CHAPTER 10

PRGF on Sports-Related Ligament Injuries

AUTHORS

Cugat R.[1,2,3], Cuscó X.[1,3], Seijas R.[1,3,4], Barastegui D.[1,2,3], Álvarez-Díaz P.[1,2,3,4], Alentorn-Geli E.[1,2,3], Rius M.[1,2,3], Steinbacher G.[2], Sala E.[2], Boffa JJ.[2,3], Grossi S.[2], García-Balletbó M.[1,3], Tizol S.[1,3], Laiz P.[1,3].
PHYSIOTHERAPISTS: Marín M.[1], Álvarez X.[1], Lama N.[1].

[1] Fundación García-Cugat, Universidad CEU-Cardenal Herrera, Spain.
[2] Mutualidad Catalana de Futbolistas – Delegación Cataluña, Barcelona, Spain.
[3] Artroscopia GC, Hospital Quirón, Barcelona, Spain.
[4] Universidad Internacional de Cataluña, Sant Cugat del Vallès, Spain.

SUMMARY

Ligament injuries have a high incidence among young athletes and they occur most often in contact sports. Treatment of these injuries has a profound impact not only for athletes but also for everyone who engages in recreational sports practice.

Knee injuries are common and potentially career ending in amateur and professional sports. There are two ligaments on the knee cavity, anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL). PCL injuries happen far less often than ACL injuries, because PCL is stronger than ACL and most commonly occurs in combined knee ligament injuries. The other two ligaments in the knee are the lateral collateral ligament (LCL) and the medial collateral ligament (MCL) which are located on both sides of the knee.

Ankle ligament injuries are also very common amongst young athletes. The front and middle bands of the lateral ligament are the ligaments commonly injured in a sprain. Recent epidemiology studies have revealed that ankle sprains have a high incidence among athletes, and are particularly common in those who practice team sport.
The benefit of using PRFG in ligament injuries is widely studied, over knee and ankle. These studies have shown that the PRGF seems to play an important role during the regeneration of the low healing potential ligament tissue, when applied. It also helps to restore the biomechanical properties of the tissue. It is important to restore the anatomy, recover function and to have a good biological environment so as to avoid degenerative processes in the cartilage joint.

E. Anitua et al. (eds.), *Platelet Rich Plasma in Orthopaedics and Sports Medicine*,
https://doi.org/10.1007/978-3-319-63730-3_10

1. INTRODUCTION

Since the emergence of regenerative medicine, a range of studies has demonstrated the efficacy of new biological treatments. During the tissular healing process, angiogenesis, tissular proliferation and extracellular matrix formation occurs. These processes are based on biological events controlled by a series of growth factors and proteins.

Until the emergence of PRGF therapies, it has not been possible to initiate healing in the same therapeutic agent using the necessary cell scaffold and molecular signals.

To understand the complexity of PRGF therapies, knowledge about platelet biology is fundamental. The primary and best-known function of platelets is their contribution to hemostasis. However, more functional facets of the platelets have been identified, and we now know that they play an important role in inflammatory and proliferative events, and also a critical role in tissue remodelling and wound healing; and furthermore, we now recognize their angiogenic power to deliver proteins to areas where tissue is damaged.

For these reasons, PRGF is a good vehicle to deliver GFs to the injured site, where it can mimic the physiological process of tissue repair.

Platelet Rich Growth Factor, PRGF, is a source of autologous Growth factors obtained by different methods. Depending on the system, the products obtained have different chemical and cellular composition, which consequently lead to different results after application. For that reason, it is very important to know the composition of the product administered.

There are studies suggesting that leukocytes in PRGF contribute to inflammatory cytokine production. But even more significant than simply minimizing inflammation is the maximizing platelet role to decrease inflammation and enhance matrix gene synthesis.

Growth Factors are substances whose biochemical signals are capable of modulating the cellular response. These substances can be vitamins or hormones with the main function of stimulating cell growth and differentiation. They are involved in a large number of other very important biological functions such as cellular proliferation, cellular survival, migration and even apoptosis.

Growth factors are cellular mediators synthetized by many different types of cells. The connective tissues are known to contain many of the signalling proteins that play a very important role in the remodelling and repair of the different types of connective tissue.

Growth Factors carry out their function at very low concentration, in the region of pico or nanograms. They bind to a cellular receptor; this receptor is specific for a second messenger where a tyrosine-kinase protein acts. This activation starts the signalling cascade, ending in the nucleus where the transcription factors activate one or more genes.
The most important Growth Factors acting in ligament healing are PDGF, TGF-β, IGF, FGF, EGF and VEGF, but also NGF and HGF in a smaller proportion.

The PDGF has mitogenic properties as a very strong mesenchymal cell activator[1], modulates important processes as endocytosis or cell migration[2], and also plays a very important role in reparation and regeneration processes. TFG-β has many different functions such as proliferation, migration and cell metabolism. It stimulates or inhibits cell differentiation and proliferation depending on its concentration, tissue environment and cell type[2]. The functions of IGF are cellular replication, synthesis of glycogen, proteins and glycosaminoglycan, and the transport of glucose and amino acids throughout the cell membrane[2]. IGF also plays an important role in increasing cartilage, bone formation, and decreasing extracellular matrix degradation[3]. The main FGF biological activity is the mitogenic, chemotactic and angiogenic capacity over many cells[2]. EGF stimulates mitogenesis, increasing DNA, RNA and protein production in fibroblasts and in endothelial cells. VEGF

is fundamental in tissue reparation-regeneration processes, and it plays an important role in early migration and proliferation phases, but is more active after the inflammatory process as a determinant in proliferation and the remodelling phase, where it is a great stimulant of angiogenesis[4]. NGF contributes to accelerate the cicatrization processes by modulating inflammatory phases, migration, angiogenesis and tissue remodelling[5]. HGF is a protein with mitogenic properties in endothelial cells which stimulates cell migration, and has a powerful synergic activity with VEGF in endothelial cells[6].

2. KNEE

ANATOMY AND FUNCTION

The knee is a large and complex joint, formed by two units:

A. The tibiofemoral joint, constituted by the distal end of the femur with the proximal end of the tibia, belonging to the bi-condylar group.
B. The patellofemoral joint, a trochlear diarthrosis genre-type, formed by the femoral trochlea and the back of the patella.

The knee has four major ligaments that help it avoid luxation. There are two positioned on the extra-articular side, called the Medial Collateral Ligament (MCL) and Lateral Collateral Ligament (LCL). There are two intraarticular ligaments crossed and located in the centre of the tibiofemoral joint, called the Anterior Cruciate Ligament (ACL) and Posterior Cruciate Ligament (PCL).

The other ligaments or capsular reinforcements are the following:

On the extra-articular of the anterior side: The Patellar Ligament connecting the patella to the tibia. On the extra-articular of the posterior side: The Oblique Popliteal Ligament or Recurring Tendon connecting the tendon of the semimembranous muscle to the external condyle of the femur. The Arched Popliteal Ligament connects the external condyle of the femur with the margin of the head of the tibia.

On the extra-articular of the inner side is the Medial Patellar Femoral Ligament (MPFL), which connects the border of the patella to the internal femoral condyle. The MPFL connects the patella to the medial meniscus. The Medial Collateral Ligament (MCL) is an extracapsular band-like ligament located in the inner side of the knee. The proximal end is inserted into the tuberosity of the medial femoral condyle and the distal end is inserted into the inner side of the tibia.

MCL function is to prevent lateral movement of the knee avoiding excessive genu valgum deformity. It also collaborates with the ACL.

On the extra-articular of the outer side is the Lateral Patellar Femoral Ligament (LPFL), which connects the patella to the edge of the lateral femoral condyle. The LPFL connects the patella to the lateral meniscus. The Lateral Collateral Ligament (LCL) or Fibular Collateral Ligament is a cordoned extracapsular ligament which is located in the outside of the knee. The proximal end is inserted into the external femoral condyle and the distal end is inserted in the outer zone of the fibular head.

As well as the MCL, its function is to prevent lateral mobility of the knee, avoiding, if necessary, excessive genu valgum. It also collaborates with the PCL and to a lesser degree with the ACL.

The intraarticular ligaments are the following: The Yugal Ligament or Transverse Ligament that connects the front face of both menisci; the Meniscofemoral Posterior Ligament or Humphrey Ligament which goes from the periphery of the posterior horn of the lateral meniscus to the medial femoral condyle; the Posterior Meniscofemoral Ligament or Wrisberg Ligament which goes from the periphery of the posterior horn of the lateral meniscus to the medial femoral condyle, located behind the Anterior Meniscofemoral Ligament.

The ACL is an intraarticular ligament located in the central area of the knee. It consists of few fascicles. The proximal end is inserted into the intercondylar area, specifically, in the postero-medial area of the lateral femoral condyle, and the distal end is inserted between the tibial spines on the antero-inner area of the tibia, adjacent to the anterior root of the medial meniscus.

The function of the antero-medial bundle is to avoid anterior displacement of the tibia relative to femur. Its injury results in Lachman Test positive and Pivot Shift negative.

The function of the postero-lateral bundle is to avoid the antero-lateral rotatory subluxation of the tibia relative to femur. Its injury produces Lachman Test negative and positive Pivot Shift.

The PCL is an intraarticular ligament located in the central area of the knee. It consists of several fascicles. The proximal end is inserted into the front area of the lateral face of the medial femoral condyle and the distal end is inserted in a depression of the posterior intercondylar area of the tibia and in the peripheral area of the posterior third of the lateral meniscus.

Its function is to prevent rear sliding of the tibia relative to femur, and with the ACL controls rotational stability of the knee.

INJURIES

When a ligament is injured, three important areas are altered: the anatomy, function and biology. This is why it is important to act on each one to solve the problem.

Epidemiology of knee injuries.

Time reviewed	Season 2014-15
Medial Colateral Ligament (MCL)	573
Lateral Colateral Ligament (LCL)	280
Anterior Cruciate Ligament (ACL)	926
Posterior Cruciate Ligament (PCL)	42

The epidemiology of knee injuries in the Mutualitat Catalana de Futbolistes, MCF, may differ from epidemiology in the general population. Soccer players from the MCF are highly active athletes whose knees suffer higher stress than the non-athlete population.

Medial Collateral Ligament (MCL)

Conservative Treatment

In acute isolated grade II and III injuries, as well as in chronic injuries with mild or moderate grade of instability, conservative treatment is recommended:

1. Ultrasound-guided infiltration with Fraction 2 (Platelet Rich) of PRGF leukocyte-free, 4 - 7 cc in the ligament and its insertions.
2. Anti-valgus brace placed for 3 weeks with free movement, unblocked.
3. Physiotherapy.
4. Rehabilitation program.
5. Regular medical and ultrasound controls.

Repetition of infiltration should be performed, if needed, according to the recovery evolution. Usually, from one to three infiltrations administered with an interval of 7-10 days is sufficient for healing.

Normally, there is a return to sport at 4-6 weeks in Grade II but 8-10 weeks in Grade III. (Figs. 1-2)

Surgical Treatment with Biological Augmentation

Surgical treatment is performed in acute grade III injuries associated with other injuries such as ACL and chronic injuries that cause instability. In these cases, surgery corrects the defect of anatomy and then biological treatment is applied with Fraction 2 PRGF. Since PRGF improves the quality of repairing tissue, and helps to have a more comfortable postoperative experience, it shortens the recovery process. Return to sport is estimated to be 6 months. (Fig. 3)

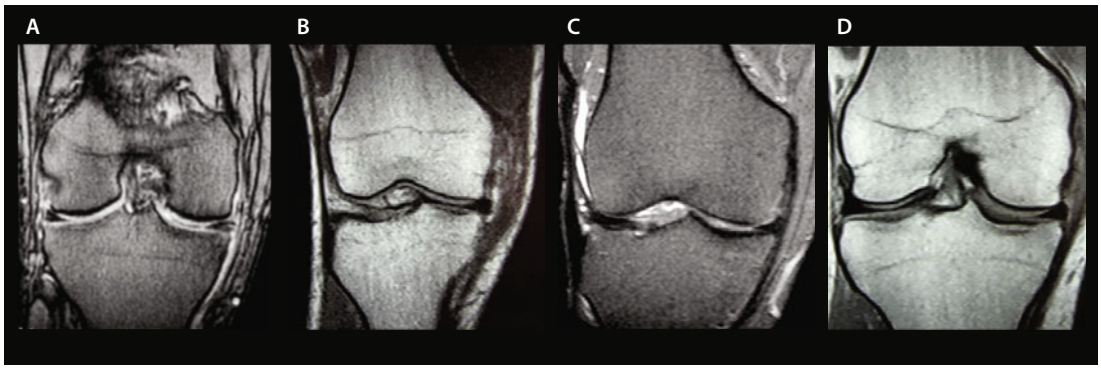

FIG. 1
MCL MRI. A) MCL rupture. Pre-treatment. B) Recovered MCL. Post- treatment with PRGF.

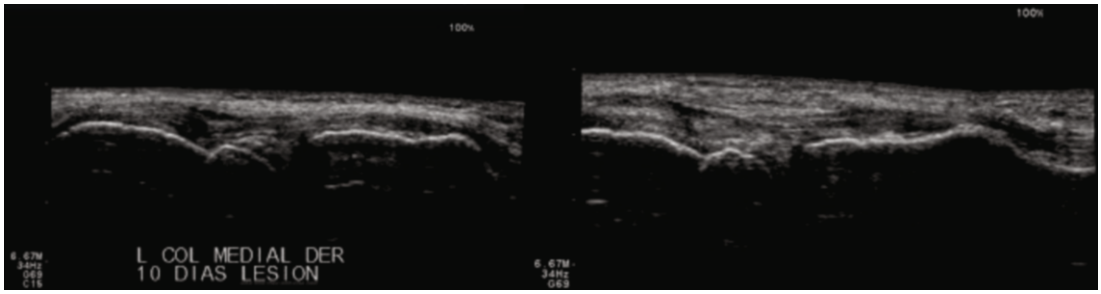

FIG. 2
Ultrasound follow-up in MCL injury with PRFG injection.

FIG. 3
Treatment of ACL and MCL ruptures: Arthroscopic ACL reconstruction with Bone- Patellar Tendon-Bone (BPTB), intraarticular injection and MCL infiltration of PRGF

In chronic injuries in which there is a major instability, reconstruction of the ligament by open surgery is mandatory. At the end of the procedure, infiltration of the new structure with Fraction 2 (Platelet Rich) of PRGF leukocyte-free, 4-6cc is recommended. After this, the Rehabilitation program is started and return to sport is estimated at between 12-16 weeks after the surgery. (Fig. 4)

Grade II Isolated Injury	• 4 – 6 cc PRGF: 1-2 Injections • Cryotherapy • Antivalgus Brace • Physiotherapy • Flexo-Extension Exercises immediately and without pain • Re-education Quadriceps & Hamstrings • Return to sport at 4-6 weeks
Grade III Isolated Injury	• 5 - 7 cc PRGF: 3 Injections • Cryotherapy • Antivalgus Brace • Physiotherapy • Flexo-Extension Exercises (without pain) • Re-education Quadriceps & Hamstrings • Return to sport 8-10 weeks

Grade II or III & ACL Injury	• ACL Arthroscopic reconstruction • 5 - 7 cc PRGF: 1 - 2 Injections • Perform Flexo-Extension with Antivalgus Brace • Re-education Quadriceps & Hamstrings • Return to sport starting at 6 months
Chronic Injury	• MCL Reconstruction • 4 - 6 cc PRGF: 1 - 2 Injections • Re-education Quadriceps & Hamstrings • Return to sport 12-16 weeks

Lateral collateral ligament (LCL)

The injury can be minimal and isolated or associated with a cascade of injuries after the LCL breakdown: avulsion of the Bicep Tendon, the Ilio-Tibial Tract and the Popliteus Tendon, traction of the internal popliteal sciatic nerve, lesion of the postero-lateral capsule and of the lateral meniscus, rupture of the ACL / PCL and internal popliteal sciatic nerve traction with or without popliteal vessel injury.

When the injury is partial, conservative treatment is recommended, as described previously for MCL:

1. Ultrasound-guided infiltration with Fraction 2 (Platelet Rich) of PRGF leukocyte-free, 4 - 7 cc on the ligament and its insertion.
2. Anti-varus brace placed for 4-7 weeks with free movement, unblocked.
3. Physiotherapy.
4. Rehabilitation program.
5. Regular medical and ultrasound controls.

Repetition of infiltration should be performed if needed, according to the evolution of healing. Usually, sufficiency comes from one to three infiltrations administered with an interval of 7-10 days.

Normally, the patient is back to sport at 8-10 weeks. (Fig. 5)

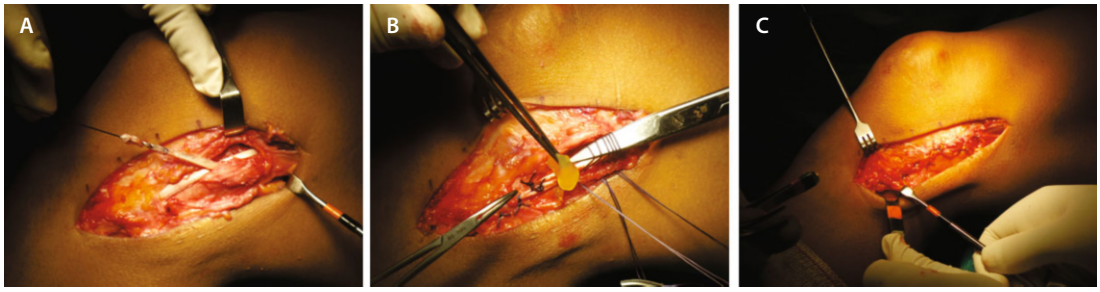

FIG. 4
MCL reconstruction surgery. A) Reconstruction with semitendinousus tendon (ST) and gracilis. B) PRGF clot after the the tendon suture. C) Articular capsule sutured.

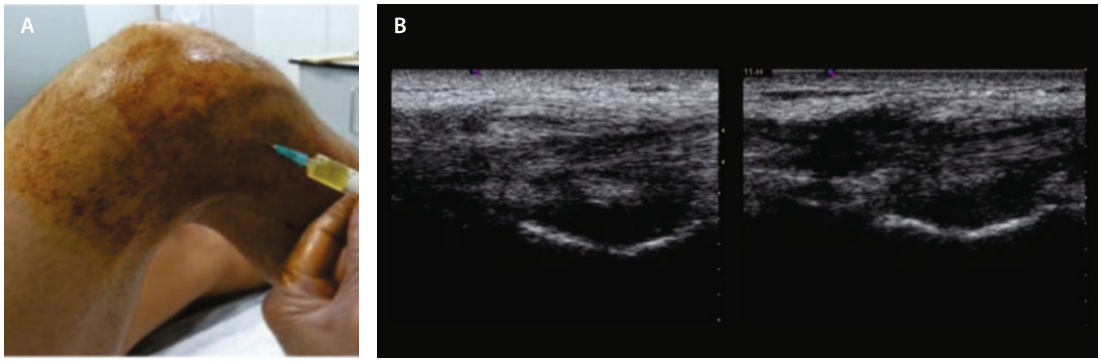

FIG. 5
A) LCL injury treated with PRGF. B) Ultrasound follow-up of the treated injury.

If the injury is complex, surgical treatment is advised. There are many surgical techniques that can be performed, and in all cases, after surgery infiltration into the repaired area with a Fraction 2 (Platelet Rich) of leukocyte-free PRGF, 4 to 7 cc. is recommended. (Fig. 6)

Isolated Injury	• 4 - 7 cc PRGF: 1 - 3 Injections • Cryotherapy • Antivarus Brace • Physiotherapy • Flexo-Extension Exercises (without pain) • Re-education Quadriceps & Hamstrings • Return to sport between 8-10 weeks
Complex Injury	• LCL reconstruction & other injured structures • 5 - 7 cc PRGF: 1 - 2 Injections • Physiotherapy • Rehabilitation program • Return to sport starting at 7-8 months

Anterior cruciate ligament (ACL)

Injuries causing only anteroposterior instability (Lachman Test + and Pivot Shift -) can be solved with a conservative therapy:

1. Infiltration should be performed under arthroscopic control of the Fraction 2 (Platelet Rich) of leukocyte-free PRGF, 3-4 cc, into the ligament and 5-6cc intraarticularly. Or alternatively, an intraarticular infiltration of the Fraction 2 (Platelet Rich) of the PRGF leukocyte-free, 7-8 cc. may be done.
2. Immobilization for 3-4 weeks.
3. Physiotherapy.
4. Rehabilitation program.
5. Regular medical controls between 8-12 weeks. (Fig. 7)

According to the recovery evolution, infiltration is repeated if needed. Usually, from one to three injections administered with an interval of 7-10 days is sufficient.

FIG. 6
Surgical Treatment of the LCL and Biological augmentation with PRGF clot.

However, injuries that cause rotational instability (Pivot Shift +), isolated or combined, the treatment performed is surgical with Biological augmentation with PRGF.

1. Arthroscopic ACL reconstruction and treatment of other structures if needed.
2. Intraarticular infiltration of Fraction 2 (Platelet Rich) of the PRGF leukocyte-free, 7 to 8 cc.
3. Physiotherapy.
4. Rehabilitation program and return to sport starting at 6 months. (Fig. 8)

Partial Rupture with Lachman Test +	• 3 – 4 cc PRGF ligament: 1 - 2 Injections • 5 – 6 cc PRGF intraarticular: 1 – 2 injections • Cryotherapy • Physiotherapy • Re-education Quadriceps & Hamstrings • Return to sport between 8-12 weeks
Injury with Pivot Shift +	• ACL arthroscopic reconstruction & surgical treatment to the other injured structures if it is necessary • 7 - 8 cc PRGF intraarticular • Physiotherapy • Rehabilitation program • Return to sport starting at 6 months

Posterior Cruciate Ligament (PCL)

In acute Grade I and II isolated injuries, a conservative treatment is recommended:

1. Infiltration under ultrasound control of the Fraction 2 (Platelet Rich) of the leukocyte-free PRGF, 3-4 cc, into the ligament and 5-6cc intraarticularly. If it is a grade II injury, more infiltrations may be needed.
2. 3-4 weeks (grade I) or 6-8 (grade II) of PCL brace placed, unblocked.
3. Physiotherapy.
4. Rehabilitation program.
5. Regular medical controls.

Depending on the recovery evolution of the patient, more infiltrations will be done. Usually, from one to three infiltrations administered with an interval of 7-10 days will suffice. (Figs. 9-10)

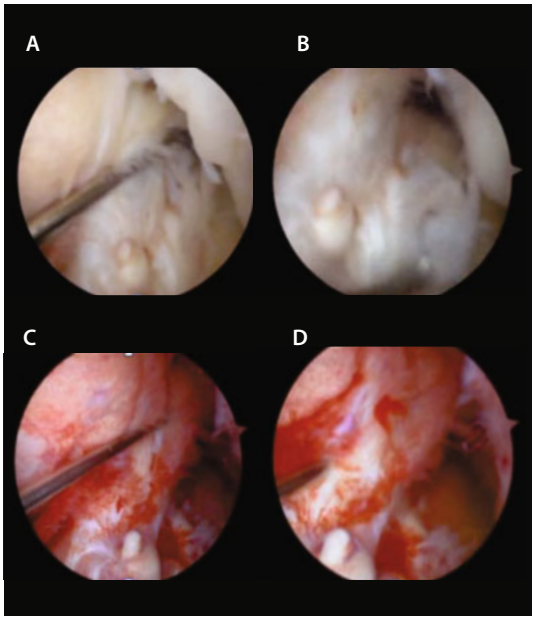

FIG. 7
A) ACL partial rupture. B) Infiltration with PRGF in the healthy posterolateral (PL) band of the ACL.

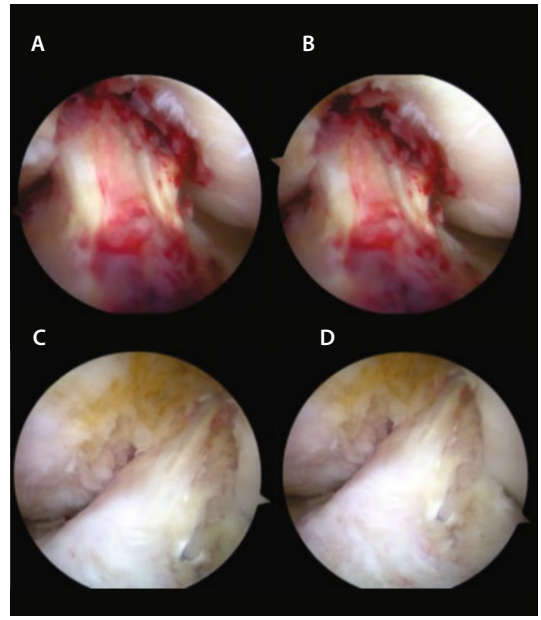

FIG. 8
A) Arthroscopic view, 7 weeks post ACL reconstruction and PRGF injection. B) Arthroscopic view, 14 weeks post ACL reconstruction and PRGF injection.

Grade I Isolated Injury	• 3 – 4 cc PRGF ligament: 1 - 2 Injections • 5 – 6 cc PRGF intraarticular: 1 – 2 injections • Cryotherapy • PCL Brace: 3 – 4 weeks • Physiotherapy • Re-education Quadriceps & Hamstrings • Return to sport 3-4 months after injury
Grade II Isolated Injury	• 3 - 4 cc PRGF ligament: 3 Injections • 5 – 6 cc PRGF intraarticular: 3 injections • Cryotherapy • PCL Brace: 6 – 8 weeks • Physiotherapy • Rehabilitation program • Return to sport 4-5 months after injury
Grade III Injury	• PCL arthroscopic reconstruction & surgical reconstruction to other injured structures if it is necessary • 3 - 4 cc PRGF intra-substance ligament & 5 - 6 cc PRGF intraarticular • 2 - 3 weeks postsurgery, PCL Brace: 3 – 4 months • Physiotherapy • Rehabilitation program • Return to sport 6-8 months after surgery
Complex Injury	• PCL arthroscopic reconstruction & surgical reconstruction to other injured structures if it is necessary • 3 - 4 cc PRGF intrasubstance ligament & 5 - 6 cc PRGF intraarticular • 2 - 3 weeks postsurgery, PCL Brace: 4 – 5 months • Physiotherapy • Rehabilitation program • Return to sport 8-10 months after surgery

Return to sport is at 3-4 months in the grade I isolated injury, and at 4-5 months in the grade II isolated injury.

In acute Grade III injuries and chronic injuries, a surgical treatment is recommended:

1. Arthroscopic PCL reconstruction and surgical reconstruction of other structures if necessary.
2. Infiltration of the Fraction 2 (Platelet Rich) of the leukocyte-free PRGF, 3-4 cc, in the ligament and 5-6cc intraarticularly.
3. 2-3 weeks after surgery, a PCL brace for 3-4 months, free and not blocked.
4. Physiotherapy.
5. Rehabilitation program

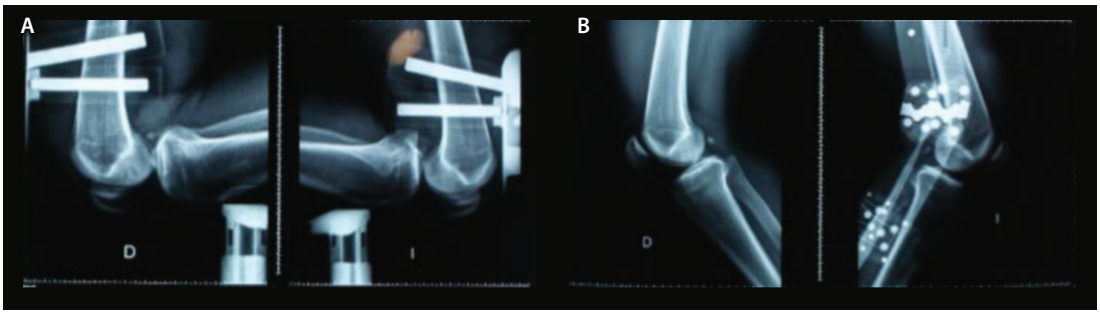

FIG. 9
A) Telos exam of both knees. D-Right (healthy knee) and I-Left (injured knee). B) X-ray profiles of both same knees. D-Right normal and I-Left with PCL brace which reduces the posterior tibial translation.

FIG. 10
PCL injury. Brace, PRGF intraarticular infiltration and PRGF ultrasound guided injection in the PCL.

3. ANKLE

ANATOMY AND FUNCTION

The ankle joint is made of three bones: Tibia and Fibula are the proximal while Talus is the distal bone.

The lower end of the tibia and fibula make an arch in which the trochlea of the talus is articulated. The peroneal malleolus, which is lateral, is bulkier than the tibial or medial malleolus.

This structure is surrounded by a fibrous capsule with ligaments, muscles and tendons. The muscles and tendons provide the movement.

Ligaments:
Internal Lateral Ligament or Deltoid Ligament is located in the medial part of the ankle joining the tibia with the talus and the calcaneus. It has two levels: deep and superficial. The deep one has two bands: anterior tibiotalus band and posterior tibiotalus band. The superficial one is larger with a triangular shape, connecting the tibia to the navicular in its lower edge and with the medial edge of the glenoid and the minor process of the calcaneus.

Lateral Collateral Ligament has three fascicles. The anterior bundle or the Anterior Talofibular Ligament joins the anterior edge of the peroneal malleolus to the talus. The medial band or Calcaneofibular Ligament (CFL) extends from the most prominent point of the peroneal malleolus to the lateral part of the calcaneus. The posterior band or Posterior Talofibular Ligament (PTFL) connects the medial side of the peroneal malleolus with posterioexternal tubercle of the talus.

The Anterior Ligament is a capsular thickening which is inserted into the talus.

The Posterior Ligament is a capsular thickening which is inserted into the talus.

The ligament of the anterior syndesmosis and the ligament of the posterior syndesmosis maintain the tibiofibular arch with the correct interosseous distance.

The movements of the tibiofibulotalar joint are plantar flexion or "flexion" and dorsal flexion or "extension".

INJURIES

Epidemiology of ligament injuries of the ankle.

Time reviewed	Season 2014-15
Anterior Talo-Fibular Ligament	1.355
Deltoid Ligament	233

The epidemiology of ankle injuries in the Mutualitat Catalana de Futbolistes, MCF, may well differ from general population epidemiology. Players from the MCF are highly active athletes in sports practise whose ankles suffer higher stress than normal.

Deltoid ligament

The injury diagnosis is confirmed with radiology (Stress Rx), MRI and static and functional ultrasound.

1. Infiltration of the Fraction 2 (Platelet Rich) of the leukocyte-free PRGF, 3-4 cc, in the ligament tissue and 5-6cc intraarticularly.
2. Placement of taping for 4-6 weeks.
3. Physical therapy.
4. Rehabilitation program.
5. Back to sport at 10-12 weeks. (Figs. 11-12)

Deltoid ligament Injury	• 3 - 4 cc PRGF intrasubstance ligament & 2 - 3 cc PRGF intraarticular • Taping for 4 – 6 weeks • Physiotherapy • Rehabilitation program • Return to sport 10-12 weeks

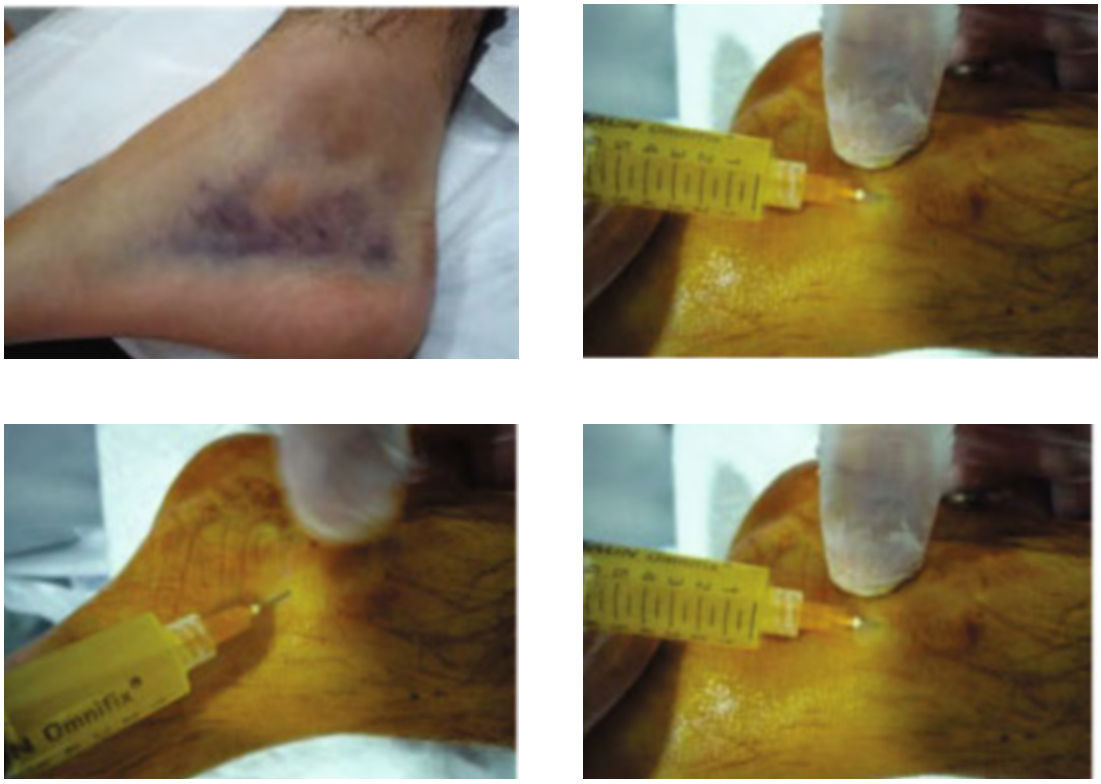

FIG. 11
Deltoid Ligament injury. Treatment with PRGF infiltration

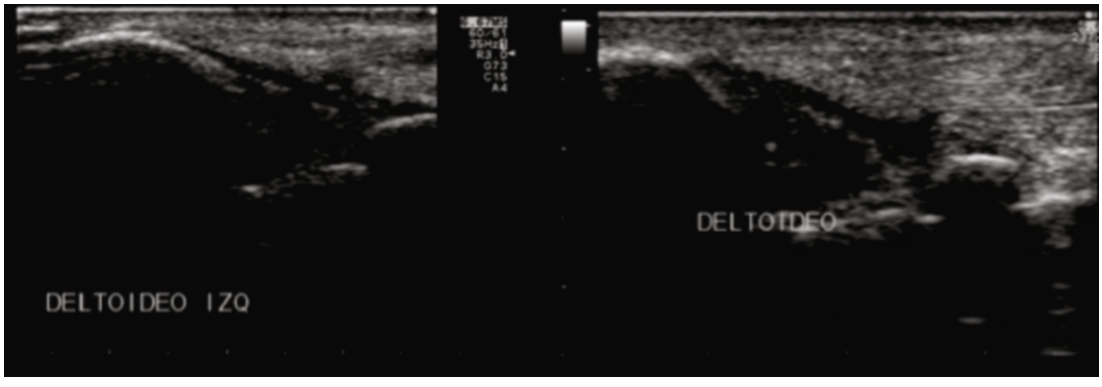

FIG. 12
Deltoid Ligament injury. Ultrasound follow-up control.

Anterior Talofibular ligament

The injury diagnosis is confirmed with radiology (Stress Rx), MRI and static and functional ultrasound.

1. Infiltration of the Fraction 2 (Platelet Rich) of leukocyte-free PRGF, 3-4 cc, in the ligament substance and 5-6cc intraarticularly.
2. Placement of taping for 4 weeks.
3. Physical therapy.
4. Rehabilitation program.
5. Back to sport at 4-7 weeks. (Figs. 13-14)

Anterior talofibular Injury	• 3 - 4 cc PRGF intrasubstance ligament & 2 - 3 cc PRGF intraarticular • Taping for 4 weeks • Physiotherapy • Rehabilitation program • Return to sport 4-7 weeks

4. REHABILITATION / RETURN TO SPORT

In ligament injuries the role of the physiotherapist is very Important. The main objective is to eliminate pain and decrease the swelling, then regain a good range of motion and finally re-establish the muscle mass.

The main objective of the first days is to diminish the swelling and pain, and next is to work with the physiotherapist on the range of motion to reestablish it, and then strength exercises must be conducted to maintain and restore good muscle tone.

FIG. 13
Anterior Talo-Fibular Ligament injury. Treatment with PRGF injection.

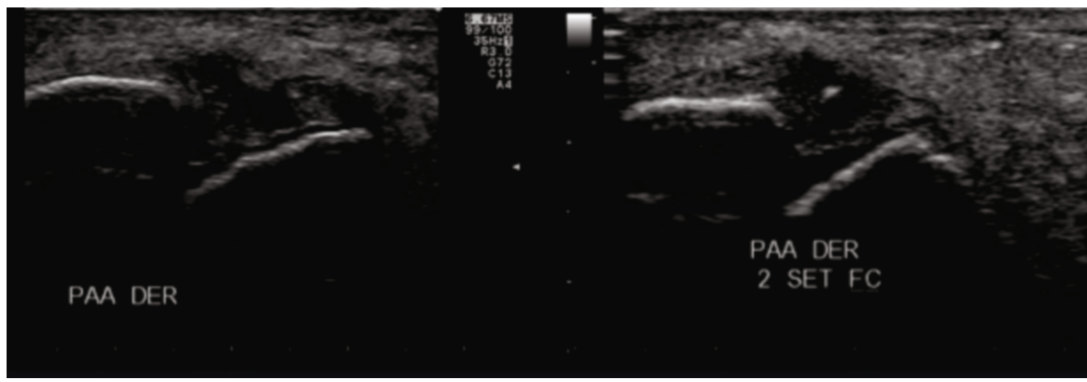

FIG. 14
Anterior Talo-Fibular Ligament injury. Follow-up control with Ultrasound.

When a brace is needed, the rehabilitation must be adapted to this circumstance.

If the injury requires surgical treatment, the recovery process could be longer and more delicate. (Fig. 15)

INJURIES IN EARLY AGE POPULATION – DEVELOPMENT IN ADVANCED AGE

Nowadays, increasing sports practise among children is a serious matter of concern. They practice sport as entertainment, training and taking part in championships, so the level of requirements has increased. It is very important to respect a young person's physical moment and age. The values, health and formative stage should be a priority. The physical formative stage is between 12 and 15 years. At that time, foundations must be created in mobility, strength, flexibility and endurance, in order to prevent a non-normal development during sports practice.

Severe injuries at an early age are becoming more common and the consequences are a subject of study. There are some studies that discuss this problem, and Dekker et al. conclude that early surgical treatment which is favoured to prevent concomitant articular injuries and an early return to play, can increase risk of re-injury and should be met with caution in this age group[7]. Conversely, Werner et al. demonstrated that paediatric and adolescent patients who underwent ACL reconstruction had significant increases in incidences of concomitant meniscal and cartilage procedures[8]. Similarly, the Vavken et al. study showed that more than half of the children and the adolescents treated for ACL tear have concurrent meniscal or chondral injury[9].

On the other side, the major problem years after the retirement of an elite athlete is osteoarthritis, OA, which he or she may develop in the injured joints. Therefore, a treatment to prevent a post-traumatic OA is fundamental to the normal behaviour of the injured joint after recovery.

PRGF treatment is not only positive and useful during an acute injury, it is also positive in the long term. PRGF injection avoids or diminishes the apparition of bone edema and early OA in ligament-injured joints. Some studies have concluded that not only are PRGF injections beneficial in treating injury, they are a good treatment to prevent OA.

FIG. 15
Rehabilitation exercises in the gym and outdoor (in a more advanced stages of the recovery).

1. *Pierce GF, Mustoe TA, Altrock BW, Deuel TF, Thomason A. Role of platelet-derived growth factor in wound healing. Journal of cellular biochemistry. 1991;45:319-26.*

2. *Kiritsy CP, Lynch AB, Lynch SE. Role of growth factors in cutaneous wound healing: a review. Critical reviews in oral biology and medicine : an official publication of the American Association of Oral Biologists. 1993;4:729-60.*

3. *Canalis E. Clinical review 35: Growth factors and their potential clinical value. The Journal of clinical endocrinology and metabolism. 1992;75:1-4.*

4. *Molloy T, Wang Y, Murrell G. The roles of growth factors in tendon and ligament healing. Sports Med. 2003;33:381-94.*

5. *Nico B, Mangieri D, Benagiano V, Crivellato E, Ribatti D. Nerve growth factor as an angiogenic factor. Microvascular research. 2008;75:135-41.*

6. *Anitua E, Andia I, Sanchez M, et al. Autologous preparations rich in growth factors promote proliferation and induce VEGF and HGF production by human tendon cells in culture. Journal of orthopaedic research : official publication of the Orthopaedic Research Society. 2005;23:281-6.*

7. *Dekker TJ, Rush JK, Schmitz MR. What's New in Pediatric and Adolescent Anterior Cruciate Ligament Injuries? Journal of pediatric orthopedics. 2016.*

8. *Werner BC, Yang S, Looney AM, Gwathmey FW, Jr. Trends in Pediatric and Adolescent Anterior Cruciate Ligament Injury and Reconstruction. Journal of pediatric orthopedics. 2016;36:447-52.*

9. *Vavken P, Tepolt FA, Kocher MS. Concurrent Meniscal and Chondral Injuries in Pediatric and Adolescent Patients Undergoing ACL Reconstruction. Journal of pediatric orthopedics. 2016.*