Module 2. Management of the injured athlete

Introduction

When interpreting an injury, it is fundamental to have a broad and flexible view on it so as to avoid a unidirectional, reductionist analysis. This approach seeks not only to observe the work planned for the injury, but also to include the injured athlete at the same level.

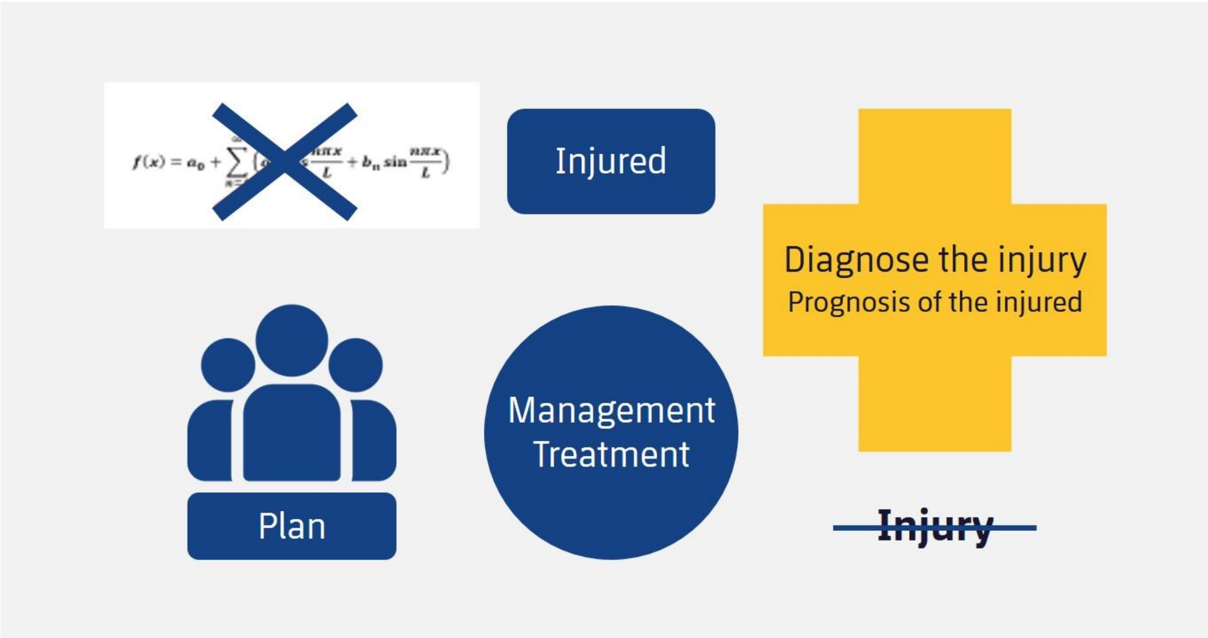
For this reason, according to Bittencourt, Meeuwisse, Mendonça, Nettel-Aguirre, Ocarin and Fonseca (2017) the researches of sports etiology of injuries have taken a reductionist approach, in which a phenomenon has been simplified into units and only the sum of the basic parts has been analyzed, and the causality has been seen in a linear and unidirectional way.

> Siff and Verchoshansky (1999) point out the importance of taking into account the complexity of the phenomena related to any biological system. According to these authors the adoption of nonlinear research methods, like the ones the chaos theory comes from, can explain the sudden beneficial or harmful conditional changes in the adaptation as well as muscle supercompesation or injuries (Torrents, 2005 p. 45).

In this respect, the idea of "individualization" gains preponderance in the recovery process. In the words of Bosch (2015), an adaptation process is highly individual, this means, it changes from one athlete to the other. This is called "individuality". For this reason, different aspects, such as the biological and emotional ones as well as the environment and its conditions should be present during the planning. This shows that it is of paramount importance to understand that an injured structure is not recovered in isolation, yet besides, its evolution should integrate the remaining features (biologic, socio-affective, conditional, etc.) that make up the athlete, which encompasses a wide spectrum in the management analysis. In short, currently, this perspective presents a new challenge for the sports rehabilitation specialist.

Authors like Siff (1999) put the emphasis on the need to individualize in training sessions, to take into account the style of each individual without highlighting an ideal model, to diversify, to respect asymmetry, delayed effects and the interaction of the processes (Torrents, 2005).

Figure 1: Priority to the Injured Athlete



Source: Prepared by authors.

There are two basic aspects related to an injury: on the one hand, the importance of making a right injury diagnosis - task performed in the first place by the physician -; and on the other hand, the information that has to be given to the injured about the steps to follow. The latter is done in a simple and realistic way. Both aspects show two different universes but with a common objective: to accompany the recovery process of the football player.

From this point of view, it will be considered optimal **to diagnose the injury and make a prognosis of the injured.** This is due to the fact that the same kind of injury will have a different prognosis for each player. His position on the playing field, his conditional values, among other characteristics, will be decisive in his readaptation process. Therefore, a kind of injury that could apparently be the same is not. This is the reason why focusing only on predicting the injury restricts the interrelation with the injured.

Because of all this, it is essential to lay out a work proposal customized for the injured, which integrates the injury and is guided under the needs and demands of the player on the playing field - which will be determinant to set the pace and evolution-, creating optimal synergies in the quality of the process during readaptation. In the end, the one who readapts is the player. Therefore, physiotherapists, physicians and physical trainers, among other professionals, will have a key role since they are the agents that accompany the process through which the one who recovers is the injured.

We should analyze the injury not from the "prevention", but from minimizing injury risks. (Brau, 2019)

From the FC Barcelona perspective, it is considered relevant to structure flexible and integrating reaptation proposals to avoid, in this respect, reducing injuries to standard protocols. On the contrary, from this view, the increase in effectiveness and efficiency in the adaptation processes, autonomy of the athletes, and their positive addiction to training are sought (Balagué, Torrents, Pol, Seirul·lo, 2014). This entails an assessment designed by each professional team, and from there, linked with the functional diagnosis obtained. This means, the more complete the functional assessment, the larger and better conclusion could be drawn when starting a readaptation process. For this, the result of the assessment will be analyzed according to the individual environment of the player. According to Romero (2017), in an interaction sport in a shared space like football, it is necessary to design tasks that point to an optimizing and preventive effect, which gets the player closer to have a greater protection throughout the development of the specific skills for the sport.

Another aspect to consider when facing a readaptation process, is the importance of team work from a transdisciplinary perspective. This contributes the idea that transdisciplinarity is concerned about the dynamics created by the simultaneous actions of diverse levels of reality (Nicolescu, 1999), which present a global and open view, in which each of the parts have the same value and importance when integrating the ideal recovery process for the athlete. This is like this because, from this point of view, a big number of professionals are part of the injury process of the athlete: doctors, physiotherapists, and nutritionists as well as physical trainers, psychologists, and of course, the coach. The common objective of this group should be to manage the readaptation process in such a way that the athlete could be in the best conditions to return to competition as soon as possible.

Figure 2: Transdisciplinary Work

Source: Prepared by authors.

The dotted lines in Figure 2 represent the integration and interaction that exist in the areas responsible for the football player's recovery process, including at the same time the injured.

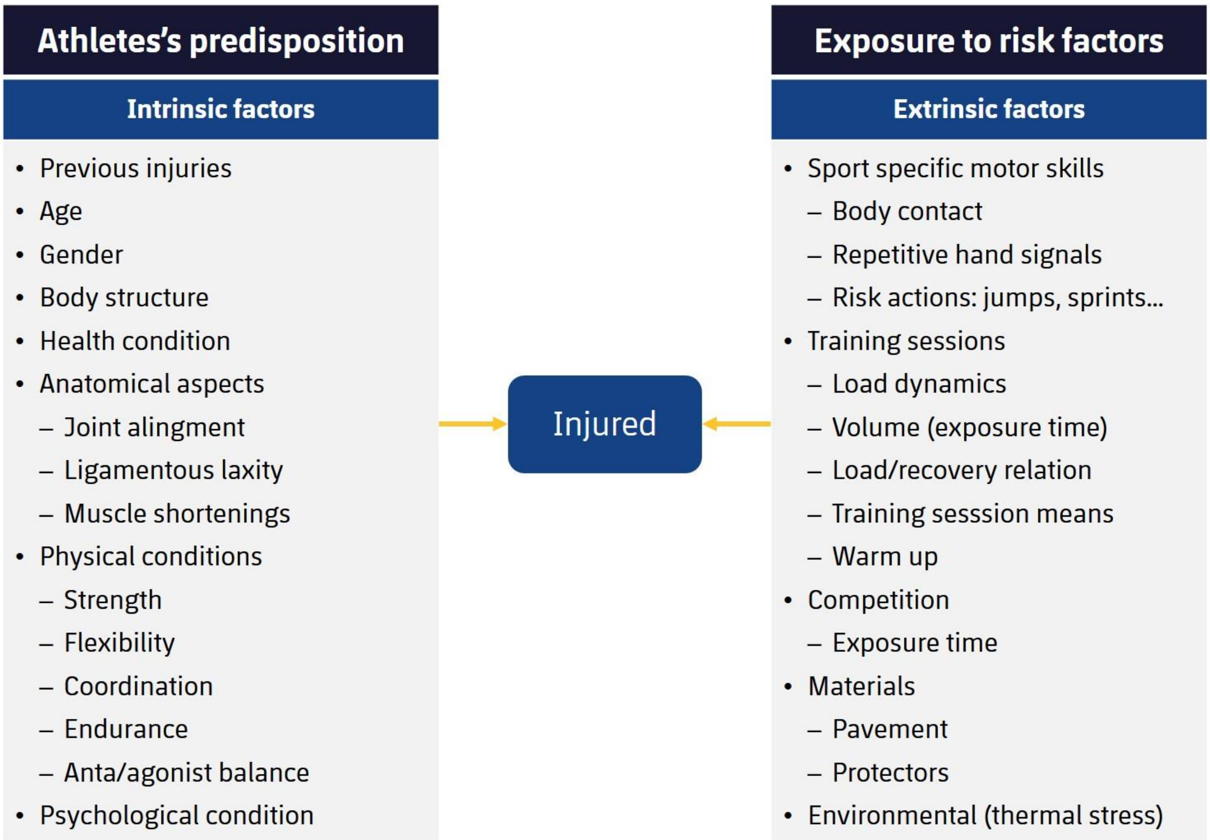
In short, it is considered paramount to start from the idea *that injuries are not treated, they are managed*. From this changing dynamic, the athlete emerges with his own environment, with his own experiences and in synergy with his culture, in which there is also an environment for the injury. This supposes a great number of variables and all of them have to be taken into account: the time of the injury, the games the player is going to miss, among others. At the same time different unanswered questions need to be considered when "coming back to the field", this means, the availability to participate: in which game will this happen?, what stage of the tournament is the team in?, which is the ideal game time to participate in the competition?, among others. Probably, by managing the treatment of this injury in a specific way, the rush of event could be avoided or reduced, even when knowing that the player always wants to participate as soon as possible. In this respect, a good management of the injured player will provide an optimal recovery process during treatment.

Above good and evil is useful. (Brau, 2019)

Taking into account that sports injuries, generally, are components that limit training, in 2008 authors like Casaís Matínez claimed that the accumulation of empirical evidence to date allowed the identification of a set of factors that should be accepted to implement preventive measures in the training session. This is, measures that cooperate with injuries reduction.

In this respect, intrinsic and extrinsic factors are included. The term "extrinsic" is related to the risk factors exposure, and, on the contrary, the term "intrinsic" relates to the athlete's predisposition, where the concept of "individualization" takes preponderance. As well, Casaís Martínez (2008) points out that both factors do not work in isolation so in the training-competition process they are exposed in a complex and interactive way.

Figure 3: Intrinsic and Extrinsic Factors



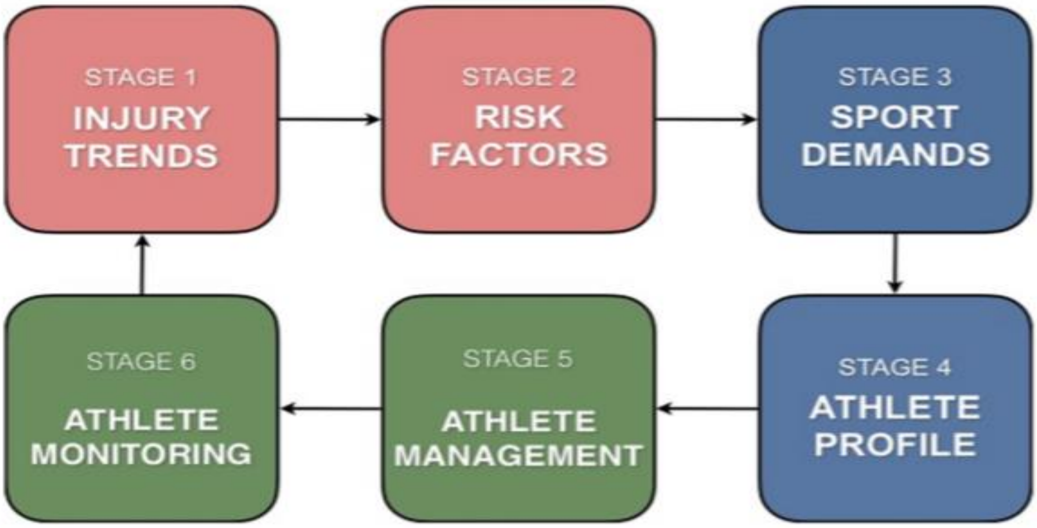
Source: Casáis Martínez, 2008, p. 32.

Currently, it is known that injuries risk management is important to maximize the availability and the performance of the athletes. In this respect, etiological models have illustrated how susceptibility is influenced by repeated interactions between the athlete (this is the intrinsic factors), and the environmental stimuli (this is the extrinsic factors). Such models also reveal that the probabilities of an injury along time is related to the interconnection of multiple factors accumulated in an adaptation pattern that could be positive (this is a better aptitude) or negative (this means an injury) (Roe, Malone, Blake, Collins, Gissane, Büttner, Murphy, Delahun, 2017).

For this reason, professionals have to be able to design, implement and monitor risk management strategies that ensure the maintenance of low susceptibility to injuries during the training sessions, and thus, improve performance (Roe et al., 2017).

In this respect, the authors develop a six-step or stages proposal: they start with the identification of injuries trends and its risk factors (stages 1 and 2), after that, they go through the demands of the specific sport and the abilities the athlete has (stages 3 and 4), and finally, they include the monitoring of the player's responses in agreement with the current scientific evidence (stages 5 and 6). All this, according to the authors, could be useful and used as a guide in group interventions.

Figure 4: Proposal to Manage Injuries Risk



Source: Roe et al., 2017, p. 3.

In Figure 4, the six-stage operating model can be seen: here it is described how to know the injuries trends and the risk factors (stages 1 and 2), outline the sports demands and the athlete's abilities (stages 3 and 4), and monitor the athlete's responses to the interventions based on the evidence (stages 5 and 6) can guide professionals in injuries risk management.

- **Stage 1:** Injuries Trends: when, where and how do some athletes hold certain injuries?
- **Stage 2:** Injuries Risk Factors: which factors increase or migrate injuries risk?
- **Stage 3:** Sporting Demands: what does the athlete need to be prepared for?
- **Stage 4:** Athlete's Profile: does the athlete have the characteristics of a risk or successful individual?
- **Stage 5:** Athlete's Management: which are positive interventions in the short and long term?
- **Stage 6:** Athlete's Monitoring: how does the athlete respond to extra training hours?

It is known that, normally, the muscles involved in injuries are biarticular and they have a complex architecture with a high proportion of fast twitch fibers.

In professional football, between 92% and 97 % of all the muscle injuries are in the lower limb: hamstrings (28–37 %), quadriceps (19–32 %), adductors (19–23 %), and calf muscles (12–13 %) (Valle, Alentorn-Geli, Tol, Hamilton, Garrett, Pruna, Til, Gutierrez, Alomar, Balius, Malliaropoulos, Monllau, Whiteley, Witvrouw, Samuelsson and Rodas, 2016).

For this reason, the most important aspects related to the muscle injuries above mentioned are described next. These injuries are a determinant factor in withdrawal during competitions.

Hamstrings

Hamstrings injury is a kind of injury that represents 12 % of all the injuries in professional male football (Ekstrand, Hägglund y Waldén, 2011). In that study, 37 % of all the muscle injuries happened in the hamstrings. The injury rate in games is almost nine times higher than in training sessions (Figure 2). This means that a team with 25 players in the squad in professional male football can expect about six hamstrings injuries each season. Studies that use images have shown that most of these injuries involve the long head of the biceps femoris. This is the one associated with a specific action or also called "sprinting injury" (Crema, Guermazi, Tol, Hamilton and Roemer, 2015; Ekstrand, Healy, Waldén, Lee, English and Hägglund, 2011).

There are other studies on high performance male players, where similar findings to the mentioned above have been reported. Such is the case of the studies proposed by Petersen, Thorborg, Nielsen and Hölmich (2010) and Woods, Hawkins, Maltby, Hulse, Thomas and Hodson, (2004). However, two studies performed in female football on university football players in the US found a lower hamstrings injuries rate (Cross, Gurka, Saliba, Conaway and Hertel, 2015; Dalton, Kerr and Dompier, 2014). On the other hand, Hägglund, Waldén and Ekstrand (2009) performed a study on Swedish elite players where there was no difference as regard gender in relation to the hamstrings injuries rate.

Table 1: Muscle injury rate of professional male football players

MUSCLE GROUP	INJURY INCIDENCE	MATCH INJURY INCIDENCE
Hamstring	0.4 per 1000 hours	3.7 per 1000 hours
Quadriceps	0.3 per 1000 hours	1.2 per 1000 hours
Adductors	0.3 per 1000 hours	2.0 per 1000 hours
Calf	0.2 per 1000 hours	1.0 per 1000 hours

Source: taken from Muscle Injury Guide: Prevention of and Return to Play from Muscle Injuries, adapted from Ekstrand, Hägglund, Waldén, 2011.

Hamstrings injury constitutes an important percentage of the total acute musculoskeletal injuries caused during sporting activities at professional as well as at amateur levels. The prevalence of that injury reported in different studies is between 8 and 25% (Mason, Dickens, Vail, 2007) depending on the specific sport. Besides, this injury presents a high risk of recurrence, which usually happens within two weeks after return to regular training sessions. It is set around 13% in the first week, during the second week around 8% persist, and 34% for cases of accumulated risks during the whole season (Orchar and Seward, 2003; De Hoyo, Naranjo-Orellana, Carrascoa, Sañudoa, Jiménez-Barroca and Domínguez-Cobo, 2012).

According to Sampietro (2018), the different injuries on hamstrings are highly frequent in sports where the *sprint,* especially in non pre-planned situations (sudden direction changes, or with decision making), is present in high volumes. In this respect, interaction sports in shared spaces like football have the characteristics described.

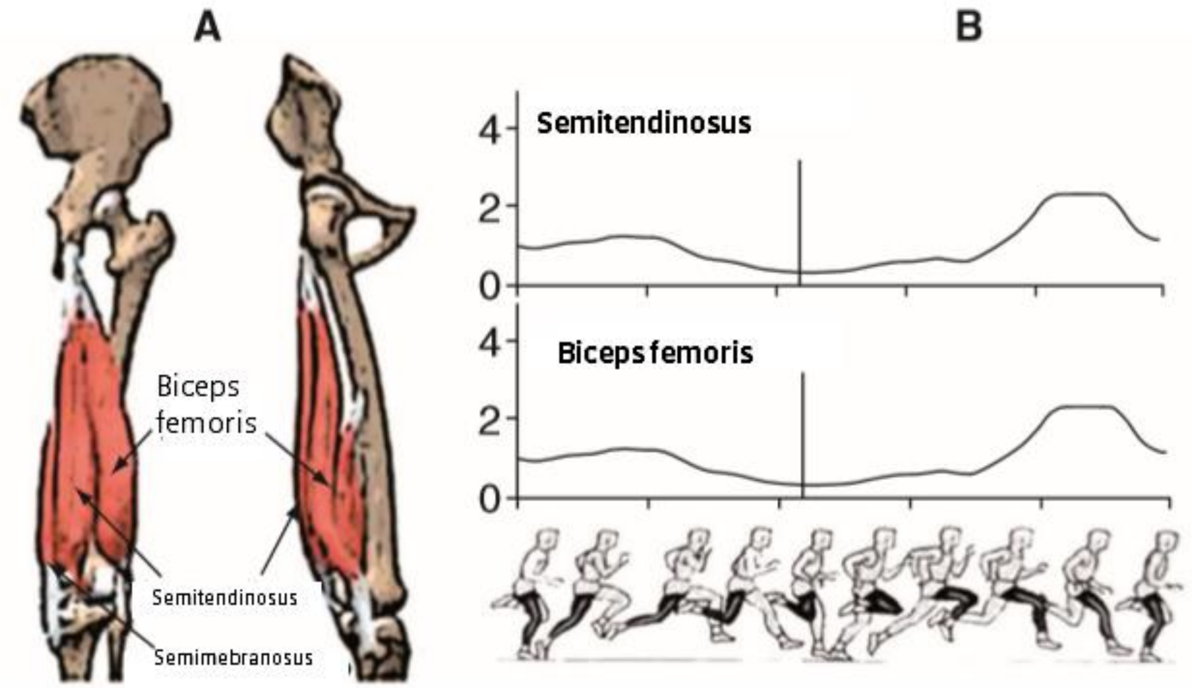
The same author describes that the biomechanical properties related to its architecture and function is the *first question* we need to answer in order to better understand the hypothesis about the analysis of the mechanism of this injury, taking into account, on the one hand, its influence as a risk factor, an on the other, acute and chronic adaptations of preventive interventions (Sampietro, 2018).

Anatomically, hamstrings are biarticular and are located in the posterior thigh muscles. In fact, biceps femoris, semitendinosus and semimembranosus are located there. For his part, Sampietro (2018) adds that this muscle group occurs through two joint cores: the hip and the knee, and they have opposite functions in each core. According to its function, it could be associated with extension of the hip and flexion of the knee when our body is in standing position (Perales Soariano, 2014).

Below, a brief description of each of them is developed:

- **Biceps femoris:** composed of a long head originated in the ischial tuberosity, and a short head originated in the linea aspera of the femur. It is inserted in the head of the fibula as well as in the lateral condyle of the tibia. The short head does not stretch to the coxofemoral joint, and as it originates in the medial side, its only function is the flexion of the knee. The long head, as it stretches more, contributes to the flexion of the knee as well as the extension of the hip.
- **Semitendinosus**: it originates in the ischial tuberosity of the coxal bone, as biceps femoris and semimebranosus do. It follows the posterior part of the thigh and goes behind the knee as semimembranosus does, and inserts in the deep goosefoot of the tibia, named in this way since the tendons insertion in that area resembles the leg of a bird.
- **Semimembranosus:** it originates in the ischial tuberosity of the coxal bone and follows the posterior area of the thigh, goes behind the knee and inserts in the tibia. It performs the same function the long head and the semitendinosus do, extension of the hip and flexion of the knee. (Gil Méndez, 2015, p. 44)

Figure 5: Hamstrings, Sprint Phases and Muscle Tension



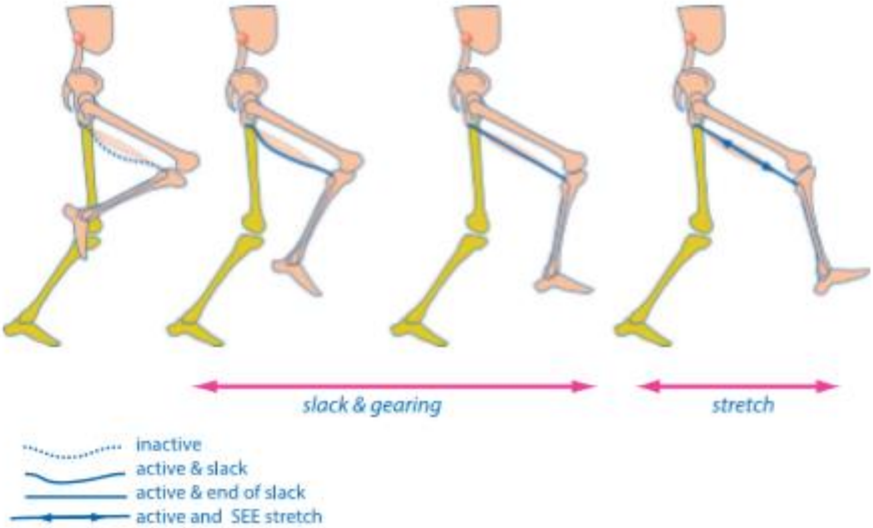
Source: De Hoyo et al., 2012, p. 31.

In Figure 5, as the authors detailed, we can observe:

A. Hamstrings group, which include the semimembranosus, semitendinosus and biceps femoris. The long part of the latter muscle is the one that normally suffers injuries during speed activities.
B. During the swing phase, the hamstrings are activated and stretched simultaneously; they uptake the energy of the lower limb and create ideal conditions for injury. (De Hoyo et al., 2012, p. 31)

On the other hand, Van Hooren and Bosch (2016) point out that when running at high speed, the action of the pendulum of the lower part of the leg could act as countermovement to reduce the relation or *muscle slack*. First, relaxation disappears from the series elastic elements (SEE) and the contractile elements (CE) during the passive elongation phase. When the CE is activated, the forward swing action of the inferior part of the leg continues reducing the named "Muscle Slack", and then stretches the SEE while the CE remains isometric. Finally, the SEE recoil makes that the swinging leg strongly contracts before contact with the surface.

Figure 6: Motor Action of Sprinting



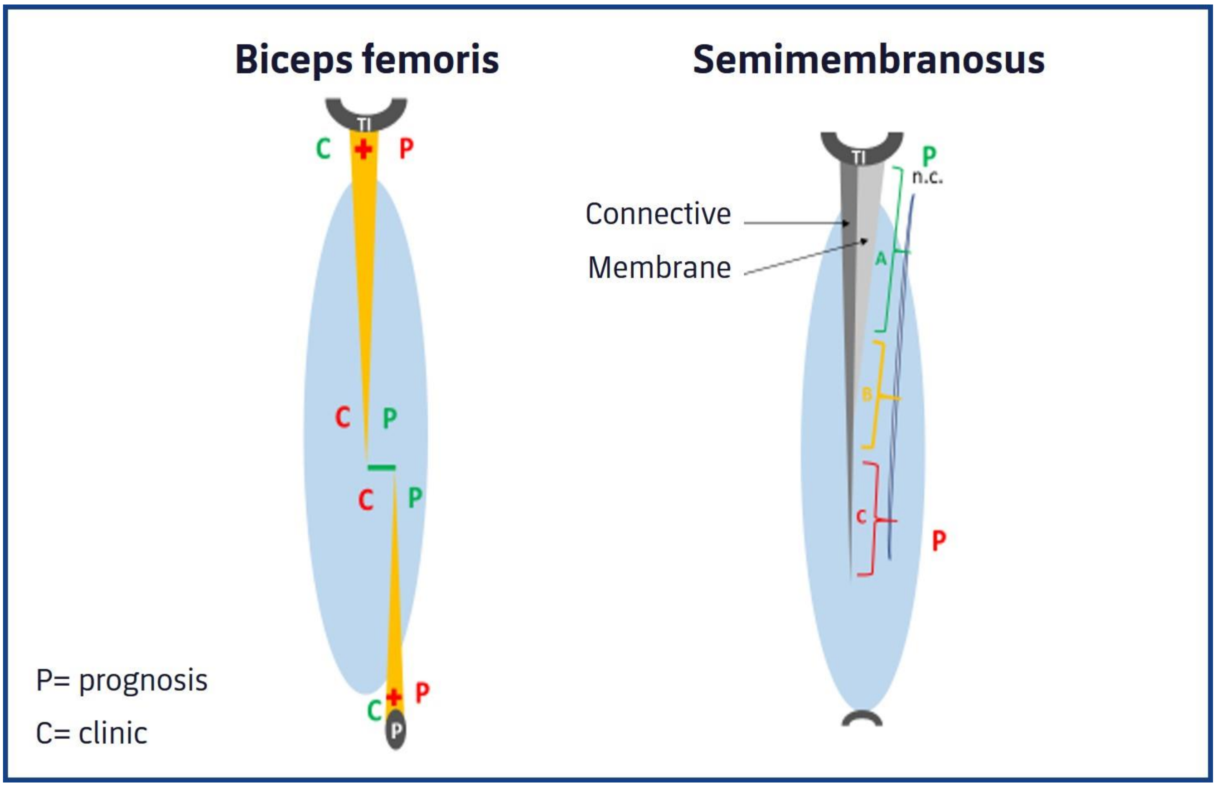
Source: Van Hooren and Bosch, 2016, p. 18.

Figure 6, shows how in the muscle slack phase the action of the CE, SEE and the total pendulum MTU (muscle-tendon unit) disappears as a result of the lower part of the leg, and after that the SEE stretches while the CE remains close to the isometric.

Frequently, the long part of the biceps femoris is the one that receives the greater injury damage. Here the regions that present more prevalence are the proximals, this means, they are the most affected. They show substantial clinical properties, like recovery time and relapse (Yanguas, Pruna, Puigdellivol and Mechó, 2017).

Since hamstrings injuries have a multifactorial nature, talking about the causes of the injuries in the biceps femoris is complex. In this respect, when talking about biceps femoris, it is possible to delimit two regions, this is, two tendons: proximal tendon and distal tendon. Here we can observe that the more connective tissue involved, the worse prognosis that injury will have (Figure 7). Next, the Figure shows in green the region with the best prognosis, and in red the one with the worst prognosis.

Figure 7: Biceps Femoris and Semimembranosus



Source: Prepared by authors.

It is considered that the same injury in the dominant leg of a football player will have an absolutely different prognosis from the one for the support leg. This complex injury indicates that the longer it is, the bigger region it takes and the closer to the ischial tuberosity, the worse the prognosis will be (medical services of FC Barcelona, 2009).

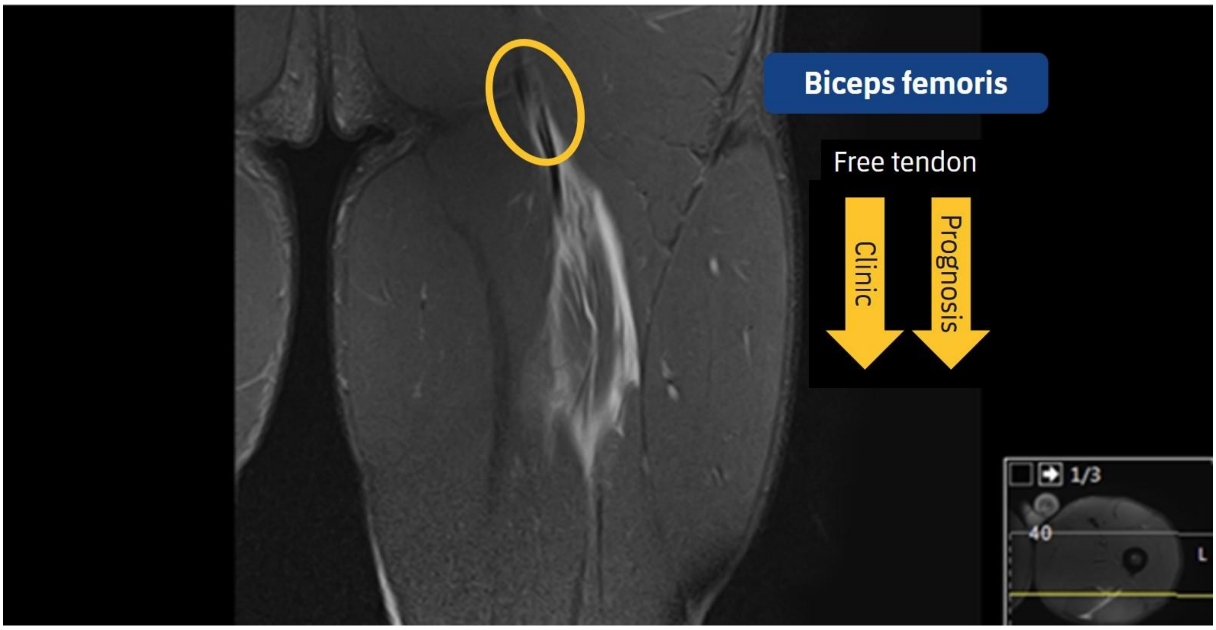
In the case of the semimembranosus (Figure 7), something peculiar happens, since the injury is the most proximal part, there will be more membrane and less connective tissue. Therefore, it will have a better prognosis. On the contrary, in the distal part we will have less membrane and more connective tissue, and hence the prognosis will be worse.

It is essential, when readpating a player with an injury in the semimembranosus, to take into account the proximity to the sciatic nerve (SN), which is on the side of this muscle. If there was a fibrosis that reached the nerve, muscle activation would inevitably cause pain (Figure 7).

In this respect, it is a muscle that gets basically injured in stretching. This means, when the player makes a motor action, such as lifting the leg to control the ball in the air, and making an excessively forced stretching, the tissue breaks. The paradox of this sequence is that the readaptation process will involve a great number of active stretching since the main objective is to avoid fibrosis. In this respect, the contact we mentioned before between the sciatic nerve and this scar does not occur, as it causes high levels of pain.

The urgency of the diagnosis is important as well, since in the case of a tear of the free tendon of the biceps femoris (Figure 8) is often a surgical injury. Here, at the beginning, the most important thing is to preserve the anatomy of the muscle, which will depend on how urgent the surgery is performed. This will avoid tendon retraction. In the case of these injuries, players have had surgeries even 48 hours after having suffered them. Besides, we need to remember that the symptoms of this kind of injuries are usually low. It will be essential to be attentive and perform an MRI to rule out a complete or partial tear of the tendon.

Figure 8: Free Tendon

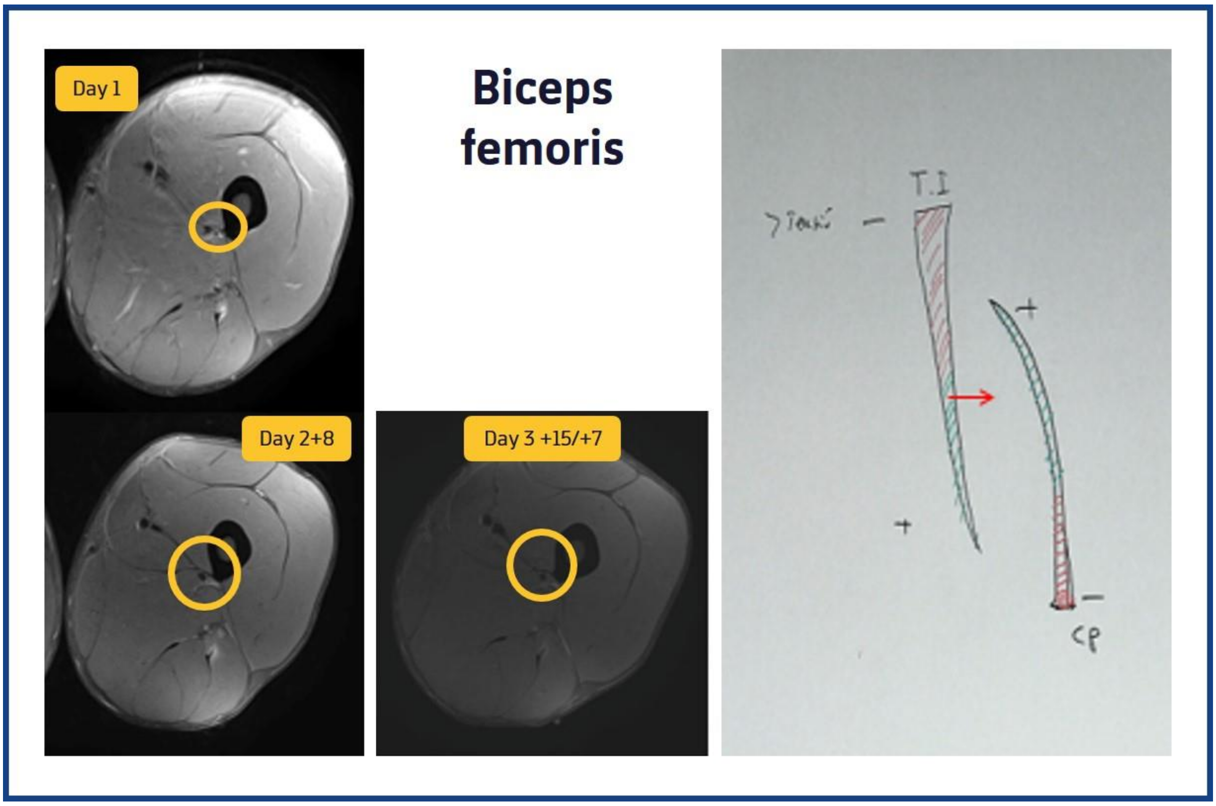


Source: Prepared by authors.

The free tendon of the biceps femoris can vary in its length depending on the athlete, so it will not be the same to manage an injury for a 5cm tendon than for a 2cm one.

For example, a player whose MRI of tendon of the biceps showed that the GAP (space you can see in the Figure as a result of the injury) was almost closed fifteen days after the injury. From day five, the player was sprinting and doing strength work, always taking into account the athlete's tolerance, while the injury was cicatrizing (Figure 9). Therefore, it is important to be quick as regards the beginning of the readaptation process when trying to adapt that scar to the muscle functionality. In this respect, readaptation and functionality are achieved simultaneously, especially when we know that the cicatrized tissue will not have the same characteristics it had before.

Figure 9: Biceps Femoris Injury Cross-section



Source: Prepared by authors.

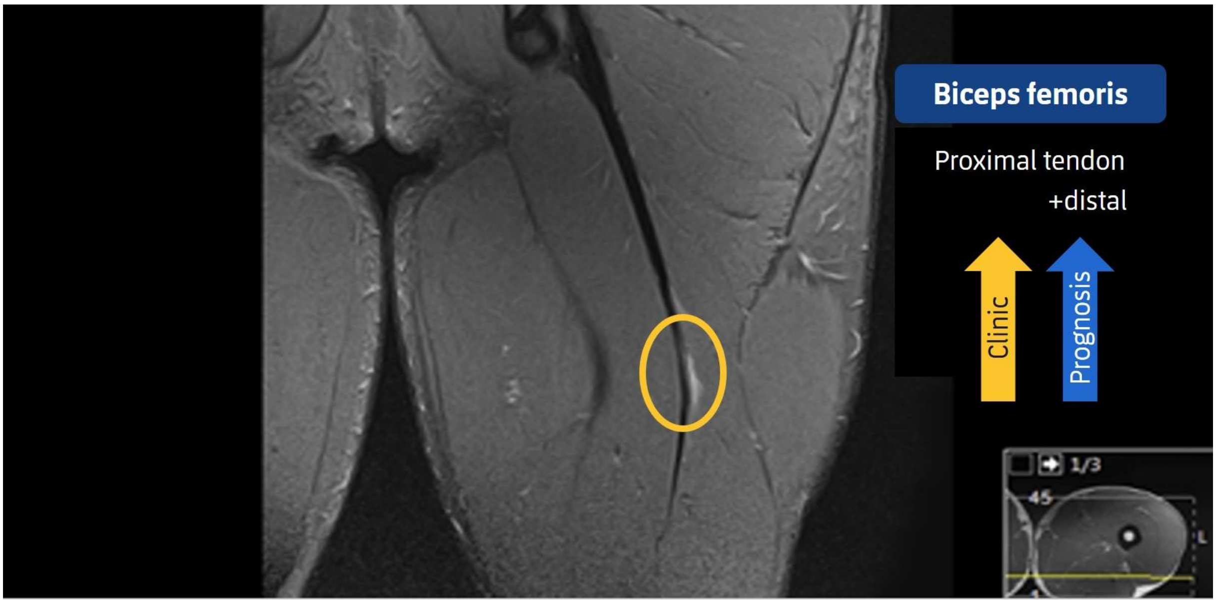
In this same respect, even when the image of the MRI does not show meaningful improvements, if the pain is not felt, we need to continue with the functionality work.

Next, some images of MRIs of different players of the first team are shown. Here we can see the importance of a correct diagnosis to have an ideal management of the injured.

Figure 10: Biceps Femoris - Proximal Tendon (+ proximal)

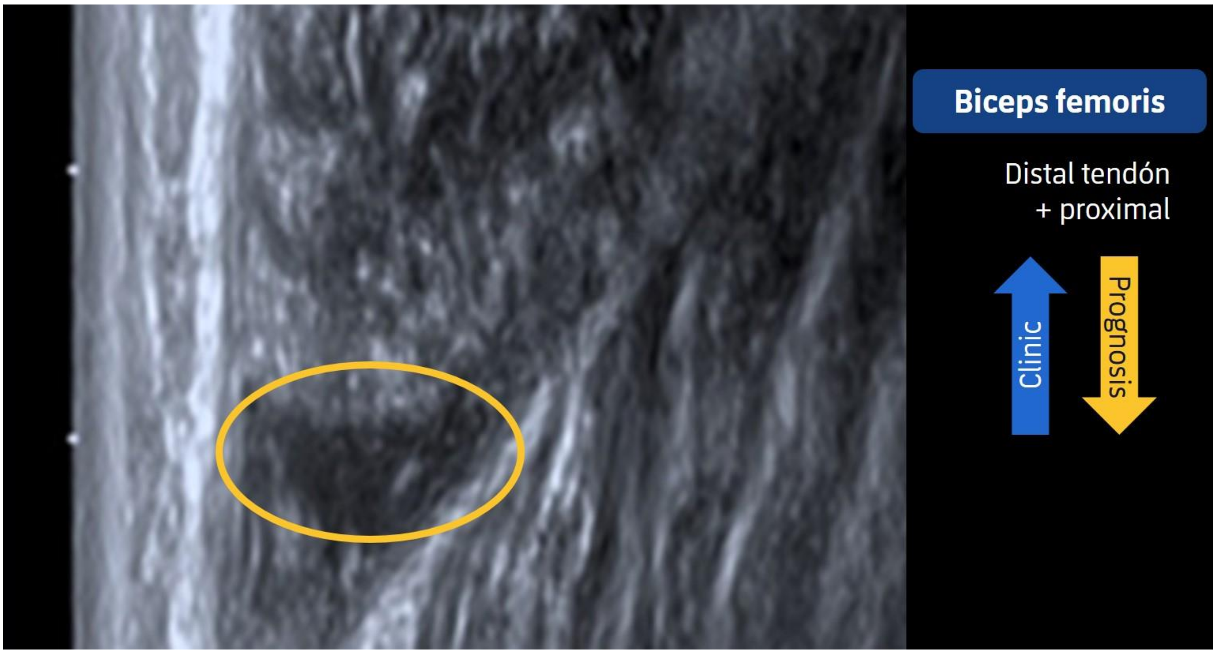
Source: Prepared by authors.

Figure 11: Biceps Femoris - Proximal Tendon (+ distal)



Source: Prepared by authors.

Figure 12: Biceps Femoris - Distal Tendon (+ proximal)



Source: Prepared by authors.

Rectus femoris

Quadriceps muscle strains are a regular kind of injury in football. Ekstrand, Hägglund and Waldén (2011) observed that quadriceps muscle strains rank second among elite football players, right after hamstrings injuries. Still, this kind of injuries cause more withdrawals than hamstrings and groin muscle injuries. This shows relatively high rates of recurrence (17%). According to Olmo, Aramberri, Almaraz, Nayler and Requena (2018), quadriceps muscle strains frequently involve the called "rectus femoris" (RF).

Table 2: Number of Injuries and Days of Withdrawal of Sport

Localization	Total			Per team		Injury average
	n	% of total	Withdrawal days	n	Withdrawal days	
Biceps femoris	88	26,5%	1.852	3,3	68,3	21,0
Quadriceps rectus femoris	81	24,4%	2.068	3,0	76,6	25,5
Adductor longus	58	17,5%	836	2,1	31,0	14,4
Gastrocnemius	25	7,5%	552	0,9	20,4	22,1
Soleum	19	5,7%	488	0,7	18,1	25,7
Semitendinosus	19	5,7%	308	0,7	11,4	16,2
Semimembranosus	5	1,5%	235	0,2	8,7	47,0
Adductor magnu	5	1,5%	118	0,2	4,4	23,6
Quadriceps vastus medialis	5	1,5%	119	0,2	4,4	23,8
Quadriceps vastus lateralis	4	1,2%	122	0,1	4,5	30,5
Glute	3	0,9%	39	0,1	1,4	13,0
External oblique	3	0,9%	30	0,1	1,1	10,0
Sartoriou	3	0,9%	18	0,1	0,7	6,0
Obturator	3	0,9%	13	0,1	0,5	4,3
Rectus abdominis muscle	2	0,6%	32	0,1	1,2	16,0
Tensor fascia lata	2	0,6%	11	0,1	0,4	5,5
Psoas	2	0,6%	7	0,1	0,3	3,5
Flexor hallucis longus	1	0,3%	22	0,0	0,8	22,0
Internal oblique	1	0,3%	11	0,0	0,4	11,0
Gracilis	1	0,3%	10	0,0	0,4	10,0
Fibula	1	0,3%	5	0,0	0,2	5,0
Biceps brachii	1	0,3%	3	0,0	0,1	3,0
Total	**332**	**100%**	**6.899**	**12,1**	**255,6**	**16,3**

Average of withdrawal days due to muscle tear for each group in this typology.

Source: prepared by authors based on Noya and Sillero, 2012, p. 119.

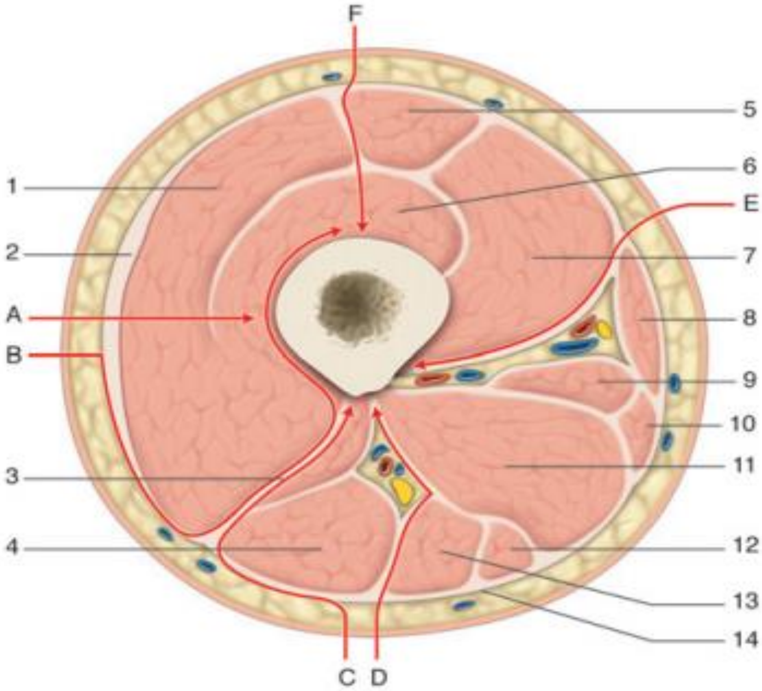
Anatomy plays a key role in the prognosis of quadriceps muscle. This is, the rectus femoris is a long, fusiform and biarticular muscle located in the anterior part of the quadriceps. This kind of muscle is designed to make movements that require a significant change in length or a high shortening speed (Mendiguchia, Alentorn-Geli, Idoate and Myer, 2012).

According to these authors, this biarticulated muscle is innervated by the femoral nerve and it has two heads of origin: the direct head that originates in the anterior inferior iliac spine, and the indirect or reflected head that originates in the superlateral crest of the acetabulum. Both heads join just inferior the iliac spine, forming the conjoint tendon. The direct head mainly contributes to the surface component of the conjoint tendon and blends with the fascia of the muscle. At the same time, the indirect head contributes to the fiber of the deep intramuscular component of the conjoint tendon and forms a deep myotendinous junction that extends down approximately two thirds form the muscle belly of the rectus (Mendiguchia et al., 2012).

As regards its function, it is associated with the movements of the extension of the knee and the flexion of the hip, and stabilizes the pelvis on the femur with overweight (Bordado-Rodríguez and Rosemberg, 2005). Besides, these authors highlight that rectus femoris has a great demand of eccentric muscle contraction and has a high percentage of type II fibers.

As it is a fusiform muscle, whose action generates high levels of tension, its function is correlated with the correct activity of its components and in synergy with its counterpart, the hamstrings.

Figure 13: Thigh Cross-section



Source: Roussignol and Lepepe, 2014, p. 2.

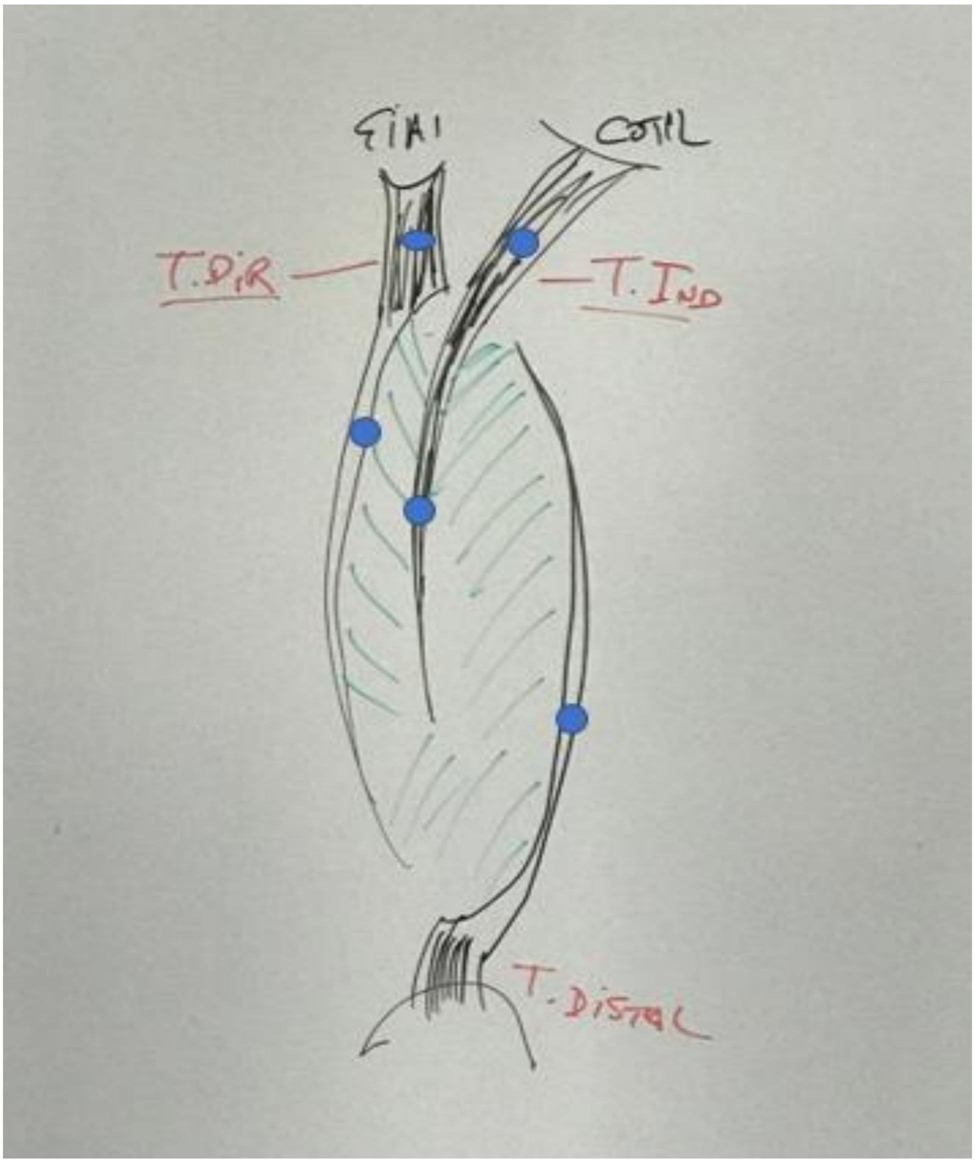
The prevoius figure shows the section at the level of the inferior and medial thirds of the thigh: approaches to the femur. A. direct lateral approach (helps to reduce fractures, access for the guide for the nail); B. posterolateral approach; C. posterior approach (Evrard); D. posterior approach (Bosworth); E. medial approach; F. anterior approach; 1. vastus laterlis muscle; 2. iliotibial tract; 3. lateral intramuscular septum; 4. vastus intermedious muscle; 5. rectus femoris muscle; 6. crural muscle; 7. vatus medialis muscle; 8. sartorious muscle; 9. medial adductor muscles; 10. gracilis; 11. adductor magnus; 12. Semitendinosus muscle; 13. semimembranosus muscle; and 14.superior aponeurosis of the thigh.

It is known, for its size and anatomy, that the anterior rectus muscle can suffer different kinds of injuries, from disinsertion and epiphysitis to central tendon injury, proximal peripheral injury, distal perripheral and superficial injuries (Balius y Pedret, 2013).

This means that in some situations when it is reported that the player presents an injury of 1cm in the anterior rectus, this information will not be useful to determine the recovery process. For example, there are injuries in this muscle that could take 6 weeks of recovery and others that could take 2 weeks. Here a complete and accurate diagnosis becomes crucial because from it a realistic prognosis can be obtained.

Following with its anatomy, and according to what has been described, in this muscle we have proximal insertions in the anterior inferior iliac spine (AIIS), and in the cotyloid cavity (CC). Here we have a direct and an indirect tendon, respectively. Different from the direct tendon, the indirect one becomes intramuscular. Therefore, if the injury is in the tendon region, a worse prognosis will be detected due to the amount of connective tissue involved in the injury. On its part, the clinical injury will be better due to the small amount of spilt blood, which could be even more confusing. However, if the injury is in the intramuscular septum region, away from the connective tissue, the prognosis will be much more encouraging, even if the size of the injury was bigger than the one in the tendon region, since there will be more muscle tissue and less connective tissue involved. This indicates a better prognosis and a greater clinic. For this reason, it is considered appropriate to thoroughly analyze this information when making a diagnosis to avoid making mistakes at the beginning of the readaptation of the athlete.

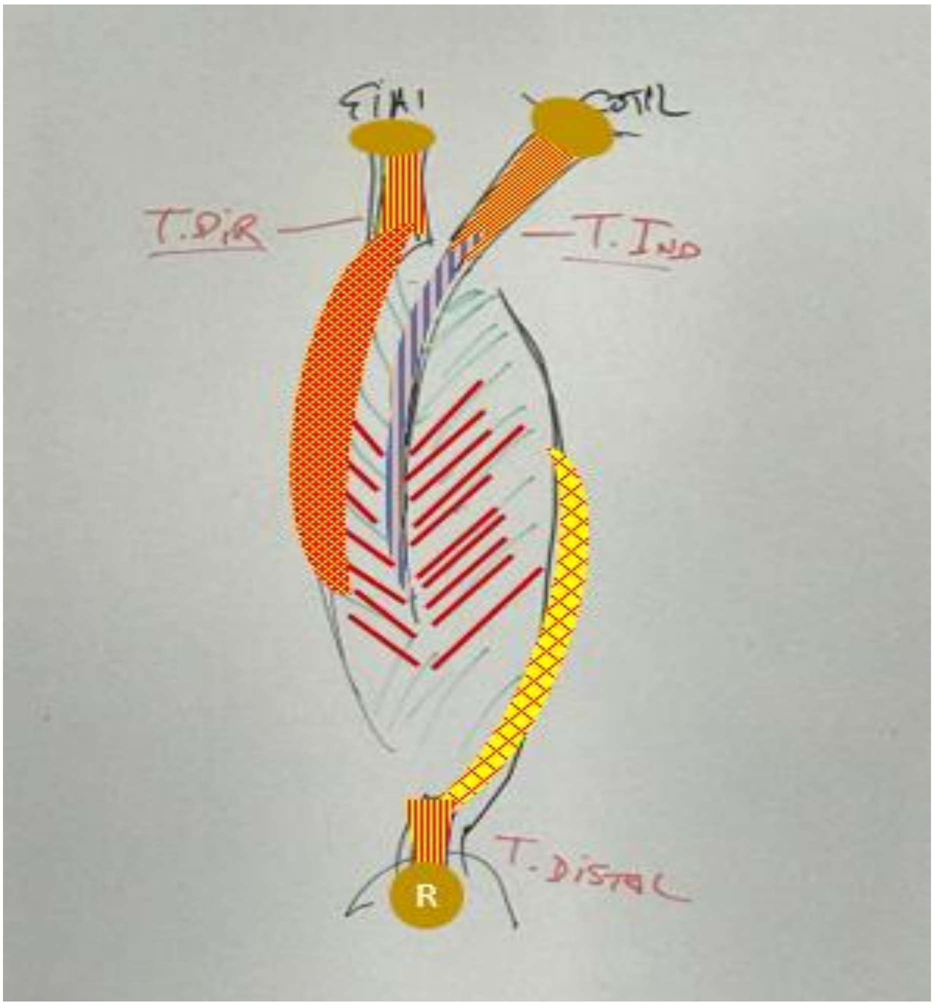
Figure 14: Places Where Injuries Occur



Source: Prepared by authors.

As regards Figure 14, five dots in blue can be observed. They refer to places where injuries can happen or occur. This shows five spaces that will have a different clinic and prognosis, so their recovery times will be different as well. At the same time, in the left upper part the anterior inferior iliac spine (AIIS) is highlighted, and in the right upper part the cotyloid cavity (CC) stands out. Then we have the direct tendon (left), the indirect tendon (right), an on the lower part, the distal tendon (Distal T.)

Figure 15: Fascias and Anterior Rectus Tendons



Source: Prepared by authors.

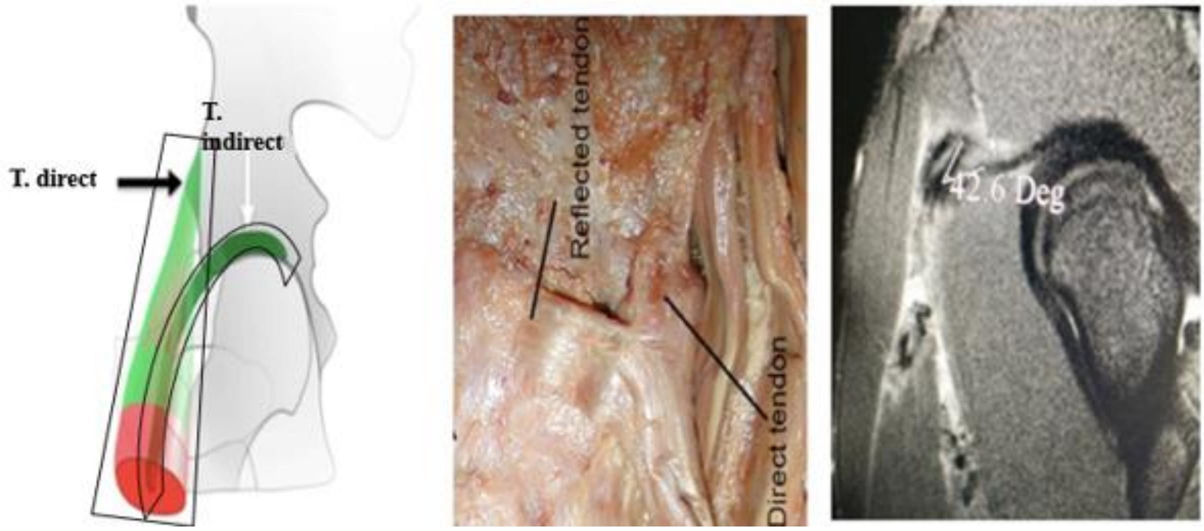
In Figure 15, in the upper part there is a detail of the anterior inferior iliac spine (AIIS), the cotyloid cavity (CC), the direct tendon (Dir T.) where you can see in orange the anterior fascia and the indirect tendon (Ind T.), intramuscular (intramuscular septum of the anterior rectus); and in the lower part the distal tendon (Distal T.), forming the posterior fascia can be observed.

In this respect, the injuries in both fascias are not related. This means, an injury of 1cm in the anterior fascia will have a much more serious prognosis than a tear of 1cm in the posterior fascia.

Why? The anterior fascia, due to its location, is completely attached to the body as a cover. On the other hand, the posterior fascia is rougher and more flexible. This description tells us that in the anterior fascia there will be loads of tension, and on the contrary, in the posterior fascia there will be little tension. Therefore, so through injuries, we can even detect that with a posterior fascia injury the player does not need to withdraw. Also, the player can feel some kind of discomfort. Now, this discomfort will disappear and can be recovered by playing. However, we always have to have in mind the communication with the athlete. This is, giving and providing the optimal tools for him to express his own sensations during the work developed. Sometimes, these sensations will translate into some point, a discomfort, among others. The communicational learning on part of the player is also built and it stimulates his development.

For its part, in the anterior fascia the situation is completely different so it should be analyzed and then move forward with a traditional approach, always respecting the tissue repair process. It is known, that in some cases, anterior fascia injury usually confuses with other injuries as a consequence of a bad initial diagnosis. This leads to a wrong interpretation, so the approach starts with a mistaken "label". As a result, the recovery process will be open to scenarios where the injury and the injured will be exposed to a relapse. This happens, for example, when an injury is detected and confused with one coming from the vastus lateralis. From there, the trigger will be the beginning of a treatment aiming at a wrong prognosticated injury, which process and planning for work will be different. Negative results will be obtained in the short term causing relapses in the football player.

Figure 16: Direct and Indirect Tendon

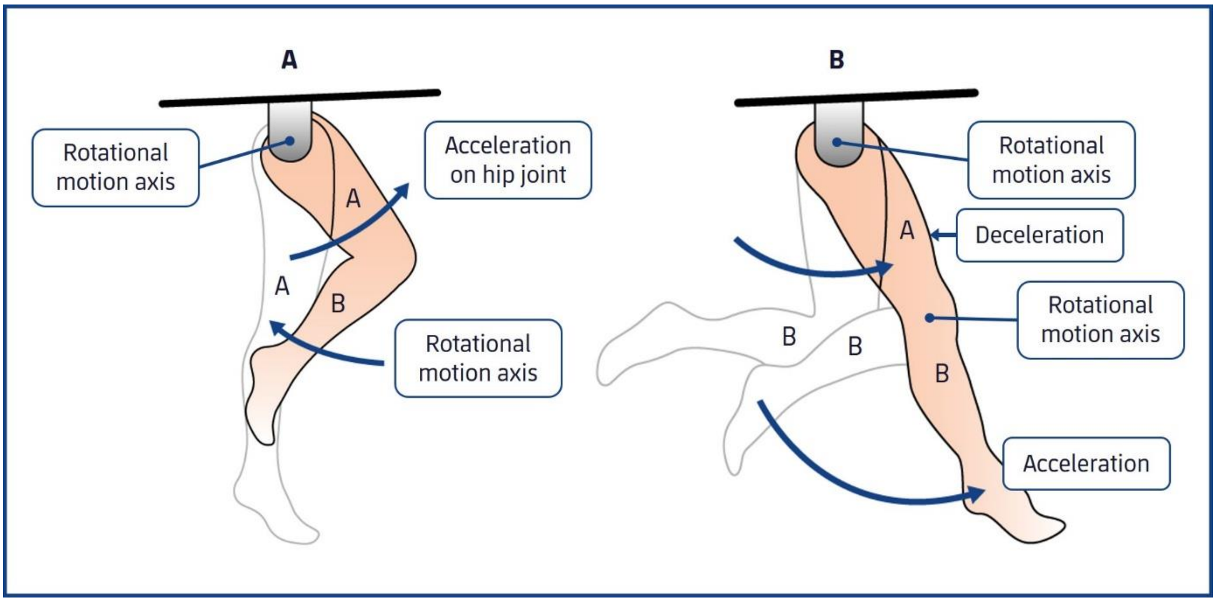


Source: Prepared by authors.

Besides, in the indirect tendon the injuries an athlete suffers are related to the hit or *kick*, this is, they are produced in the intramuscular septum. As Crespo and Fernandez (2015), point out the injury mechanism that prevails in football is the kick to the ball, where there is an action in which movement is an important eccentric contraction of the rectus femoris, trying to keep the flexion of the hip when the foot hits the ball. This creates a great decrease of the speed of the limb that hits, and so a forced extension of the flexor muscles of the hip. In this respect, the closer the injury, the more serious and worse prognosis, better clinic, but worse prognosis there will be. On the other hand, when the injury is towards the extremes, where there is a lot of muscle tissue, the prognosis will be better, but the clinical will be serious. In this respect, there might be a tear of the direct tendon, which could be for surgery in some cases, in contrast to what happens in the indirect tendon.

Knowing that the architecture of the anterior rectus of the quadriceps is highly complex, in general, the mechanism associated with this injury are related to acceleration actions, for example, the beginning of the recovery as well as the components of deceleration, like a more extended trunk position. As it was mentioned before, the attempt is also part of these mechanisms. Here the called "posterior *swing*" is produced when the heel goes towards the glute, in the moment of the extension of the hip and the flexion of the knee. It is an eccentric deceleration action or "**quasi isometric**", in words of Van Hooren and Bosch (2016). This is, the moment of the attempt, with the anterior crossed chain in tension, contralateral arm in extension, is the higher electromyographic activation of the rectus femoris.

Figure 17: Acceleration and Deceleration of Segments



Source: Izquierdo, 2019, p. 15.

In Figure 17, as Izquierdo (2008) points out, the attempt starts with the forward movement of the proximal segments, creating a delay in the distal segments. Here it is possible to observe, in the first stage (A), how an acceleration of the thigh and a delay of the leg are started as a product of the flexion of the knee. On the other hand, in the second stage (B), the most relevant one, the acceleration of the leg is produced, and as a consequence, the deceleration of the thigh is also produced.

Figure 18: FCB Player Kicking the Ball in a Training Session

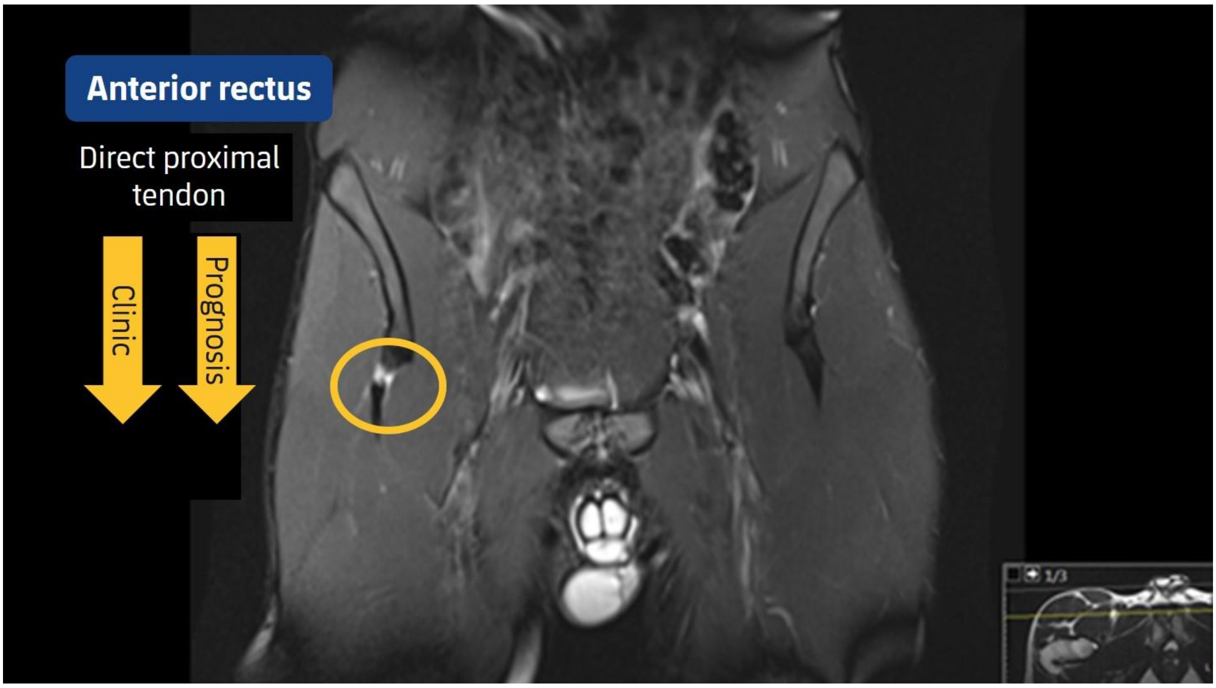
Source: Ruíz, 2019. Unpublished internal file.

Now then, following with the aspects related to the anterior rectus, some injuries in the direct tendon will have marked clinic and bad prognosis; these will probably be surgical injuries. This is due to the complete tear (Figure 19) together with an injury in the kicking leg of the player, the "skilled leg", so, depending on the result, it will be advisable to have a surgical intervention.

> As regards the dominant leg, the rates of injuries in adductor and quadriceps are higher in the kicking leg, which probably exposes the player to higher risk actions (shots, passes, overlaps, blocks, etc). On the contrary, the dominant leg is not related to a risk factor as regards hamstrings and calves injuries. This is probably due to other injury mechanisms involved (Pruna, Einar, Clarsen and McCall, 2018, p. 15).

On the contrary, having a traditional treatment could create problems in the sensations of the player and in the short/long term become a surgical case. These indicators, which on the surface could be treated as "supposed", are key contributions that arise from the immediate needs when taking decisions. They are always based on scientific contributions and on the environments and needs and sensations of the injured player.

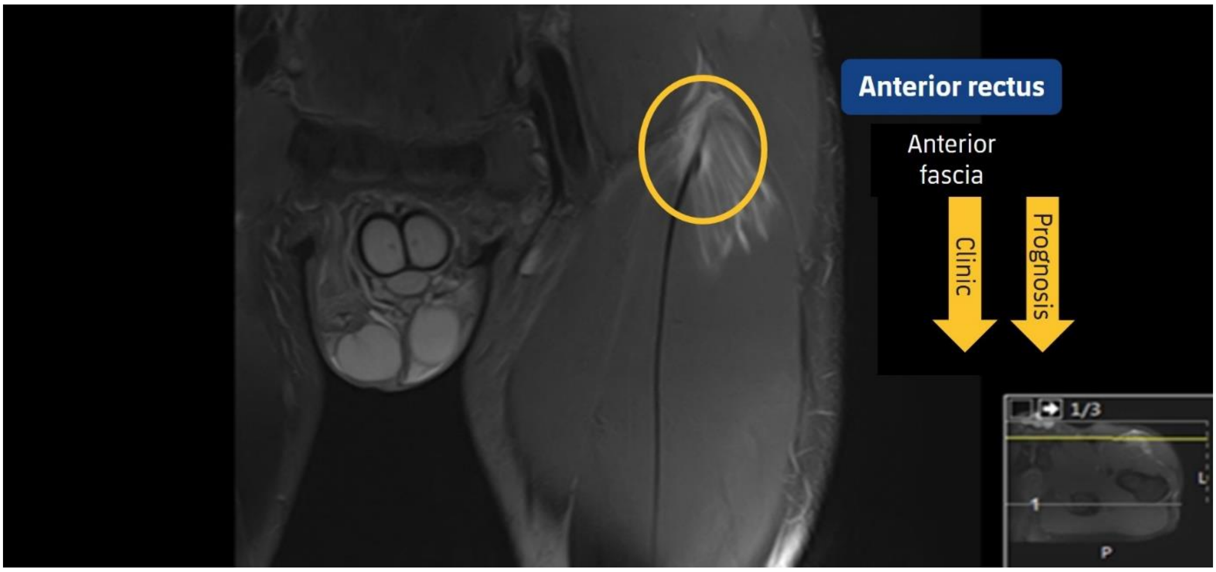
Figure 19: Anterior Rectus



Source: Prepared by authors.

In the anterior rectus, specifically the anterior fascia, (Figure 20) can sometimes, due to its location, show symptoms and create a mistake in the approach, since the injury could be associated with a lateral one in the vastus lateralis or the tensor fascia lata when it really is an injury of the anterior fascia of the rectus. This injury has a great clinic and a complex prognosis, so it is of paramount importance to avoid underestimating it. This injury, due to what we have said before, runs the risk of not being properly rehabilitated and of creating relapses.

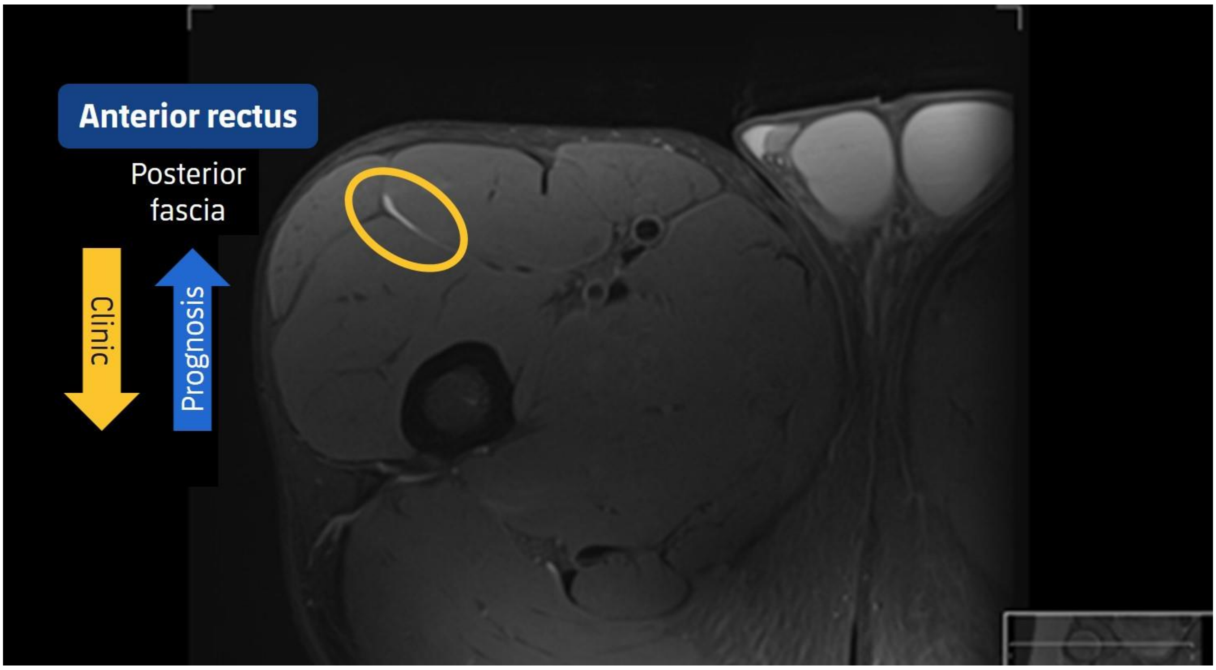
Figure 20: Anterior Fascia



Source: Prepared by authors.

As it was mentioned before, it is important to highlight and to have in mind that the anterior fascia of the rectus of the quadricep is like a neoprene cover compared to the posterior fascia, and it is completely attached to the muscle. In contrast, the posterior fascia is a rougher tissue (Figure 21). Therefore, an injury in the posterior fascia will allow a functionality that is impossible to get if the injury is the anterior fascia, due to the attachment mentioned earlier.

Figure 21: Anterior and Posterior Fascias



Source: Prepared by authors.

A player with an injury in the posterior fascia can play with no problem, if and when his tolerance and pain threshold allow him to bear the symptoms, which will not increase or worsen them. It is an injury that is recovered by playing, competing. Here the management on the part of the rehabilitation specialist is of vital importance, taking into account that what will make the player continue with his activity is his ability to bear the load and pain, and the understanding that this will not worsen the injury per se. In case the player cannot tolerate pain or load, the pertinent treatment should take place.

The previous example clearly shows the importance of an accurate diagnosis when assessing an injury.

It is known that there will be players who will logically have a really low pain threshold. To these kinds of players, any kind of discomfort will create doubts and inhibitions to compete, and they will prefer to avoid participating in the game and start the treatment. On the other hand, there are players who have a higher threshold and who with a posterior fascia play perfectly without showing any discomfort symptoms.

This is why when doing an imaging diagnosis through an MRI, it will be essential to pay attention to the location and size of the tear, and not to the image of the bleeding.

Adductors

Adductor muscles in the hip are associated with a group of muscles in the lower limb which function is to create the adduction of the hip.

According to Balius (2004), these muscles are organized in three layers:

- **superficial layer:** made up by the pectineus, adductor longus and gracilis;
- **medial layer:** made up by the adductor brevis; and
- **deep layer:** made up by the adductor magnus.

In this respect, it is described that -except for the "gracilis"- all the muscles are "monoarticular", since they cross one joint (the one in the hip) and their movements involve only such joint. On its part, the gracilis crosses the joints in the hip and knee.

It mainly acts as an approximator, this is why its biomechanical function is to take the leg towards the medial line of the body. These muscles have the ability to be influenced by conditional aspects such as changes in direction and speed. For this reason and for the fact that in a sport like football the changes in pace in unexpected situations prevail, their motor skills are linked to a frequent inflammation of the region.

In terms of innervation, the obturator nerve has the main role. Besides, the adductor longus is also innervated by the femoral nerve, and the adductor magnus (is innervated) by the sciatic nerve.

A study carried out by Noya Salces (2015), where the injury incidence in a professional football season of the Spanish league was analyzed, points out that as regards the injuries located in the hip and adductor regions, 59 % of the cases do not specify the exact location (187 out of 317). For this reason, in the remaining 41% it was found that the most frequent injury was in the adductor longus (28.7% of all the injuries in this region). This results highly superior to other regions involved such as the adductor magnus or the glute (4.1% and 3.8% respectively).

In the following figure you can see the recording frequency of the injuries in the hip-adductor region.

Table 3: Injuries in the Hip/Adductor Region

Hip / adductor	N	%
Adductor longus	91	28,7
Adductor magnus	13	4,1
Glute	12	3,8
Psoas	7	2,2
Obturator	3	0,9
Pectineu	3	0,9
Femur cyst trochanter	4	0,3
Without specifications	187	59,0
Total (injuries):	**317**	**100**

Source: adapted by authors from Noya Salces, 2015, p. 140.

On the other hand, Noya Salces (2015) highlights that after pair comparisons using the chi-squared test, significant differences of tendon injuries of the adductor magnus over the adductor longus were found.

Table 4: Tendinopathy in the Longus and Magnus Adductor

	Adductor longus	Adductor magnus	Glute	Psoas
	(A)	(B)	(C)	(D)
Muscle tear	64,9	46,2	25,0	28,6
Muscle contracture	15,4	15,4	25,0	0,0
Muscle overload	16,5	0,0	41,7	57,1[a]
Tendinipathy	3,3	30,8[A]	0,0	14,3
Total (injuries)	**91**	**12**	**11**	**7**

Source: adapted by authors from Noya Salces, 2015, p. 141

Serner, Weir, Tol, Thorborg, Roemer, Guermazi, Yamashiro and Hölmich (2017) developed another study using magnetic resonance (MR) to detect acute injuries in the adductor. The study, performed in male athletes, took place for 7 days and used a standardize protocol. Through a magnetic resonance, the acute adductor muscle injury in the athletes was confirmed. In this respect, it is important to highlight what the authors express about the study under consideration. Out of 156 athletes with acute pain in the groin, 71 athletes were of middle age, 27 years old (range 18-37). Besides, there were 46 isolated muscle injuries, and 25 athletes with multiple injuries in adductors. This indicates that a total of 111 acute adductor muscle injuries were registered: 62 were in the adductor longus, 18 in the adductor brevis, 17 in the pectineous, 9 in the external obturator, 4 in the *gracilis* and 1 in the adductor magnus. It is important to highlight that the injuries in the adductor longus took place in three different places: the proximal insertion (26%), musculotendinous junction (MTJ) of the proximal tendon (26%), and the MTJ of the distal tendon (37%). Lastly, the intramuscular tendon injury was observed in only one case and in the proximal insertion. 12 out of 16 injuries were total avulsions. Due to this evidence, we can say that the study shows that acute adductor injuries generally occur isolated from other muscle groups.

Table 5: Muscle Injury Distribution

Total muscle injuries (n=71)	
Adductor longus	62 (87%)
Adductor brevis	18 (25%)
Pectineus	17 (24%)
Obturator externus	9 (13%)
Gracilis	4 (6%)
Vastus medialis	4 (6%)
Rectus abdominis	3 (4%)
Sartorius	2 (3%)
Adductor magnus	1 (1%)
Obturator internus	1 (1%)
Total	***121***

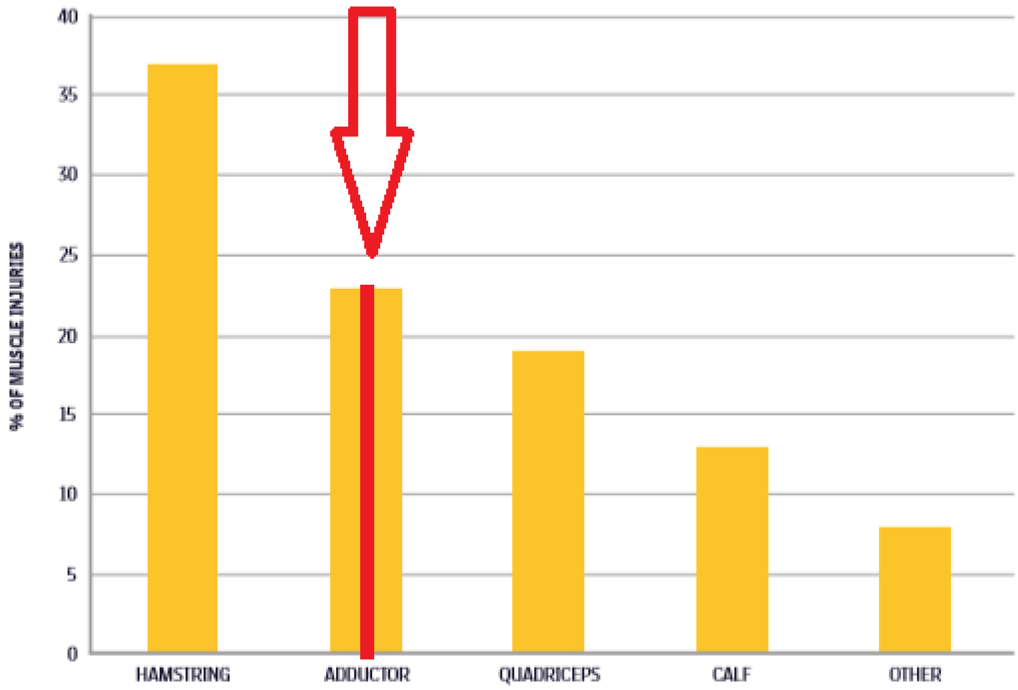
Source: Serner et al., 2017, p. 19.

Another relevant aspect as regards the magnetic resonance is its validity in the assessment of the adductor longus (AL), since it has the ability not only to detect, but also to the classify acute injuries and determine the prognosis for the football player. In this respect, the British Athletics Muscle Injury Classification (BAMIC) consensus as well as the

Munich one significantly correlate with RTP (R = 0,958 y 0,974, respectively) (Pezzotta, Pecorellia, Querquesa, Biancardia, Morzentia and Sironia, 2018).

It is known that adductor injuries rank second among male professional football players. This represents 23% of all muscle injuries (Pruna, Anderson, Clarsen and McCall, 2018).

Figure 23: Male Professional Football Players Muscle Injuries



Source: adapted by authors from Ekstrand, Hägglund and Waldén, 2011, p. 11.

The role of strength is decisive in team sports. In Tous Fajardo (2017) words it is "the genesis of motor". As regards strength, there is a study by Moreno-Pérez, Travassos, Calado, Gonzalo-Skok, Del Coso and Mendez-Villanueva, (2019), in which they investigated the maximum isometric strength in the hip adductor during preseason. The test was performed with isometric compression of the adductor. Here it was highlighted that the strength of the hip adductor compared the body mass among players who suffered an injury in the groin (n=18), and those who did not suffer such injury (n=53). The risk factor (RF) was used to assess the odds player have to suffer from this kind of injuries. The authors point out that the results revealed that the numbers of maximum strength in the isometric adductor inferior to 465.33N increased the odds of suffering an injury in the groin in a 72%. On its part, the number linked to the body mass inferior to 6.971N/k increased the odds to have an injury in the groin in a 83%. In this respect, the authors concluded that the assessment of the isometric strength in the hip adductor could be a tool which collaborates with and determines the possibility of suffering excessive use of injuries in the groin in elite football players.

Figure 23: Measurement with 45º Compression Adductor Test

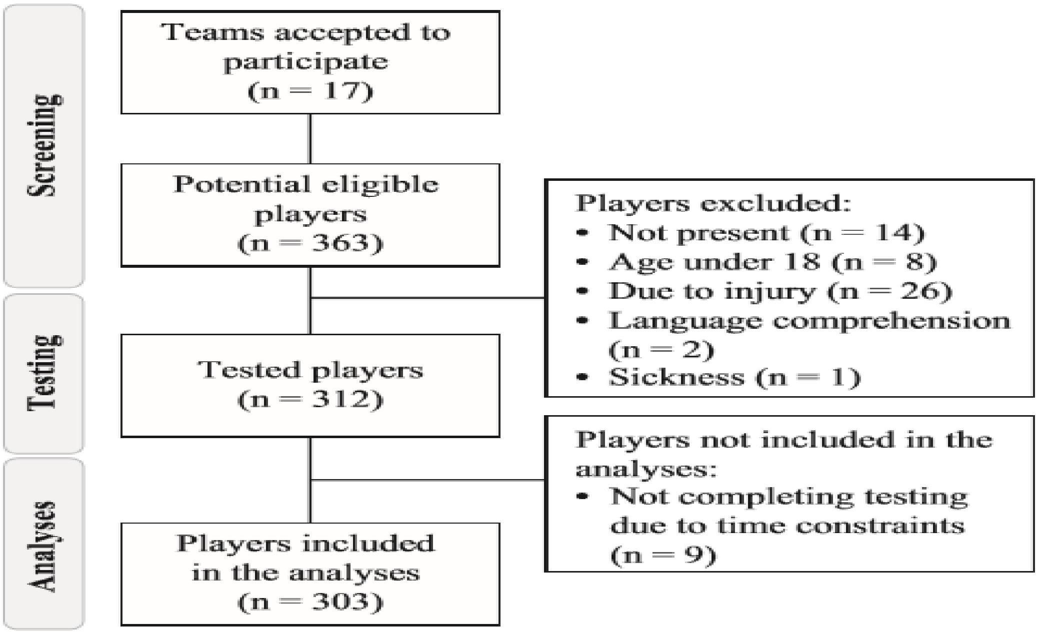
Source: Moreno-Pérez et al., 2019, p. 19.

Anoter study from Copenhague University, relates the groin pain with the strength in the adductors and the age of the athletes involved. Esteve, Skovdal Rathleff, Vicens-Bordas, Bek Clausen, Hölmich, Sala and Thorborg (2018) included 303 male football athletes in this study (mean age23 ± 4 years; mean weight 74.0 ± 7.9 kg; mean height 178.1 ± 6.3 cm). During this cross-sectional research, information about the athletes' pain in the groin and its duration in that moment and in the previous season was gathered. The strength of the adductor in the hip was obtained using two reliable different test procedures:

On the one hand, short lever squeeze test (resistance between knees, feet on the examination table and 45° of flexion of the hip); and on the other, long lever squeeze test (resistance between ankles and 0 of flexion of the hip).

The authors say that differences were not found between those with pain (n=123) and those with no pain (n=180) in the previous season in relation with the squeeze strength of the hip adductor, when comparing groin pain at that moment and age. Finally, the authors concluded that it is probable that the football players who have "carried" their groin pain from the past season, started the next season with a high risk groin injury profile and weakness in the hip adduction.

Figure 24: Study Analysis



Source: taken from Esteve et al., 2018, p. 3.

In Figure 24, the study development can be observed. 303 football athletes were included in the analysis (mean age, 23 ± 4 years; mean weight, 74.0 ± 7.9 kg; mean height, 178.1 ± 6.3 cm). Out of 363 potentially eligible athletes, 51 did not meet the inclusion criteria, so they were excluded. Besides. 9 athletes did not complete all the relevant tests, and therefore were not included in the analysis.

Table 6: Adductor Strength Values in Preseason

Hip Adductor Strength Values[a]

	n (%)	Short-Lever Squeeze Test, N·m/kg	Long-Lever Squeeze Test, N·m/kg
Past-season GP			
No	180 (59.4)	1.818 ± 0.346 (0.98-2.77)	2.816 ± 0.482 (1.67-3.87)
Yes	123 (40.6)	1.770 ± 0.400 (0.67-2.55)	2.664 ± 0.572 (1.31-4.30)
Duration of past-season GP			
≤3 wk	74 (24.4)	1.856 ± 0.351 (1.18-2.55)	2.768 ± 0.493 (1.56-3.82)
>3 to ≤6 wk	22 (7.3)	1.713 ± 0.458 (0.67-2.37)	2.783 ± 0.654 (1.38-4.30)
>6 wk	27 (8.9)	1.580 ± 0.416 (0.71-2.26)	2.280 ± 0.556 (1.31-3.31)
Current GP			
No	257 (84.8)	1.814 ± 0.359 (0.67-2.77)	2.797 ± 0.505 (1.38-4.30)
Yes	46 (15.2)	1.713 ± 0.412 (0.71-2.60)	2.515 ± 0.576 (1.31-3.70)
Overall	303 (100.0)	1.798 ± 0.369 (0.67-2.77)	2.754 ± 0.525 (1.31-4.30)

[a]Values are shown as mean ± SD (range) unless otherwise indicated. GP, groin pain.

Source: Esteve et al., 2018, p. 3.

Another interesting contribution as regards the strength in adductors, and aimed at collaborating with injury reduction processes, is the one made by Jensen, Hölmich, Bandholm, Zebis, Andersen and Thorborg (2012), who with a simple and "functional" proposal, compared to previous studies, designed a strengthening programme for hip adductors. It had an 8-week duration and included an exercise of hip adduction, this is, creating movements from a standing position and using resistance bands as external load, which allowed the adduction of the isometric and eccentric hip. Even though the selection of young players was random, regarding the training and control groups, the authors say that strength training using resistance bands induce a significant increase in hip adduction eccentric strength in football players. It is for this reason that it can have implications like a promising approach to groin injury prevention in football.

Figure 25: Hip Adduction with Resistance Band

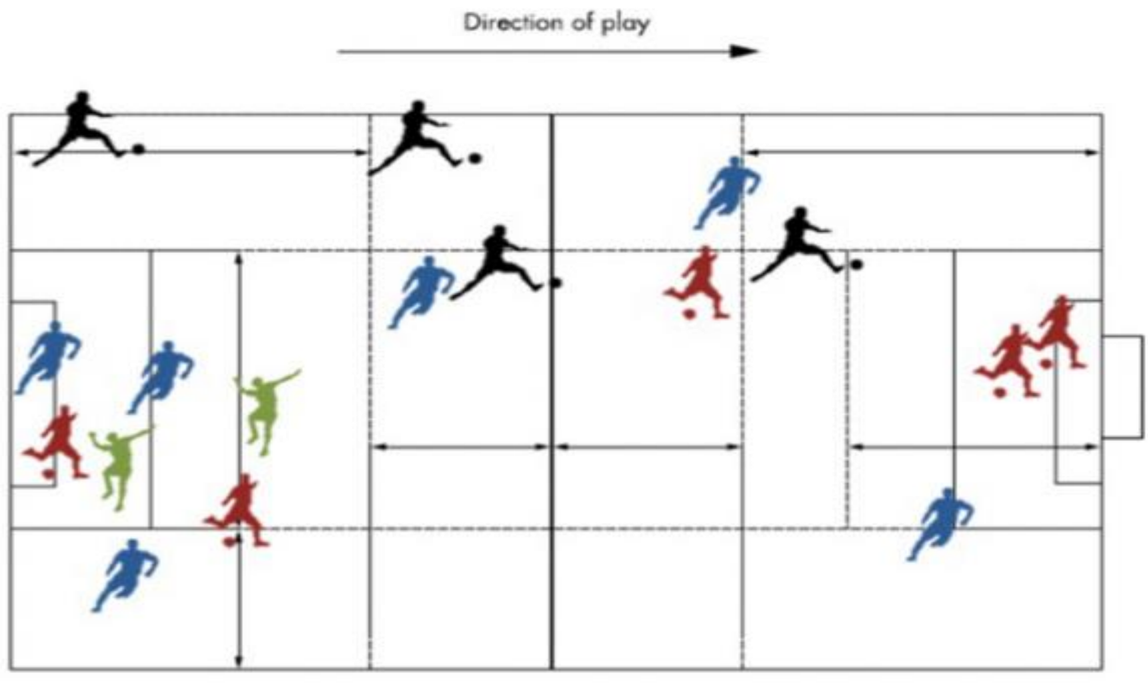
Source: Jensen, 2012, p. 3.

In the previous Figure, (A) the intervention exercise, the initial and final position, the total hip adduction position; and (B) the intervention exercise and the total hip adduction position can be observed.

It is important to outline that the 34 sub-elite players were considered healthy players and they were middle aged (± DE), 22.1 (± 3.3) years. On its part, in the process carried through the mid-season break, the group trained for 8 weeks having a supervised and progressive hip adduction strength with resistance band training. The participants involved had two training sessions per week (weeks 1–2) with 3 × 15 repetitions with maximum load (RM), three training sessions per week (weeks 3–6) with 3 × 10 RM, and three training sessions per week (weeks 7 –8) with 3 × 8 RM. The maximum eccentric hip-adduction (EHAD), the isometric hip-adduction (IHAD), the strength of isometric hip-abduction (IHAB) and the relation IHAD / IHAB were measured before and after the intervention. The players were guided by the tester using reliable procedures and manual dynamometry.

The plan presented by Serner, Britt Mosler, Tol, Bahr and Weir (2018) turned out to be interesting. The authors analyzed 17 male professional football players using a video. There, they found that most of the injuries occurred in situation without contact (71%) after a quick reaction to a change in the game (53%). In this respect, the injuries related to the adductor longus occurred when there is a change in direction (35%), kick (29%), stretch, this is blocking the ball, sweeping actions (24%), and jump (12%).

Figure 26: Different Actions on the Football Pitch



Source: Serner, 2018, p 3.

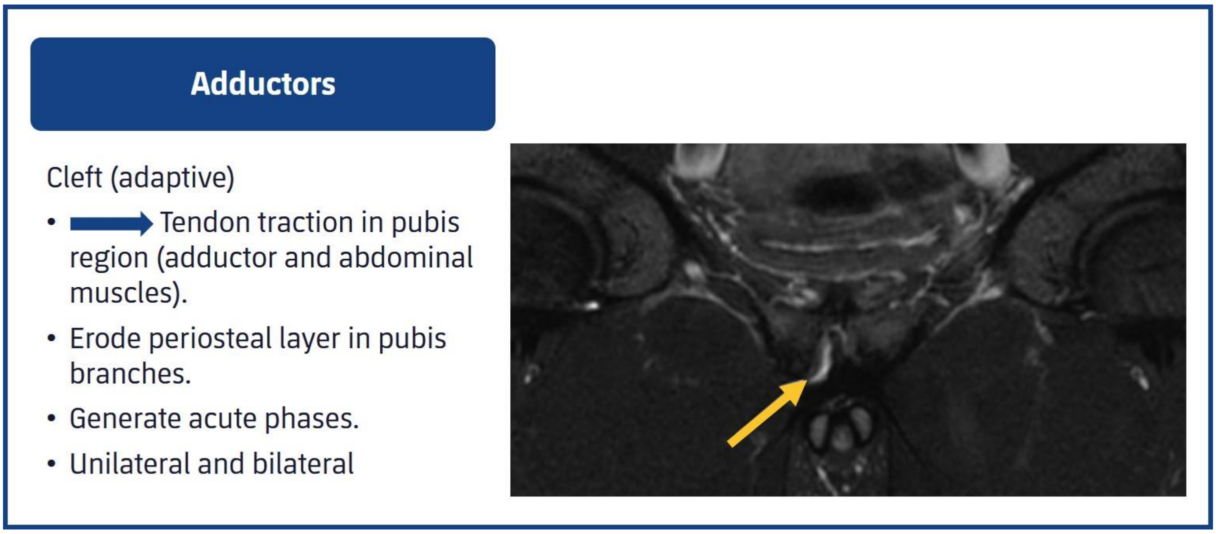
In Figure 26, we can observe the location of the players on the pitch, which is divided in zones with the figure of the players showing the location on the pitch where the adductor longus injury occurred. The different categories of actions that caused injuries are presented with the coloured figures of the players.

- ❖ Blue player: change in direction.

- Maroon player: kick.
- Black player: stretch in search of ball.
- Green player: jump.

Another important aspect to highlight are the possible confusions created when the player has symptoms in the adductor region, and they are immediately considered as an adductor injury and related to a pubalgia, but it is really a *cleft* (Figure 27). These are fissures in the pubic branches. They cause pain without altering the tissue, and they appear at the tendon level. However, the traction of the adductor produced these fissures. In acute phases, they are usually highly painful, and sometimes, what we need to do is a restructuring and adaptation of the complete adductor muscle and of the core. This allows us to acquire a degree of movement freedom.

Figure 27: Adductors - *Cleft*



Source: Prepared by authors.

Due to the multifactorial characteristics of adductor injuries Cheatham, Hanney, Kolber and Salamh (2014) say that there is still a lot of research to do in order to determine the usefulness of the clinical diagnosis as well as of the interventions. Also, and based on the environment, it is essential to use an integral approach which takes the injury and the injured as inseparable agents to have an optimal recovery and return to play competition.

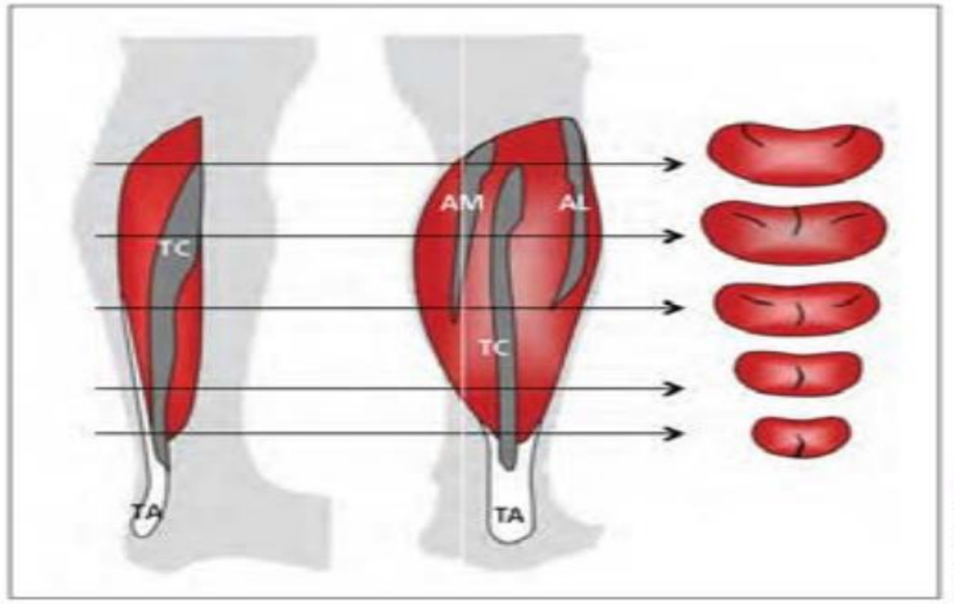
Soleus

According to Pedret (2003), the soleous muscle has a complex anatomy. This muscle is related to slow characteristic. Since it is located inside the complex triceps surae, it needs to develop explosive contractions in many occasions.

Authors like Dalmau-Pastor, Fargues-Polo, Casanova-Martínez, Vega and Golanó (2014) describe that the soleus is the third component of the triceps surae, together with the medial and lateral heads of the gastrocnemius and the plantar (if present).

Its anatomical and geographical location is in the posterior surface compartment of the leg, its insertion is in the 23 posterior part of the calcaneal tendon via the Achilles tendon. The origin of the soleus is in the bones of the tibia and fibula and in the aponeurosis that covers it (Elias, Faust, Chu, Chao y Cosgarea, 2003; Testut and Latarget, 1979).

Figure 28: Intramuscular Anatomy of the Soleus



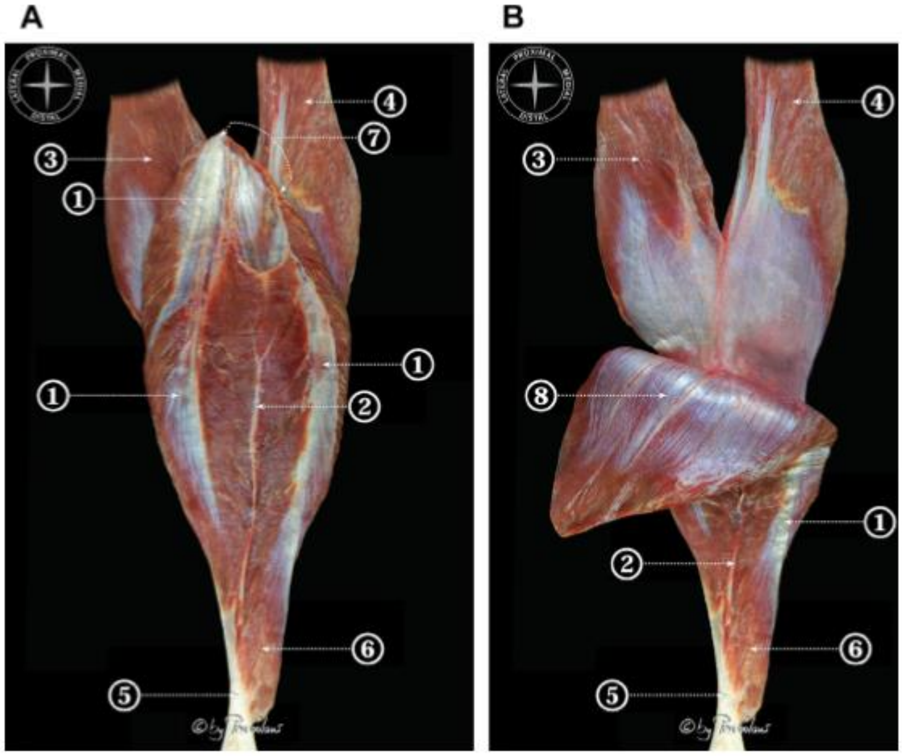
Source: Balius Matas and Pedret Carballido, 2013, p. 128.

In figure 28, the authors describe the following: LA: lateral aponeurotic expansion; MA: medial aponeurotic expansion; AT: Achilles tendon; MT: medial tendon.

Balius Matas and Pedret Carballido (2013) outline that since these aponeurotic expansions begin, they go to the medial line of the muscle, which turns into soleus aponeurosis. On its part, the central tendon expands and reaches the Achilles tendon.

Finally, the authors state that the function of these muscles is related to the posture control of the lower limb and to the ability of walking.

Figure 29: General Description of the Components of the Triceps Surae



Source: Dalmau-Pastor, Fargues-Polo, Casanova-Martínez, Vega and Golanó, 2014, p. 617.

Regarding the previous figure, the authors highlight that the muscles have been triceps surae: (A) anterior view; (B) anterior view of soleus muscle. 1) intramuscular aponeurosis of soleus; 2) median septum; 3) lateral head of gastrocnemius; 4), medial head of gastrocnemius muscle; 5) calcaneal tendon; 6) accessory soleus muscle; 7) tendinous arch of soleus; 8) posterior aponeurosis of soleus.

On the other hand, Balius, Alomar, Rodas, Miguel-Perez, Pedret, Dobado, Blasi and Koulouris, (2013) carried out an interesting study, which focus was on discovering the anatomy of the soleus using magnetic resonance (MR), anatomic dissection, and histology correlation in cadavers. Pedret (2013) outlines that the research proposed was developed in 11 legs of cadavers using 3.0 Tesla magnetic resonance (MR) to have images in axial, coronal and sagittal planes.

According to the author, who was also part of the research, the magnetic resonance constitutes an evidence of great value and quality, whose image is optimal to assess the intramuscular anatomy of the soleus.

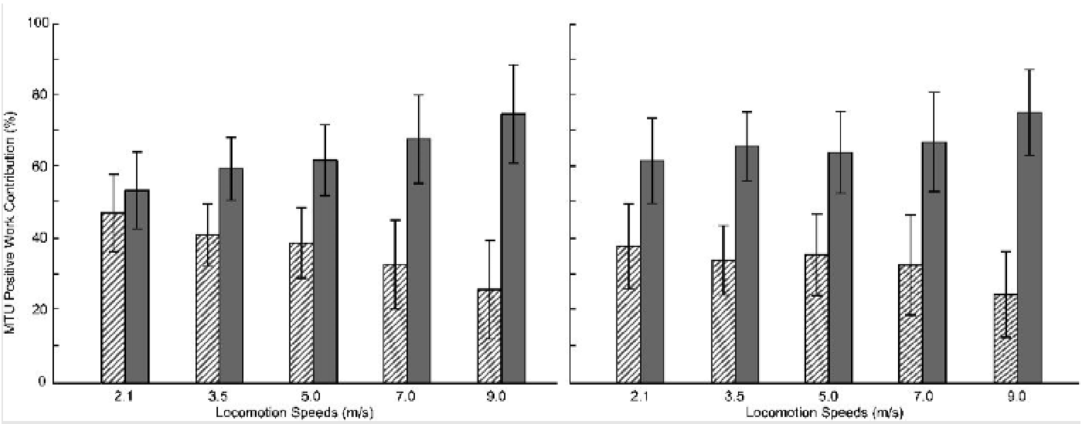
On the other hand, in agreement with the idea that a good clinic is what matters when searching an optimal management of the injured, Dixon (2009) performs simple clinical tests aimed to collaborate with the diagnosis, and in this respect contribute to the knowledge of the anatomy and the common clinical presentation. According to the author, the clinical records and a correct physical exam together with image studies allow the location of the injured muscle. From there, the differentiation of strains in the gastrocnemius and the soleus will allow an accurate prognosis, which entails an appropriate treatment in search for a successful prevention of recurrent injuries in that region.

It is known thanks to Lai, Lichtwark, Schache, Lin, Brown and Pandy (2015), that the interaction between muscle twitches and the components of the tendon of the soleus influences the ability of the muscle to generate strength and mechanical work when walking and running. In this respect, the authors highlight that the elastic tendon contributes to most of the changes in the length of the myotendinous junction when walking or running. But when we go from walking to running close to the preferred transition speed (2.0 m/s), the development of higher torque of the ankle is more economic, and this is probably explained by the shortening of the muscle twitches of the soleus.

On the other hand, in a research led by the group of Lai, Schache, Lin and Pandy (2014), the participation of the soleus and the gastrocnemius in a *sprint* action was analysed. Here, the authors highlight that as the sprint increases in speed, the participation of the elastic components in the series is higher than the contractile action in the called "propulsion phase", so the participation of the soleus in high speed is important.

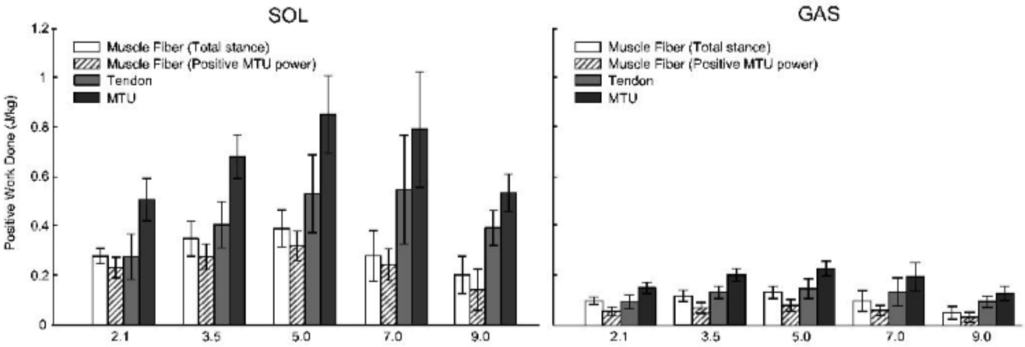
In this respect, the soleus-gastrocnemius complex participates in synergy with respect to the contractile component to the point of reaching quasi-isometric actions as speed increases.

Figure 30: Soleus-gastrocnemius



Source: Lai, Schache, Lin and Pandy, 2014, p.9.

Figure 31: Differences between Soleus and Gastrocnemius



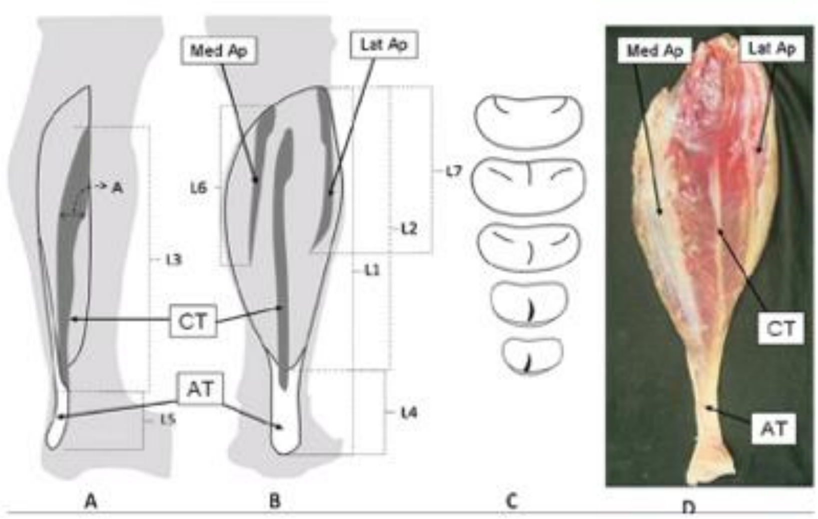
Source: Lai, Schache, Lin and Pandy, 2014, p.9.

In figure 31, it can be observed that as the speed increases, the participation of the tendon and the tension also increase. The contractile participation of the soleus is higher at moderate speed compared to *sprint*.

Balius Matas and Pedret Carballido (2013) highlight that there are injuries that affect the myotendinous junction, and others that affect the myofascial. In consequence, the injuries in this region of the lower limb have five different spaces where to occur:

1. myotendinous junction of medial tendon;
2. myotendinous junction of lateral aponeurotic expansion;
3. myotendinous junction of medial aponeurotic expansion;
4. anterior myofascial region in contact with the deep compartment of posterior leg; and
5. posterior myofascial region in contact with the gastrocnemius muscle.

Figure 32: Schematic Representation of the Anatomy of the Soleus Muscle



Source: Balius, Alomar, Rodas, Miguel-Perez, Pedret, Dobado, Blasi and Koulouris, 2013, p. 524.

In figure 32, the authors detailed the following: (A) sagittal view of medial region, (B) posterior view and (C) axial section. In a cadaver sample can be seen that the central tendon of the soleus originates in muscle mass of the soleus, the medial aponeurosis of the muscle originates in the tibial region, and the lateral aponeurosis originates in the fibula. (Med Ap = medial aponeurosis; Lat Ap = lateral aponeurosis; CT = central tendon; A = Achilles tendon). L1: total length of the leg; L2: length of soleus muscle; L3: length of central tendon; L4: free tendon length of the Achilles tendon; L5: insertion level of the central tendon into Achilles tendon; L6: length of medial aponeurosis; L7: length of lateral aponeurosis. A: amplitude of central tendon.

This kind of injury must be moved quickly, since the scars formed are tense in nature.

In summary, as regards the soleus tear - which is constantly more frequent -, we should pay attention to the individual characteristics of the athlete, especially, in this case, to the details such as the way they step on. At the same time, in general terms, if a player injures a lateral, medial or central tendon, the prognosis will be completely different whether he is supinator or pronator. If the player is affected in the medial tendon and he is supinator, he will have much more load in the medial region of the soleus, so the prognosis could be different. If the player is supinator and has had an injury in the lateral septum, the prognosis will also be completely different.

Conclusion

In this module the most frequent muscle injuries suffered by high performance football athletes have been presented. From our perspective, it is considered relevant to highlight the **management of the injured**. In this respect, the focus of the injury should be reinterpreted, and from there, it is necessary not only to understand the scientific contributions, but also, in this new scenario, the *sensations* of the players, since they play and mark a determinant role in the development of the recovery process. In this respect, it is essential to understand the injury taking a multifactorial approach, which should include the clinic and respect the biology (recovery process of the injured tissue), understanding its diagnosis and management. To all this, we should add the different personal characteristics, the environment and culture of the injured subject. From there, from an integral perspective, team work should be given priority, and all the variables that encompass the injured should be cared for. Under this new multidimensional view, work parameters in search of a correct construction of the planning are established. It is for this reason that the new models of intervention in the etiology of injuries (Bittencourt, Meeuwisse, Mendonça, Nettel-Aguirre, Ocarino and Fonseca, 2017; Roe, Malone, Blake, Collins, Gissane, Büttner, Murphy and Delahun, 2017; Oakley, Jennings and Bishop, 2017;Ayala, López-Valenciano, Gámez Martín, Croix, Vera-García, García-Vaquero, Ruiz-Pérez and Myer, 2018; O'Brien, Finch, Pruna and McCall, 2018) leave behind the traditional and unidirectional reductionist view, and get closer to the new changing needs and realities that include not only the sport, but also the player, who is understood as an athlete that is in constant transformation.

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