

Functional rehabilitation and sports readaptation program in soccer patients between 17 and 20 years old after for reconstruction of anterior cruciate ligament

Programa de rehabilitación funcional y readaptación deportiva en pacientes futbolistas entre 17 y 20 años de edad después de reconstrucción de ligamento cruzado anterior

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DOI: 10.35429/JHEW.2021.9.5.15.22

Received July 20, 2021; Accepted December 30, 2021

Abstract

In sport, the main mechanism of injury is related to mechanical force, which is characterized by its magnitude, location, direction, frequency, variability and speed of application. The knee is a frequent site of injuries in soccer, particularly in the ligaments, since they are structures that contribute significantly to the stability of the joint. The anterior cruciate ligament is the main stabilizer against the anterior displacement of the tibia on the femur. Providing 87% of the resistance against this displacement when the knee is at 30° of flexion, in addition, the anterior cruciate ligament acts as a secondary stabilizer against valgus tension during full extension.

Functional rehabilitation, Sports readaptation, Anterior cruciate ligament

Resumen

En el deporte, el principal mecanismo de lesión se encuentra relacionados con la fuerza mecánica, la cual se caracteriza por su magnitud, localización, dirección, frecuencia, variabilidad y velocidad de aplicación. La rodilla es una localización frecuente de lesiones en fútbol, en particular en ligamentos, ya que son estructuras que contribuyen de manera importante a la estabilidad de la articulación. El ligamento cruzado anterior es el principal estabilizador frente al desplazamiento anterior de la tibia sobre el fémur. Proporcionando el 87% de la resistencia contra este desplazamiento cuando la rodilla se encuentra a 30° de flexión, además, el ligamento cruzado anterior actúa como estabilizador secundario contra la tensión en valgo durante la extensión completa.

Rehabilitación funcional, Readaptación deportiva, Ligamento cruzado anterior

Citation: SANTANDER-VELÁZQUEZ, Fabiola. Functional rehabilitation and sports readaptation program in soccer patients between 17 and 20 years old after for reconstruction of anterior cruciate ligament. Journal-Health Education and Welfare. 2021. 5-6:15-22.

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Introduction

The anterior cruciate ligament (ACL) is a structure that plays a fundamental role, since it ensures the normal function of the knee. This ligament is stretched or torn in 70% of all severe knee injuries (Tortora & Derrickson, 2006).

Seco (2016) describes that the anterior cruciate ligament is a cordonal ligament with very little elongation power and with no healing capacity, since when it breaks its ends retract.

Sports rehabilitation of an injury such as the anterior cruciate ligament requires not only the complete restoration of the functional performance of the knee joint, but also includes the maintenance of the athletic physical capacities of the athlete, through their work according to a training plan. modified according to the characteristics and time of the injury, which helps in the same way that the athlete feels safe and without fear when returning to their sports activities in their team.

In this way, the model of a treatment plan for a sports injury is very similar to a training plan, with additions from the psychology area that allow the athlete to be prepared for full integration into the activity and the necessary physiotherapy on the pathological focus. , considering the treatment, and the surgical technique, as well as the recovery time necessary for the footballer to fully reintegrate into his sporting life.

That is why there must be a set of designed strategies that are framed in the area of injury re-adaptation, which is understood as the set of medical-therapeutic and physical-sports measures aimed at preventing the risks of injury, reestablishing and developing health sports and improve or optimize the athlete's performance to enable a greater sports life (Lalín & Peirau, 2011).

The intervention systems for the physical preparation of the current soccer player are based on optimizing in isolation each of the components that make up the structure of the athletes' performance, such as coordinative, conditional and cognitive elements, which could be applied to injured patients, who require a longer recovery time, this as long as the patient's own physiological principles of recovery are respected, taking into account the work and the physiotherapeutic objectives.

In various texts related to the physiotherapeutic objectives, they greatly emphasize that the knee must have an adaptation process prior to the reintegration of the athlete through techniques related to physical preparation and sports training, as well as techniques of physical rehabilitation, taking into account various biological processes suffered by the postoperative patient, to avoid generating damage to the graft of the same.

It is necessary to propose and validate theoretical methodological elements that explain how to link sports rehabilitation and sports rehabilitation that allow contributing to the reintegration process to sports training but considering the stages of ligamentization to avoid damage to the graft and optimize the rehabilitation of the athlete.

This research aims to carry out a functional rehabilitation and sports rehabilitation program that considers the ligamentization process necessary to improve the reincorporation process of a soccer athlete in the sports field, in which the objectives and methodological aspects of two areas of the sport are considered. knowledge that involve the readaptative process of the patient, such as physiotherapy and physical preparation or sports training.

Anterior cruciate ligament injury

The knee is a frequent site of injuries in soccer, particularly in the ligaments, since they are structures that contribute significantly to the stability of the joint (Kolt & Snyder, 2004).

In this sense, the anterior cruciate ligament:

“It is the main stabilizer against the anterior displacement of the tibia on the femur, providing 87% of the resistance against this displacement when the knee is at 30 ° of flexion, in addition, the anterior cruciate ligament acts as a secondary stabilizer against tension. valgus during full extension” (Kolt & Snyder, 2004).

Therefore, the anterior cruciate ligament is a structure that plays a fundamental role, since it ensures the normal function of the knee (Scott, 2007). However, for Tortora & Derrickson (2006), the ligament is stretched or torn in 70% of all severe knee injuries.

The most frequent injury mechanism in the anterior cruciate ligament is described by Álvarez et. to the. (2008):

“It is the rotation of the femur on a fixed tibia, that is, when the foot is supported, during an excessive or forced valgus movement. Hyperextension of the knee is also common, isolated or in combination with internal rotation of the tibia, however, recently ACL injuries have been observed during forced knee flexion, so it can be considered a third mechanism of injury”.

Surgical treatment after an anterior cruciate ligament injury

Currently, to replace a broken anterior cruciate ligament of an athlete patient, a ligamentoplasty is performed, which is the replacement of the ligament by a tendon, with an autologous graft, that is, tendons from the patient himself or with a cadaver graft.

The two most used techniques are: the one that uses the central third of the patellar tendon as a plasty (bone - tendon - bone or HTH) or the one that performs a plasty with the tendons of the goose foot (double semitendinosus and internal rectus or T4).

Both techniques attempt to reproduce the anatomy of the anterior cruciate ligament, and for this, tunnels are made in the tibia and femur to introduce the implant, anchoring them to the bone with different fixations (Seco, 2016).

Ligamentization process after anterior cruciate ligament surgical procedure

Living tissues and organs are dynamic, they change their mechanical properties and structure, in response to stress alterations as a phenomenon of their functional adaptation and seeking optimal activity. This model is known as the remodeling process.

Tendons and ligaments have the ability to adapt to new working conditions in response to changes in tension and movement within suitable working conditions.

The functional adaptation that takes place in a tendon graft after 30 weeks to become the ligament it replaces was called "ligament." This is the integration process of the plasty, that is, the ligamentization, it is the process by which a tendon is transformed into a stabilizing ligament with the same shape as the ACL, following the well-known "law of functional adaptation" established by Roux, at the end of the 19th century.

In short, ligamentization is a process by which a tendon transplant, after implantation, is modified to give rise to a neoligament. For Quelard, Ratchet, Sonnery-Cottet and Chambat (2010), this transformation consists of the following stages:

- From 0 to 2 months: cell colonization phase during which there is an increase in fibroblasts and inflammatory cells and the formation of neovessels from the periphery of the graft. In the transplant, small areas of degeneration of the collagen fibers are seen. A synovial neomembrane surrounds the graft after the third week.
- From 2 to 12 months: rapid collagen remodeling phase, during which the increase in fibroblasts is maximum and their activity is very intense. In addition, areas of degeneration are observed. The organization of collagen fibers and their vascularization begin in the sixth month. After 1 year, the biochemical components of the transplant are those of a ligament.

- From 1 to 3 years: maturation phase during which the cellularity and vascularization of the graft slowly decrease. At 3 years, the histological and biochemical structure of the transplant is similar to that of a normal anterior cruciate ligament and the differences only concern the proportions of some elements and the lack of innervation.

After the ligamentization phases have been completed, the mechanical performance of the transplant decreases its initial resistance by up to 50%, therefore, an excessive increase in loads is capable of causing elongation or rupture of the graft, on the other hand, an increase in loading is necessary for collagen to mature and organize (Quelard, 2010). For this reason, it is extremely important to consider these phases when planning a rehabilitation and rehabilitation program for the athlete patient.

Rehabilitation and readaptation of the anterior cruciate ligament in soccer players

Rehabilitation after anterior cruciate ligament reconstruction has undergone very important changes in recent decades as a result of new scientific knowledge and clinical observations, which have allowed the development of more aggressive protocols to accelerate the rehabilitation process.

Sánchez, Fernández, Llorensí, Pérez, Soto (2009), mention that accelerated rehabilitation protocols have shown better results, as long as the minimum recovery period of 6 months is respected, compared to classic rehabilitation protocols, whose main characteristics are long periods of immobilization, and very gradual muscle reinforcement kinesitherapy. And the basic principles of these rehabilitation protocols are: control of pain, effusion and edema. mobilization and early loading of the limb, specific kinesitherapy that does not produce excessive tensions in the plasty, exercises in a closed kinetic chain, proprioceptive neuromuscular re-education, and finally rapid reincorporation to sports practice and / or activities of daily life.

The sports rehabilitation of an injury such as the anterior cruciate ligament requires not only the complete restoration of the functional performance of the knee joint, but also includes the maintenance of the athletic physical capacities of the athlete, through their work according to a modified training plan. according to the characteristics and time of the injury.

In this way, the model of a treatment plan for a sports injury is very similar to a training plan, with the addition of the necessary physiotherapy on the pathological focus, considering the treatment, and the surgical technique, as well as the recovery time. necessary for the footballer to fully reintegrate into his sporting life.

On the other hand, the time taken by the athlete in his recovery must be considered, since the footballer will be unable to train with his sports team, and that his physical capacities, mainly of a conditional type, will be affected, in addition to the importance of taking care of the anterior cruciate ligament graft, to prevent damage to the graft. Hence the importance of comprehensive work that two large areas of knowledge can provide, such as physiotherapy and physical preparation.

In this sense, Lloret (1989) conceptualizes that sports rehabilitation is the basic entity of sports medicine, which is based on the application that kinesitherapy provides.

It is essential to consider that in order to develop a rehabilitation protocol, theoretical and methodological aspects must be considered dominated by professionals in physical preparation and sports, with the approval of the sports doctor and physiotherapist, guaranteeing the biological recovery times of the injury, as well as the development of the physical and technical capacities of soccer.

And currently there is little documentation focused on retraining and on the tasks planned by the physical trainer or retrainer. Almost all of the studies investigate from a sports medicine perspective and not from a physical education and sports perspective. (Caraffa, Cerulli, Progetti, & Aisa, 1996; Ramos *et al.*, 2008).

Various authors mention that the readaptative process must be based on the principles of reeducation, with a correct prescription of exercises, which may well be organized in different phases, respecting the biological processes of physiological and anatomical recovery.

Ageberg (2005) considers that sports rehabilitation is understood as the set of medical-therapeutic and physical-sports measures aimed at preventing the risks of injury, reestablishing and developing sports health and improving or optimizing the athlete's performance to enable a longer life sporty.

Material and methods

It is essential to explain that the functional rehabilitation and sports rehabilitation program in soccer players between 17 and 20 years of age after anterior cruciate ligament surgery is based on the traditional planning of soccer training, considering the ligamentization phases of the graft, in order to identify the elements to consider that allow us to validate said proposal, in addition to knowing the areas of opportunity, as well as the methodological elements, which must be taken into account to apply this type of work proposal.

Injured footballers will begin rehabilitation as soon as possible with specific interventions aimed at reducing pain, inflammation, regaining range of motion, proprioception, and increasing conditional physical abilities, while specific gestures are attempted to be introduced early, but taking into account the time of injury, and the physical limitations that the graft presents, to avoid affecting it.

It will work with 5 phases, since it takes into account the rehabilitation objectives that represent a progress in the treatment and physiological adaptations to the injury, as well as the objectives of sports training that are focused on improving sports performance through work in conditional and coordinative capacities.

Phase 1: Diagnosis and medical treatment

At this stage, the moment in which the footballer is injured, the medical diagnosis, including the performance of the imaging studies, as well as the surgical intervention are considered, ending this stage when the patient arrives at the physiotherapy area.

Phase 2: Physiotherapeutic treatment and maintenance of sports form

This phase lasts approximately 8 weeks, in which the graft undergoes the first two phases of ligamentization, which are the necrosis phase and the coating of the synovial membrane. In this phase, greater importance is given to the rehabilitation area and according to the physiological recovery times, the main objectives in the rehabilitation and physiotherapy area will be to decrease pain and inflammation, as well as gradually recover the optimal range of motion, as well as work unloading exercises in order to gradually remove the accessories for support as well as re-education of the gait and treatment of the scar. On the other hand, the rehabilitation area will enter this phase with the acquisition stage, where it seeks to develop the foundations for the sports form, produce the accumulation of multilateral motor and coordinative capacities, that is, a general motor development.

Phase 3: General re-adaptation

During this phase, the graft is undergoing complete revascularization, spanning the third month to the sixth month. Sports rehabilitation is taking more importance. The physiotherapy area will modify and decide which objectives it is going to treat depending on the needs of the patient. While the rehabilitation area enters a stabilization stage where the gradual improvement of the level of preparation is sought, consolidating the stability of the preparation and improving the results in competitive performance.

Phase 4: Specific re-adaptation

The graft is in the last phase of ligamentization, which is the remodeling of the implant, however this stage lasts up to 18 months, but the risk that the graft suffers some type of damage decreases considerably. In this phase, it is intended that the athlete perform exercises with technical and tactical gestures with a higher level of complexity, getting closer and closer to the physical demands of the sport.

Phase 5: Total integration to the team

In this phase, the aim is for the soccer player to fully integrate with his team, while in the re-adaptation area the training of high loads will be interrupted, facilitate active recovery and renew the athlete's adaptation reserves.

Conclusions

Currently, an injury with the characteristics of the rupture of the anterior cruciate ligament places the footballer at a severe disadvantage, either due to lost time, or due to the complexity of the re-adaptation and rehabilitation process that this type of injury entails. Leads to wanting to accelerate the recovery processes, and despite the fact that there are various rehabilitation protocols, these are directed with a medical approach, without specifying or deepening on the loss of conditional and coordinative physical capacities that occurs due to the time of injury, in this way, an area of opportunity can be found, where it can be complemented through two large areas such as physical preparation and physical rehabilitation, and create a tool that enhances sports rehabilitation while recovering capacities physical losses, respecting recovery times, with the help of specific objectives you are looking for in the physiotherapy area.

It is important to emphasize that the times established in this program are estimated, that is, they are not absolute, since it must be remembered that each patient has a different evolution and recovery time, and it is important to remember that each work methodology must be individualized. It is used with patients with any type of injury.

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PHASE I	
Objetives	Diagnosis and medical treatment
Activities	Pruebas ortopédicas, estudios de imagen

Table 1 Phase I. Functional rehabilitation and sports rehabilitation program in soccer patients between 17 and 20 years of age after anterior cruciate ligament reconstruction

Phase	Phase I	Phase II	Phase III	Phase IV	Phase V
Start	1	2	3	4	5
Ligamentization	1	2	3	4	5
Physiotherapeutic work	1	2	3	4	5
Strength	1	2	3	4	5
Flexibility	1	2	3	4	5
Speed	1	2	3	4	5
Neuromuscular and proprioceptive control	1	2	3	4	5
COSE exercises	1	2	3	4	5

Table 2 Phase II to Phase IV. Functional rehabilitation and sports rehabilitation program in soccer patients between 17 and 20 years of age after anterior cruciate ligament reconstruction

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