while the remaining 13% of cases in men (9 cases) were injured on natural grass.

Regarding the type of cue, the Artificial Ground (AG) type was the most used at the time of injury with 32 cases (46.4%) in men and 7 (77.8%) in women. In addition, the Firm Ground (FG) type was the second most represented with 19 cases in men (27.5%) and 1 in women (11.1%).

Injury mechanism

The predominant injury mechanism in both samples was non-contact, with a total of 51 cases (73.9%) in men and 7 (77.8%) in women. The remaining injuries were contact, with 18 episodes (26.1%) in men and 2 (22.2%) in women.

Dominance

Regarding the dominance of the injured leg, in men 50.7% of injuries were recorded in the non-dominant leg (35 cases), while in women 55.6% of injuries occurred in the dominant leg (5 cases).

Preventive work

In 66.7% of both men (46) and women (6) did not carry out any type of preventive work in their club, in contrast to the remaining 33.3% who did carry out this type of work.

Month

Both the male and female groups had the highest number of injuries in April, with 10 (14.5%) and 3 (33.3%) cases, respectively.

This was followed by January (9 cases, 13%) and February (8 cases, 11.6%) for men (Figure 1).

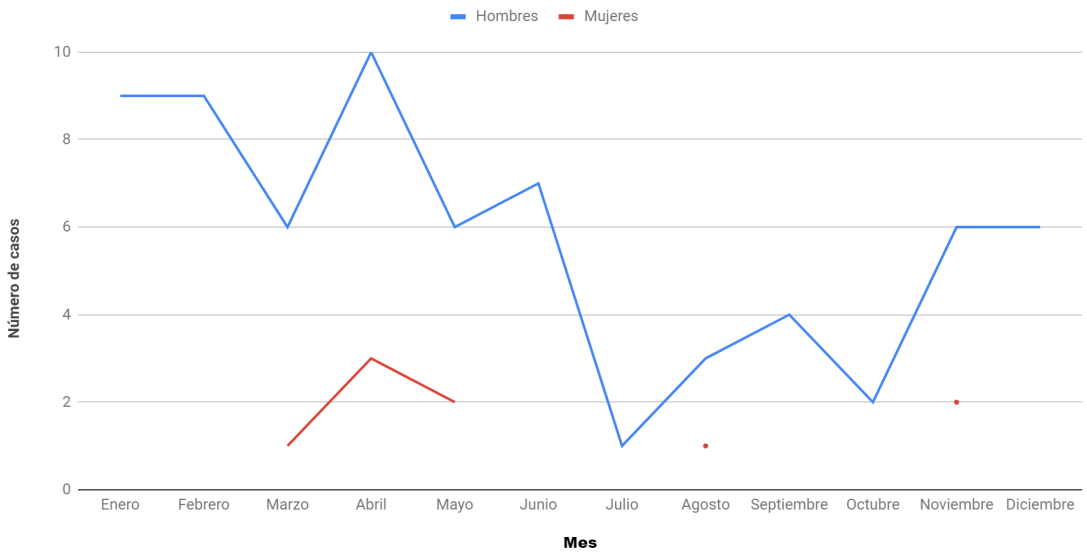

Figure 1. Distribution of lesions throughout the year.

Discussion and conclusions

ACL rupture is one of the most worrying injuries in Cantabrian soccer. Thus, the objective of this study was to determine several of the risk factors that may be involved in the occurrence of this injury.

The main findings show that competition affects ACL injuries to a greater extent, being the first part where the greatest number of injuries are concentrated. In addition, it can be seen how the artificial grass turf combined with the type of AG studs has registered a large number of injuries and the failure to carry out preventive work can lead to an increase in the probability of non-contact injuries.

In the study carried out by Ekstrand, Hägglund, and Waldén (2011), they analyze the characteristics of all the injuries produced over several seasons in different professional European soccer teams, seeing that the highest percentage of these occur in competition and not during training. Following this line, Schiffner et al (2018), shows how in the German professional soccer league (Bundesliga) the highest percentage of ACL injuries occurs in competition (72%). These results are similar to those obtained in this study, where ACL tears occur mainly in competition for both sexes, which may be due to the fact that the intensity in matches is different from that in training (Gaspar-Junior, Onaka, Barbosa, Martinez, & Oliveira-Junior, 2019).

Regarding the period of the match in which most people are injured, we find disparate results. Faunø and Jakobsen (2006) point out that the second half of the match is the most injury-prone period, in contrast to Waldén, Hägglund, Magnusson, and Ekstrand (2011), whose results show that the period with the most injuries is the first half, specifically the first 15 minutes. This second proposal is the one that agrees with the results obtained in this analysis where the highest number of injuries for both sexes appear in the first part.

In men, attending to the positions that players occupy on the field, we see how defenders are those who accumulate more injuries followed by midfielders. In the case of goalkeepers, the percentage of the injured is very low, as in other publications (Schiffner et al, 2018). In contrast to our study, Barth et al (2019) analyze that the midfield position shows the most records (42.5%), but again, the goalkeeper position is the least affected (4.6%).

As for the girls, the position with the highest number of injuries is midfielders as in Giza, Mithöfer, Farrell, Zarins, and Gill (2005).

According to Acevedo et al (2014), in outdoor sports, as is the case of soccer, the natural grass surface presents less risk of injury than that which is artificial. This is reflected in our results, where artificial grass represents the highest number of cases in both men and women. It should be noted that in Cantabria the number of artificial grass fields is predominant.

On the other hand, attending to the type of studs, we see how the AG is the most used at the time of injury representing a high percentage of the sample. These data do not match with the results obtained by Meyers (2017), where no differences are observed in terms of the type of studs used and the injuries produced.

In soccer, the main ACL injury mechanism is non-contact (Ekstrand, Waldén and Hägglund, 2011; Waldén et al 2015; Dick, Putukian, Agel, Evans and Marshall, 2007; Teresa, 2003). Our results confirm this fact, reflecting that the highest percentage in both men and women are produced through this mechanism. Given this, we see that these types of injuries are due to inadequate movement patterns that can be modified through preventive work (Dai, Mao, Garrett, & Yu, 2014). Thus, even if we can reduce the number of injuries through this type of work, the reality is that, in both sexes, a high percentage does not perform any type of preventive training.

Regarding the dominance of the injury, there is no consensus on whether this factor is a variable to be taken into account. On the one hand, Rochcongar, Laboute, Jan, and Carling (2009) find that the right leg is injured more, regardless of dominance. On the other hand, Waldén et al (2011) observe that there is a relationship between the injured leg and the dominance of the player, being in this case the left leg the most damaged.

Finally, it is seen how in both groups the month where the highest number of ACL injuries occur is April, as in the study conducted by Schiffner et al (2018) in German professional soccer.

Limitations

Due to the fact that this is a sample collected by the Cantabrian Football Federation through interviews, 15 people had to be eliminated from the initial sample because they presented all the variables in full, going from a sample of 93 to a sample of 78. Since there is no data prior to 2016, there is no possibility of comparing more seasons with each other or any specific factor. In addition, the selected sample is amateur and most studies are based on professional leagues, which may imply that some results are not similar. Finally, the sample of women with ACL injuries was very small.

Conclusion

The aim of this article is to know some of the risk factors as well as mechanisms of anterior cruciate ligament injury in Cantabrian soccer players from the 2016 to 2019 seasons.

Analyzing whether the ACL injury entailed the involvement of other body parts or not, it was observed that this occurs mainly without any associated structure.

The main mechanism of injury is non-contact, with a greater number of people affected during the first part of the competition and in the month of April. In addition, this injury occurs mainly on artificial turf and with the AG type of studs.

Men are usually injured between the 23rd minute and half-time of the first half, with defenders being the most affected. On the other hand, women are injured mainly between the start of the match and the 23rd minute and the most injured position is midfielder.

Regarding the dominance of the injured leg, no significant conclusion can be drawn and preventive work is recommended to reduce the number of injuries.

In future lines of research, it would be interesting to be able to carry out an intervention in the different clubs, acting on those modifiable risk factors and analyze whether the number of ACL injuries is reduced or not.

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