BARÇA
INNOVATION HUB
Universitas

PATHOLOGIES IN TEAM SPORTS

INJURIES IN SOCCER

3.1 Injuries in Soccer

(Xavi Yanguas)

Given that soccer is a professional and contact sport it requires maximum competitive demands, making its players especially vulnerable to traumatic injuries to muscles, knees, and ankles as a result of accidental twisting. It would be impossible to mention each and every one of the injuries that could occur in this sport therefore we will list and discuss some of the most common ones. We will describe:

- 5th metatarsal stress fracture
- Other traumatic bone fractures
- Sprains of the ankle's collateral ligament
- Sprains of the ankle's anterior-inferior tibiofibular ligament (syndesmosis)
- Knee ligament injuries: medial collateral ligament and anterior cruciate ligament injuries
- Meniscal injuries
- Athletic pubalgia
- *Concussion*.

Since we are discussing injuries in soccer, it is useful to note that the UEFA estimates that the injury incidence of some of these will increase in upcoming seasons. Specifically, an increase in hamstring and anterior cruciate ligament injuries is anticipated (despite efforts to establish preventative measures), and a decrease in groin injuries, ankle sprains, and medial collateral ligament knee injuries is expected.

1. Muscle Injuries:

Muscle injuries represent about a third of all injuries that occur in the world of professional soccer. A team of 25 players may expect around 15 muscle injuries per season (which represents each player suffering 0.6 muscle injuries per season). Of all muscle injuries occurring in soccer, 92% of them are located in the lower extremities, more frequently in hamstrings (37%), in adductors (23%), then in quadriceps (19%) and finally in triceps surae (19%). The main problem presented by

muscle injury is their recurrence, which is estimated, in general terms, at 16% (Ekstrand, Hägglund, Waldén, 2011).

2. 5th Metatarsal Stress Fracture

A stress bone fracture is one that occurs when a healthy bone receives constant overloads and is not capable of assimilating them over time, so that the healthy bone becomes progressively weak until it suffers a "true" fracture. The 5th metatarsal of the foot is an area particularly sensitive to suffering this type of injury. In professional soccer, there is a rate of 0.04 for every 1,000 hours of exposure, and it is estimated that in a team of 25 players there will be one 5th metatarsal stress fracture every 5 seasons (Ekstrand & Van Dijk 2013).

The base of the 5th metatarsal is an area with poor blood supply, which makes it especially vulnerable to these fractures and limits its treatment afterward (Figure 1). The base of the 5th metatarsal can be divided into three zones: A, B and C (Figure 2). In zone A fractures are due to avulsion of the tuberosity of the 5th metatarsal, which is caused by a stressed varus in the ankle (classic lateral collateral ligament sprain mechanism) and excessive traction in the peroneus brevis which then fractures the styloid. In zone B the type of fracture initially described by Dr. Robert Jones (1902) can be found. In zone C, the metaphyseal-diaphyseal transition junction located 1.5 cm distal to the styloid process, true stress fractures are found given that this area suffers from the most significant vascular compromise.

Let's focus on stress fractures, which can be occur in three different situations. The first of these is as an accidental finding during an X-ray performed for any other reason. In the B-C transition zone there may be a small fracture in the bone cortex that does not bother the soccer player. The second would be the existence of some discomfort over a long period of time which is not sufficiently bothersome to impact the soccer player's performance; on an X-ray, it will appear in the same way as the previous type. The third occurs when, after a twisted ankle (similar to that which would produce a sprain in the lateral collateral ligament), the weakened bone fractures, lead to a clear diagnosis of a bone fracture, with difficulty walking, significant pain upon selective palpation, and an X-ray that clearly shows the fracture (Figure 3). When the soccer player experiences discomfort, an X-ray may be negative; in that case, a magnetic resonance or a bone scan may show a stress reaction in the bone, anticipating the diagnosis.

There is a very close relationship between pes cavus, which increases pressure on the external lateral edge of the sole of the foot, and this type of stress fracture (Lee, Kim Park, Kim, Lee 2011). Likewise, athletic footwear that does not stabilize the midfoot and allow flexion in that area generates added stress for the metaphyseal-diaphyseal junction and create excess stress to that area. The use of proper orthoses can 1) avoid the development of future stress fractures by stabilizing the midfoot

and 2) give that area the necessary stability once surgery has been performed after a stress fracture.

Once a stress fracture has occurred in the 5th metatarsal, the recommended treatment is surgery for intramedullary screw fixation to stabilize the fracture. Surgery is necessary, especially in professional soccer players, given that the aforementioned lack of blood supply makes fracture healing much more difficult using a conservative course of treatment. The estimated downtime after surgery before a player can return to training and return to play is approximately 3 months.

3. Other Traumatic Fractures

Although soccer is a contact sport and the risk of suffering a bone fracture exists, its likelihood is not as high as in rugby or American football. They represent 3% of all injuries in professional soccer, and 12% in amateur soccer. In professional soccer, the incidence of fractures caused by direct trauma is 0.25 per 1000 hours of exposure, while that of stress fractures is 0.03 per 1000 hours. A professional team can expect 1-2 fractures per season. Without taking into account stress fractures (such as 5th metatarsal fractures discussed in the previous section), the most common fractures in the upper extremities are metacarpal and phalangeal fractures. Metacarpal fractures also occur due to torsional mechanisms during player-on-player tussles when one player's finger becomes tangled in the other's jersey and this torque fractures the metacarpal bone. In the lower extremities, the most frequently occurring traumatic fractures are those that affect the ankle (the medial and lateral malleolus, or both) and which affect the proximal third and the middle third of the fibula. Thoracic trauma can cause fractured ribs, and the most fractures from facial trauma are to the nasal bones themselves (Larsson**,** Ekstrand, J. Karlsson, M.K 2016).

4. Sprain of the ankle's lateral collateral ligament (LCL)

Ankle LCL sprains represent 51% of the total injuries located in the ankle joint; they exhibit an injury incidence of 0.7/1000 h of exposure, and in up to 40% of these injuries there is a direct contusion due to a foul by the opposing player (Waldén et al 2013).

The anterior fascicle of the LCL (anterior talofibular ligament: ATFL) is the most frequently affected, followed by the middle fascicle (calcaneofibular ligament: CFL), while the posterior fascicle (posterior talofibular ligament) is not usually injured. Although in theory the injury mechanism is a sprain due to a varus force combined with plantar flexion in the anterior fascicle and pure varus in the middle fascicle, the reality is that in practice, regardless of the injury mechanism, there are three grades of injury to the ATFL: grade 1 (stretching), grade 2 (partial tear), and grade 3

(full tear). The grade is based on the trauma caused by the injury mechanism, and the impact on the CFL is added to that, such that when the sprain is more traumatic, the impact on the ligaments is greater, and both ligaments can be affected at the same time.

Minor sprains of the ATFL can be treated with taping-type bandages for training and competition and proprioceptive work before practicing sports without having to suspend the soccer player from performing his activity. However, when the symptoms make playing soccer impossible and requires treatment, the most recommended treatment during the acute phase of injury is immobilization. There are studies which advocate for premature mobilization; however, in our experience, we consider the best strategy to be immobilization using a Walker boot during the first few days to manage inflammation and encourage the injured ligament to heal. If this is not done, the future stability of the ankle may be compromised (chronic instability) when we are talking about elite-level competition and ongoing pain for the soccer player once discharged. We think this is the key point to keep in mind when treating ankle sprains. It is currently believed that if a conservative, well-planned course of treatment is used, surgery will be unnecessary regardless of the sprain severity.

Sprain symptoms vary depending on their severity, from mild ATFL sprains which permit a player to finish a match before reporting the injury, to severe sprains which cause the player to hear an audible crack when the injury occurs. These may cause marked difficulty in walking, evident inflammation at the external perimalleolar region, and the appearance of a hematoma the day after the sprain. Physical examination may show ligamentous laxity during the anterior drawer test (ATFL injury) and the forced varus test (CFL injury) when the injury has caused tearing in some ligament fibers, and ultrasound may also show the injury (Figure 4). Occasionally, especially when dealing with severe ATFL injuries, the hypertrophic scar that results from healing may cause further irritation that will require subsequent corticosteroid infiltrations to treat the painful symptoms.

5. Ankle Sprain of the Anterior Inferior Tibiofibular Ligament (Syndesmosis)

A different type of ankle sprain which is greatly feared by soccer players, is that of the anterior inferior tibiofibular ligament (a syndesmotic ankle sprain), given that it requires greater downtime than a classic LCL sprain and can have bothersome and even incapacitating consequences if it does not heal correctly. It has an injury incidence of 0.05/1000 hours, which represents one injury every three seasons on

a professional team. Despite that, its incidence (which is 13 times higher in matches than in training) has been on the rise in the last 10 years (Lubberts et al 2017).

The tibiofibular syndesmosis ligament consists of three fascicles (the anterior inferior tibiofibular ligament, the interosseous ligament, and the posterior inferior tibiofibular ligament). The first is the most frequently affected and the second and third are impacted based on the severity of the injury. For practical purposes, the syndesmotic ligament serves as the distal support for the tibiofibular interosseous membrane. The injury mechanism is a combination of compression with internal rotation of the foot and external rotation of the tibia and the fibula (which can be produced by a direct contusion of the external surface of the ankle or by a traumatic sprain without previous issues). Depending on the force of the trauma, the injury can go from affecting the most anterior fibers of the deltoid ligament of the ankle, to the syndesmosis ligament, to the interosseous membrane, and finally, in cases of severe trauma, can cause a fracture in the proximal third of the fibula (a Maisonneuve fracture).

The isolated, yet severe, syndesmosis injury can cause 8 to 10 weeks' downtime and, just like complex LCL injuries, surgery can usually be avoided if conservative measures are followed (do not forget strict immobilization in these cases for at least 2-3 weeks). However, in complex syndesmosis ligament injuries, such as a Maisonneuve fracture, surgery (stabilization with a trans-syndesmotic screw) is necessary given that it is an unstable injury that causes chronic pain and instability in the ankle if surgery is not performed. As with an LCL sprain, and even more so in this case, the scar may be thick and cause discomfort (anterior ankle impingement) once the player has returned to training and competition, and may require corticosteroid infiltrations.

There are two exploratory maneuvers used to confirm ankle syndesmosis:

1. An external rotation test consists of holding the leg with one hand and using the other to cause pure external rotation of the foot, applying light axial pressure, the goal of which is to cause the talus to impact the tibiofibular mortise, leading to pain if its stability has been compromised by damage to the anterior tibiofibular ligament, and;
2. The squeeze test, which consists of compressions and decompressions performed with both hands, one on the tibia and the other on the fibula, in order to trigger syndesmotic pain. While the first maneuver has shown to be highly specific in diagnosing this injury, the second is more closely related to the prognosis of the same (*Ebraheim et al 1997*). Ultrasound and magnetic resonance can be used to confirm the diagnosis (Figure 5).

6. Knee Ligament Injuries (Lateral Collateral Ligament, Medial Collateral Ligament, and Anterior Cruciate Ligament)

The ***medial collateral ligament*** (MCL), which presents a strip-shaped morphology, becomes injured because of a mechanism of pure valgus stress or valgus stress combined with an external rotation of the femur in relation to the tibia. It can occur:

1. after direct contact to the outside of the knee;
2. through a knee sprain when the soccer player's foot is driven or pinned to the ground; and
3. when the player tries to reach the ball by extending his leg and the ball touches the tip of the foot, forcing an external rotation of the foot and the leg.

The symptoms vary depending on the severity of the trauma which caused the injury and can go from simple irritation in the proximal or distal insertion of the ligament (stretching of the ligament /grade 1 injury), without causing instability in the knee, to physical examination (valgus stress test) which may require 7 to 10 days of rest; up to severe injuries, with partial tears (2nd degree injury) or complete tears (3rd degree), with marked instability when the valgus is stressed, difficulty walking, and significant disruption shown in imaging tests (ultrasound and magnetic resonance).

Grade 2 and 3 sprains should be treated conservatively. Initially they require 3 weeks of immobilization with a knee brace that limits the knee's range of motion, from 0 degrees (full extension) to up to 30º of flexion the first week, between 30º and 45º the second week, and 45º and 60º the third week. Again, we insist on the need to correctly immobilize the joint during the acute phase of injury to ensure the correct healing process. During this phase, platelet-rich plasma (PRP) therapy is also recommended. Although a consensus has not been reached on the subject, based on our experience we recommend 3 applications, one per week, of between 6 and 8 cc of PRP. As of the 4th week until the 6th (when medical release is given for grade 2 sprains) or the 8th-10th week (for grade 3 sprains), a treatment plan including physiotherapy, muscle strengthening, and low-impact cardiovascular exercise is employed to allow the player to start the final stage of soccer-specific rehabilitation.

Surgical treatment is reserved for chronic knee instability. Grade 3 MCL sprains are currently treated conservatively with a very high success rate. Once the player has been released, residual discomfort may remain, which will require corticosteroid infiltrations to dissipate the pain.

The lateral collateral ligament (LCL), which has a cordlike morphology, is not as vulnerable to isolated injury as the MCL but is sometimes injured along with the anterior cruciate ligament. There are also 3 grades of impact with regard to instability when the varus is stressed during physical examination. In the case of severe injury, due precisely to its morphology, the treatment of choice is surgical, unlike in grade 3 MCL injuries.

The **rupture of the anterior cruciate ligament** (ACL) is the injury most feared by soccer players. Despite not being the most frequent (it is estimated that a professional team will only undergo 1 rupture of the ACL every 2 seasons), it leads to significant downtime: between 6 and 9 months, taking into account that surgery is required. The injury incidence is approximately 0.06/1000 hours, and is four times more common in female soccer players and 20 times more common in matches than in training (Waldén et al. 2011). Data from FC Barcelona: 0.04/1000 hours in men vs. 0.16/1000 hours in women.

There are predisposing factors such as: 1) Hormonal factors: ACL injury in women is more common in the ovulatory phase of the menstrual cycle, with a proven lower injury incidence in users of oral contraceptives, leading to the theory that these drugs modulate the female soccer player's hormones and protect her against ACL tears. Moreover, specific receptors for estrogen, progesterone, and relaxin have been identified in the ACL. 2) Anatomical factors such as having a narrow intercondylar groove, more common in women than in men; and 3) Mechanical factors such as having a longer knee valgus (a consequence of having a wider pelvis than men) which encourages a larger dynamic valgus when landing after a jump.

The injury mechanism is a combination of knee valgus with internal femur rotation and external tibia rotation when using the leg for support. This can occur when landing after a jump or when making a change of direction. The pain is sudden and prevents the soccer player from continuing to play. In many instances, the player even hears a crack. The athlete typically needs to be helped to their feet and usually leaves the playing field on a stretcher or with the help of several teammates. The anterior cruciate ligament forms part of the central pivot point of the knee and is a critical element in knee stability. For this reason, physical examinations demonstrate this instability using the following:

1. The Lachman test (to test anterior instability) where an examiner uses one hand to hold the femur at its distal end, and the other holds the tibia at its proximal end while pulling the tibia anteriorly to confirm that the torn ACL does not put a firm end or stop to the movement; and

2. The pivot-shift test (to test rotational instability test) uses flexion and extension of the knee, forcing the valgus to show a protrusion in the knee. The ACL has two bundles, the anteromedial bundle (which is responsible for anterior instability when torn) and the posterolateral bundle (responsible for lateral instability when torn). Magnetic resonance is the imaging test of choice for confirming an ACL tear (Figure 6).

Surgery is the preferred treatment and two types of grafts are typically used to substitute for the torn ligament: a bone-tendon-bone graft (a bone plug from the lower pole of the kneecap-1/3 of the middle of the patellar tendon-a bone plug from the anterior tibial tuberosity) or a semitendinosus tendon graft. Generally speaking, both are satisfactory substitutes for a torn ACL and both require the same type of post-surgical rehabilitation and the same type of rehabilitation on the field. The rate of re-ruptures of the plasty is around 4% and the risk of breaking the ACL of the contralateral knee increases. A recent publication stated that only 65% of the players who underwent ACL rupture continued to play at the same competitive level 3 years after the event (Waldén et al., 2016).

Finally, it must be remembered that early specialization in sports among children brings with it the occurrence of injuries that years ago were considered typical in older soccer players and now occur in younger ones. As a result, the incidence of ACL injuries has increased considerably in children in the last 20 years. In players over 12 years of age, 90% of tears occur in the body of the ACL, just as in adults, while in those younger than 12 the ACL is most frequently injured through an avulsion of the tibial spine at its most distal insertion. The dilemma arises when it is time to choose the appropriate course of treatment. Today there are surgical techniques used to treat growing knees with femoral tunnels that are narrow enough not to interfere with future growth in the knee through premature fusion of the physis; a semitendinosus tendon graft is always used, rather than a bone-tendon-bone graft. Surgical treatment should be reserved for children expected to have a real future in sports, and it should always be well-explained and consented to by the minor's parents. It is not misbegotten, however, to initially employ a conservative course of treatment focusing on strengthening the muscle so that, when the physes fuse, a deferred surgery can be performed. When surgery is performed, downtime is approximately 6-9 months; both the downtime and the recovery period are the same as for adults.

7. Meniscus Injuries

Meniscal injuries are frequent in soccer and have come to be considered critical, with consequences for the future of the knee. The meniscus is a fibrocartilaginous structure that serves as a buffer between the tibia and the femur. It has an anterior horn, a body, and a posterior horn. Injury to the medial meniscus (C-shaped) does not have the same repercussions as injury to the lateral meniscus (O-shaped). This is because the lateral meniscus, due to its anatomical configuration, causes more chondral issues in the short term and osteoarthritis of the knee in the long term when injured and treated through meniscectomy, regardless of how conservative it is. The mechanism by which the injury is produced is a twisting of the knee and depending on the severity of the injury 1) the pain will be more or less intense and 2) the presence, in most cases, of synovial or serosanguineous effusion will be more or less. In the case of a meniscal-capsular avulsion, the effusion may be clearly sanguineous.

Upon clinical suspicion, the McMurray, Apley, or Mastromarino tests will be positive: 1) The McMurray test for the medial meniscus has the examiner place his thumb and index finger on both sides of the intercondylar line with the knee flexed while performing external rotation of the foot, abduction of the lower knee, and gradual, complete extension of the knee. For the medial meniscus, rotation will be internal along with an adduction. 2) The Apley grind test: with the patient in prone position and the affected knee flexed, pressure is applied to the knee joint and external rotations (to examine the medial meniscus) or internal rotations (to examine the lateral meniscus) are performed. 3) The Mastromarino test: maximum forced flexion is applied to the meniscus to test the posterior horn.

Magnetic resonance is the preferred imaging test to confirm the injury. There are various types of meniscal tears (Figure 7) and the treatment of choice depends on whether the tears are in the periphery or wall of the meniscus (the red zone) or the inner portion of the meniscus (the white zone). The difference is that the red zone is better vascularized than the white zone, meaning that tears in the former may require surgical sutures that try to preserve the meniscal function (cushioning), although the recovery period will be longer. Meniscal sutures require downtime of at least four to five months for a medial meniscus suture and around six months for a lateral meniscus suture. If a meniscectomy is performed, the recovery period will vary from around two months for the medial meniscus and approximately three months for the lateral meniscus. In soccer players with long sports careers, the meniscus suffers from degeneration which is typically well-tolerated (myxoid degeneration of the meniscus) despite the fact that magnetic resonance images may be alarming. In those cases, when painful symptoms are experienced, we recommend viscosupplementation by reticulated and high molecular weight sodium hyaluronate.

8. Athletic Pubalgia

Athletic pubalgia is an injury which is considered to be the domain of soccer players. However, whether under this name or the more common designation of pubalgia, an entire category of issues is encapsulated, some of which are occasionally misdiagnoses.

The different types of injuries included under pubalgia can be divided, according to the Doha experts' consensus (Weir et. al. 2015) into 4 different categories: those related to the adductor, to the pubic symphysis, the iliopsoas and hip, and to the abdominal inguinal ring (Figure 8). Each type must be treated differently, as their causes are different, and in no case should all "pubalgias" have the same treatment. In addition, pain in the pubis has a very high clinical-radiological disassociation, such that up to 60% of soccer players who do not experience symptoms have pubic edemas appear on magnetic resonance images (Branci et al 2015), which reflects the chronic adaptations of the pubis to the tensing of the adductor muscles in their insertions. When there is an imbalance and pain appears, that is when it is labeled an injury, such that we do not categorize radiological findings as injuries that are not accompanied by a diagnosis.

In the case of pubic pain resulting from excessive traction in the adductors (traction of the adductor longus tendon is the most common), the chief cause is usually an imbalance between some adductors which are pulled too much (by inside passes, kicks with backspin, jukes, changes of direction, among others) versus an abdominal musculature that is inserted in the upper part of the pubic symphysis, and which does not compensate for this traction. This asymmetrical force is what causes the symphysis to become imbalanced. Physiotherapy, adjusted training loads, and retraining of the adductor and the rectus abdominus muscles will all be key in decreasing pain. Later on, preventative work will be needed to maintain this balance. Should medical treatment be needed so that analgesics can be used to allow for physiotherapy, corticosteroid infiltrations into the insertion of the adductor longus and/or in the symphysis, an anesthetic block administered to the anterior branch of the obturator nerve, and anti-inflammatory drugs such as indomethacin can be used. When a conservative course of treatment does not give results after at least 6 months, surgery should be considered. Bilateral adductor tenotomy is the most common option.

When pubalgia is caused by an inguinal hernia (also known as sports hernia: weakening of the abdominal wall with a protruding hernial bulge), surgery to reinforce the abdominal wall (suture/reinforcement of the transverse fascia) is the recommended treatment.

When pubalgia is caused by issues in the hip (cam or pincer variations of the morphology in the femoral head and neck), with damage to the acetabular labrum and/or additional encumbrance of the iliopsoas, the cause in this anatomical area must be addressed in order to resolve the referred pain in the pubic region. Cam and pincer morphological variations (especially the former) are typical as a chronic kinetic adaptive mechanism in soccer players (Harman and Olufemi 2014), and over the years, the overgrowth of the femoral head-neck transition zone leads to pain from femoroacetabular contact. Good results have been obtained by injecting sodium hyaluronate (high molecular weight and reticulated) into the coxofemoral joint to increase its lubrication, decrease the irritating effects of the femoroacetabular contact, and reduce tension in the adductors, which are trying to center and stabilize the femoral head in the acetabulum, generating referred pain in the pubic region.

9. Concussion

Concussion refers to a concern that should be kept in mind, and which refers to traumatic brain injuries (TBI) which can occur in soccer (for example, head-to-head collisions or direct, powerful hits to a player's head with the ball), which do not cause structural brain injury but which lead to neurological symptoms and which can be resolved spontaneously (with physiological or metabolic alterations) (Figure 9). Neuroimaging tests show as normal, and recovery from metabolic alterations lags behind recovery from symptoms. Symptoms of concussion are resolved within the first 10 days for 85 and 90% of cases. Symptomatology includes: mild to moderate headache; difficulty concentrating, remembering, answering questions easily, or thinking; amnesia with regard to the traumatic episode; irritability and changes in mood; sleepiness; fatigue; nausea and vomiting.

To assess an athlete's orientation and consciousness after a TBI on the playing field, Maddocks' questions are used: Five questions to ask a soccer player to assess his state of consciousness: 1) What match are you playing? 2) What half of the match are we playing? 3) Who was the last player to score a goal in this match? 4) Who was our last match against? and 5) Did we win our last match? Once these questions have been asked, a balance test is performed: with the soccer player upright, one foot in front of the other (the heel of one foot touching the toe of the one behind it), knees slightly bent, eyes closed, and hands on hips, the player must stay balanced for 20 seconds. Errors are counted during this time (losing balance, opening the eyes, or moving the hands from the hips), with up to 5 errors being normal. If all of the preceding are normal, we can approve the player to return to the match, or if

the opposite is true, take him out of play. Under current rules, the referee will always ask the medical personnel assisting the player (and not the player himself) if he is able to continue playing.

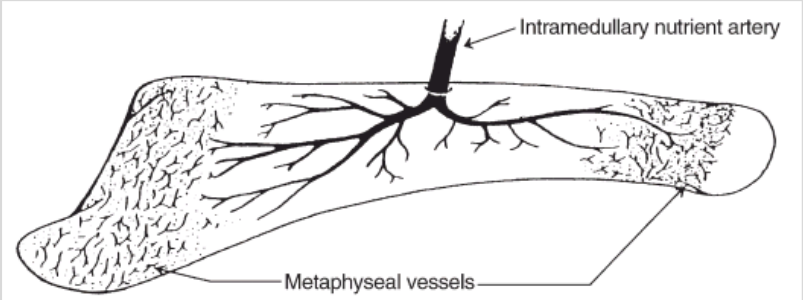
In the days that follow, the SCAT5 test is recommended to monitor progressive resolution of symptoms:

See also:
http://bjsm.bmj.com/content/bjsports/early/2017/04/26/bjsports-2017-097506SCAT5.full.pdf

Finally, return to play shall be done gradually over the course of 7-10 days, going through steps as long as the player does not present further symptoms: 1) No physical or mental activity; 2) Light aerobic exercise (e.g. stationary bike); 3) Soccer-specific individual exercises (easy run while dribbling, passing); 4) Training with the rest of the team, avoiding contact situations; 5) Regular training with the team; and 6) Return to play.

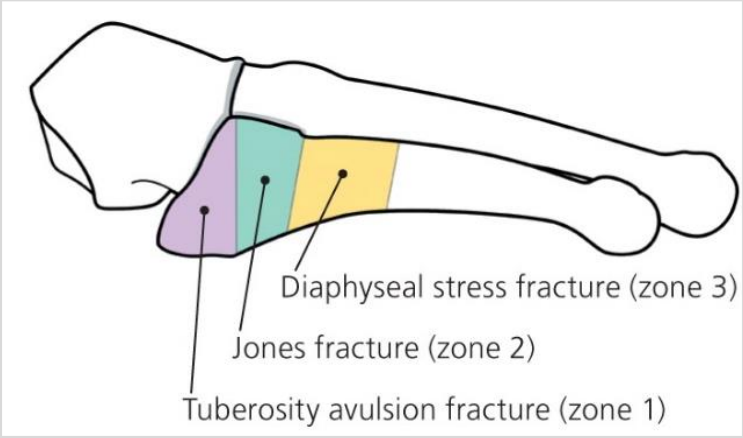
10. Figures

Figure 1: Diagram of 5th metatarsal blood supply



Source: Taken from Foot & Ankle. 1992.

Figure 2: Zones A, B, and C of the 5th metatarsal base (also known as zones 1, 2, and 3)



Source: Taken from Am Fam Physician. 2016;93:183-191.

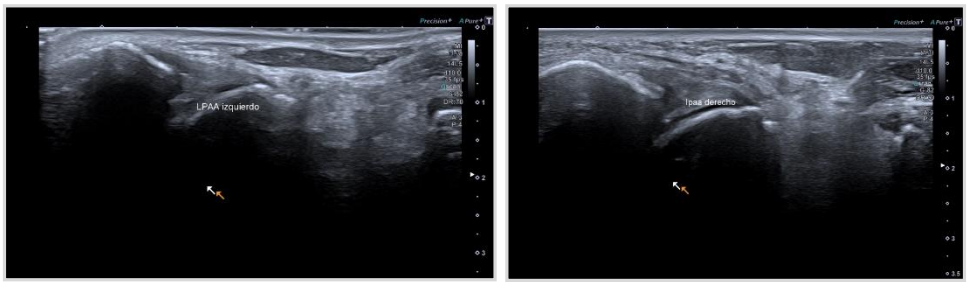
In zone A or zone 1 there are tuberosity avulsion fractures, in zone B or 2 the "true" Jones fractures can be found, and in zone C or 3 the true stress fractures in this bone.

Figure 3: X-ray images of a 5th metatarsal fracture

Source: Prepared by the author

On the first X-ray, a small image appears, which is compatible with a stress injury and which does not yet require treatment. In the second, there is a small fracture which will cause the player some discomfort but will not prevent him from training or competing. In the third, there is a clear fracture line in the B-C transition zone, caused by an ankle sprain with a slow onset of pain and which is an incapacitating diagnosis.

Figure 4: Comparison of healthy and injured ATFLs

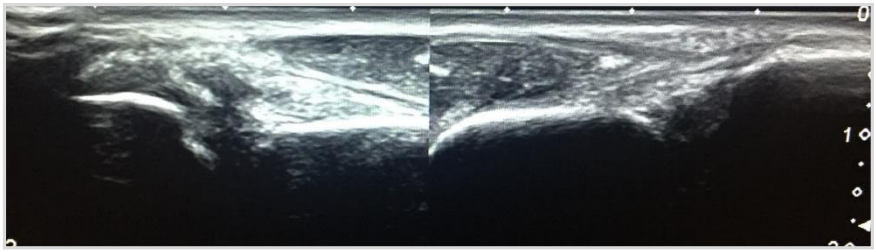


Source: Prepared by the author

On the left, there is an ultrasound of a healthy ATFL. A hypoechoic mass with a triangular shape can be seen, with the apex in the left edge of the bone (the tip of

the fibular malleolus) and with its base on the talus. On the right, this structure appears insufflated and much thicker, indicating an injury to the ligament.

Figure 5: Ultrasound of syndesmotic ligaments



Source: Prepared by the author.

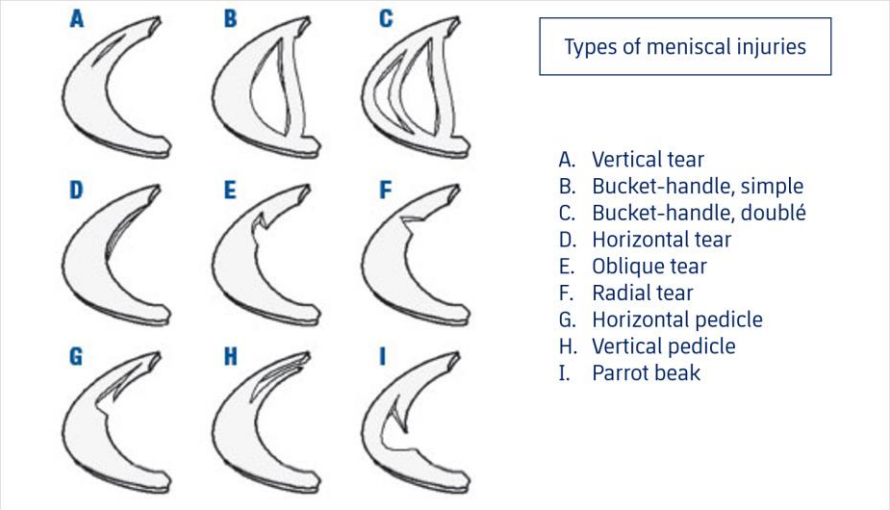
While in the right-hand image a linear structure can be seen in the ligament, which is oblique both upward and to the right, maintaining the tibia and the fibula together, in the left-hand image, a bulge can be seen in the ligament, indicating that it is injured.

Figure 6: Absence of ACL

Source: Prepared by the author.

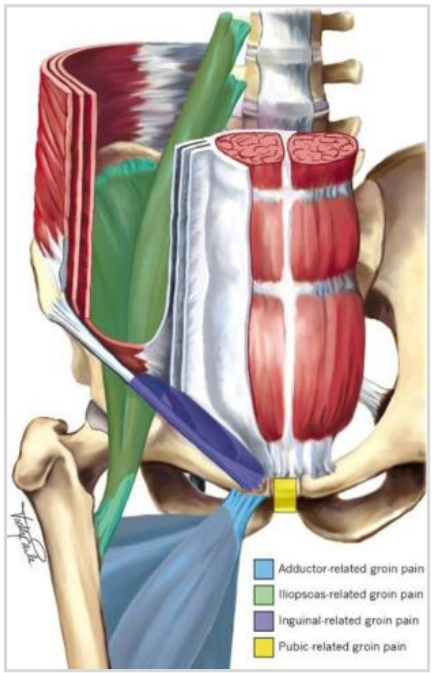
This sagittal view of the knee shows the absence of the ACL, which should appear as a thick black band going from behind the tibia to the femur.

Figure 7: Types of meniscal injuries



Source: Kinect Fissioterapia, 2012, retrieved from https://goo.gl/HYrbUf

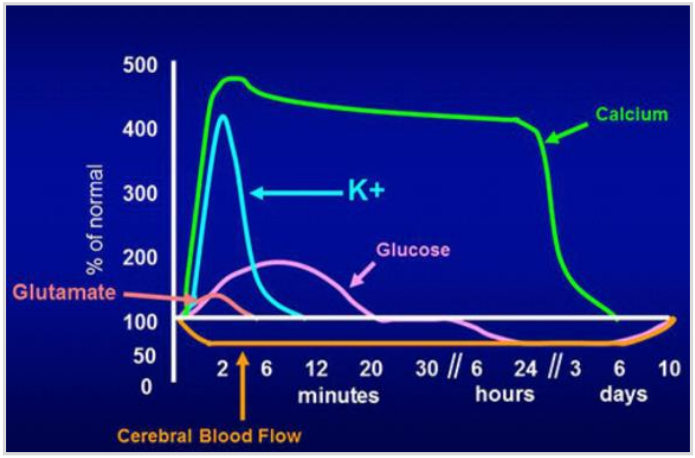
Figure 8: Anatomy of pubalgia



Source: Weir et. al. 2015

Lesional entities to keep in mind for pubalgia in soccer players (Weir et al 2015): in relation to the adductor, pubic, iliopsoas and hip and inguinal regions.

Figure 9: Metabolic alterations after a concussion



Source: Prepared by the author.

Functional symptoms are believed to be caused by alterations to glucose metabolism.