

**Proprioceptive training a method adopted to prevent injuries in players of 13 years****Entrenamiento propioceptivo un método adoptado para prevenir lesiones en futbolistas de 13 años**

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**Abstract**

Objetives: To know the efficacy, the benefit, and the importance of proprioceptive training in children 13 years of age. As well as the application of an injury prevention program designed according to the age of the players analyzed. The proprioception previously was used for the recovery of injuries, nowadays it has been implemented in daily training of different disciplines. One of the first works for the prevention of injuries was the FIFA 11+ which mentions that the injuries can be reduced from 30% to 50%. Methodology: The investigation was Longitudinal, Experimental, Prospective and Quantitative. Contribution: The collection of information resulted in a high benefit of prevention of sports injuries with proprioceptive exercises in the sport of soccer. It was possible to reduce a 67% injury rate

**Proprioception, Injury, Therapeutic Training, Skeletal Muscle, Prevention****Resumen**

Objetivos: Conocer la eficacia, el beneficio, y la importancia del entrenamiento propioceptivo en los niños futbolistas de 13 años de edad. Asi como la aplicación de un programa de prevención de lesiones diseñado de acuerdo a la edad de los futbolistas analizados. La propiocepción anteriormente se utilizaba para la recuperación de lesiones, hoy en día se a implementado en los entrenamientos a diario de diferentes disciplinas. Uno de los primeros trabajos para la prevención de lesiones fue los FIFA 11+ el cual menciona que las lesiones se pueden disminuir de un 30% a un 50%. Metodología: La investigación fue de tipo Longitudinal, Experimental, Prospectiva y Cuantitativa. Contribución: La recopilación de información arrojó como resultado un beneficio alto de prevención de lesiones deportivas con los ejercicios propioceptivos en el deporte del futbol. Se logro reducir un porcentaje lesional del 67%.

**Propiocepción, Lesión, Entrenamiento Terapéutico, Musculo Esquelético, Prevención**

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## Introduction

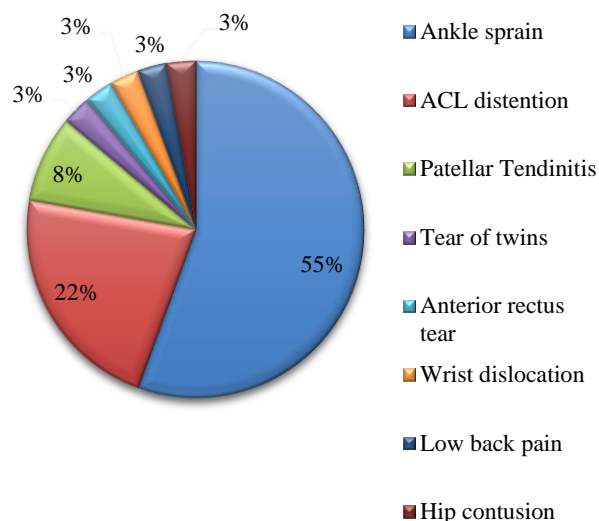
Proprioception refers to the ability of the body to detect the movement and position of the joints. It is important in the common movements that are made daily, especially in sports movements that require a greater level of coordination (Saavedra, 2003; Lephart, 2003; Griffin, 2003). This has as an important role to maintain joint stability under dynamic conditions, providing control of the desired movement and joint stability. The proper coordination of muscle coactivation (agonists - antagonists) attenuates the loads on the articular cartilage (Ibid.). There are multiple programs that facilitate the training of the conditional and athletic physical capacities necessary for the demands of football<sup>10</sup>.

The programs that already exist complement the sports training programs in each club and help prevent injuries to athletes. They include stability exercises, agility, neuromuscular control and proprioception. Some others mix coordination activities, facilitating the improvement of the static and dynamic balance. Such is the case of the exercise program called The 11 FIFA®, developed with the support of the International Federation of Associated Football (FIFA) ® and published in the renowned British Medical Journal in 2008., which focuses on the prevention of injuries and it consisted of a complete heating divided into 3 stages.

Lephart in 2003 mentioned that the best sensory source to provide the necessary information to mediate neuromuscular control and improve functional joint stability is proprioception.

During 7 months in the year of 2017, from June to December an investigation was made which consisted in detecting the type and number of injuries in soccer children of 13 years of age, 36 injuries were found, 27 of them were presented during the first 3 months leaving the other 9 for the 4 months in which the proprioceptive training work was implemented.

**Injuries detected during the investigation work for 7 months**



**Graphic 1** Prevalence in percentage of injuries during the 7 months of investigation

Source: Self Made

The ankle sprain is the most frequent covering 55% of the total injuries, the incidence of distention of ACL has 22% of the total, this injury was frequent due to extrinsic causes since it was trained in an irregular terrain, as well as in a synthetic court which had edges and produced a bad footprint to the player, 8% corresponds to patellar tendinitis, and 15% is divided into twin tear, anterior rectus tear, wrist dislocation, lumbago and hip contusion.

It was demonstrated that when performing a proprioceptive training during the work week, in different unstable bases and with different degrees of difficulty in the applied exercises, a 67% injury rate is decreased based on our injuries obetenidas.

## 1 Influence of other stimuli on proprioception

Frequently the human being receives sensory stimuli that are multiple of stimuli of the environment that influence our senses and our body. The concept of doing proprioceptive exercises to restore neuromuscular control was initially introduced in rehabilitation programs. It was thought because the ligaments contain mechanoreceptors, and an injury to a ligament would alter afferent information, so in training, after an injury, it would be necessary to restore this altered neurological function.

The afferent pathways synapse in the dorsal horn of the spinal cord and from there they pass directly, or through the interneurons to the alpha and gamma neurons, which control the information coming from the periphery. Proprioception will depend on sensory stimuli such as: visual, auditory, vestibular, skin, joint and muscle receptors.

### **Proprioceptive system**

It is the one that provides us with information about the harmonic functioning of muscles, tendons and joints: it participates by regulating the direction and ranges of movement; allows reactions and automatic responses important for survival; intervenes in the development of the body schema and the relationship with space and sustains the planned motor action.

### **Vestibular system**

It responds to the movements of the body through space and the changes of position of the head, together with the proprioceptive system maintains muscle tone, automatically coordinates the movement of the eyes, head and body, maintaining a stable visual field and is fundamental in the perception of space and in the orientation of the body in relation to this.

When these three sensorial systems work correctly, a regulated, organized and skilled person can be observed, being able to develop responses adapted to the demand of the environment.

### **Touch system**

It is responsible for recording external information related to temperature, pain, touch, cold, heat; in this way it allows us to discriminate both the stimuli of the medium and react when they are threatening.

### **Sensory branch of the oculomotor nerve**

The sensitive branch of the oculomotor nerve is composed of afferent axons that send information from the receptors to the central nervous system and that come from proprioceptors of the extrinsic muscles of the eye. These axons report proprioception, non-visual perception of movements and body position.

### **Hearing receptors**

It acts as an acoustic analyzer that registers the sound waves and provides information of different situations: it indicates the orientation, technical and tactical measures. In the ear are the senses of hearing and balance these senses are captured through mechanoreceptors located in the human ear, the phonoreceptors are mechanoreceptors sensitive to sound stimuli, waves, produced by vibration and transmitted by a gaseous, liquid or liquid medium solid. They capture acoustic stimuli and their equilibrium information about changes in the position of the body in space.

### **Receptors of the skin**

They provide information on muscle tonic state and on movement, contributing to the sense of position and movement, especially of the extremities, where they are very numerous.

### **Skin receptors**

The cutaneous mechanoreceptors that surround the joint exclusively provide information on external events (exteroceptors) that affect the joint system. Cutaneous receptors on the plantar surface play an important role in postural control by signaling the distribution of weight and location of the center of gravity (Childs, 2003; Buz, 2004). In general, the skin receptors constitute sensations, that is, the superficial sensitivity of the body.

Some authors also claim that not only lesions diminished, but in no case could the work of proprioception be harmful (Owen, J.L. and Cols, 2006).

### **Receptors of the joint capsule and articular ligaments**

They are sensitive mechanoreceptors located in the soft structures of the joint. (joint capsule and ligaments). The load that these structures support in relation to the muscular tension exerted, also activates a series of mechanoreceptors capable of detecting the movement of the involved joint. These are important proprioceptors when the structures are damaged.

**Ruffini capsule corpuscles:**

These receptors are located mainly on the anterior and posterior sides of the joint capsule and are sensitive to the movements of flexion and extension of the joints.

**Golgi joint terminations:**

They are located in the articular ligaments and are more sensitive to abduction, adduction and rotation movements of the joint.

**Modified organs of Vater-Pacini:**

Are found in the periarticular tissues, that is around the joint, and are sensitive to any rapid movement of the joint and also to the pressures exerted on it.

**Muscular spindle**

It gives us information about changes in muscle length and participates in the stretch reflex. It sends information to the central nervous system where information is used to coordinate movement, the spindle muscles help us control movement, there are more muscle spindles where finer movements are made, such as fingers, it also helps to maintain stability of a joint.

**Tendinous spine (Golgi tendon organ)**

These are in the union of muscle and tendon, these respond to increases and decreases in muscle tension, they protect the tendons and muscles from damage caused by excessive tension. This is because the articular receptors contribute sensory information at the end of the joint movement available.

**Myotatic reflex**

It is a reflection of protection against a sudden or excessive stretching, the most common example is the patellar tendon strike to combrobar if we have normal reflexes (patellar reflex).

**2. Relationship of the joints with proprioception and mechanoreceptors**

The joints are characterized mainly by their proprioceptors and articular mechanoreceptors (Ruffini, Pacini corpuscles, free nerve endings, Golgi tendon organs) (Saavedra, 2003).

Research has shown that mechanoreceptors play an important role in joint stabilization. Afferent information is also processed and modulated in the cerebellum and cortex. Working completely subconsciously, the cerebellum has a role in planning and modifying motor activities.

The cerebellum is divided into three functional areas:

<b>Vestibulo-cerebellum</b>	Controls primary axial muscles responsible for postural balance
<b>Cerebro-cerebellum</b>	Plan and initiate movements of precision, speed and dexterity
<b>Hawthorn cerebellum</b>	Receives somatosensory, visual and vestibular afferent information. Adjusts movements and regulates muscle tone.

**Table 1** Cerebellum Divisions

*Source: Evidence of proprioceptive work used in the prevention of sports injuries*

Proprioception occurs by a complex integration of somatosensory impulses (conscious and unconscious) which are transmitted by means of mechanoreceptors, allowing neuromuscular control on the part of the athlete. (Childs, 2003; Buz, 2004)

Childs in 2003 and Buz in 2004 mentioned that there are three types of mechanoreceptors: joint, muscle and skin which have a joint role for maintaining good joint stability.

**3. Injury**

The WHO considers "injury" to any damage, intentional or unintentional, to the body due to acute exposure to thermal, mechanical, electrical or chemical energy; or due to the absence of heat or oxygen that leads to temporary or permanent bodily or psychic damage and that may or may not be fatal. Dvorak and Junke in the year 2000 for the supplement of the FIFA of the AMSM defined the injury as to that circumstance that occurred during the practice of football that caused the athlete the absence to training and / or matches followed by the need for a diagnosis of some damaged tissue and its corresponding treatment.

#### 4. The proprioceptive training

The work of proprioception over the years has worked effectively as a method of recovery and integration after an injury in sports, in recent years has been adopted as a method of injury prevention obtaining positive results, it is about a series of focused exercises. On this occasion we took on the task of conducting research on the effectiveness of this same proprioceptive work for the prevention and reduction of injuries in children 13-year-old soccer players.

Many authors recommend the proprioceptive work of the knee and ankle joint after the injuries, for the strengthening of these joint groups, but there is scientific evidence that the work of proprioception of these joints without these having any previous injury reduces the risk of suffering some injury (Jerosch . J. y Cols , 1996).

Nowadays, several studies have shown that the improvement of proprioception can reduce the risk of sports injuries, both in adolescent and adult children.

We must bear in mind that proprioception is of great importance and has always been present in our daily lives to carry out our activities of daily life, both at home, school, recreational and sports activities as said by Safran, M.R. And Cols in the year of 1999.

The work of proprioception, strength, coordination, are relegated many times only for the recovery of athletes and injured and are not used as a means to prevent the occurrence of injuries. Training techniques should be designed to develop individualized neuromuscular compensatory responses for potentially destabilizing charges that may occur during various sports activities and daily life. The application of these charges must be in a controlled manner. (Childs, 2003).

Thacker et al, 2003 mentioned that proprioceptive and neuromuscular work had better prevention results than the use of orthotics and some orthopedic shoes. More recently, neuromuscular conditioning techniques have been used for the prevention of injuries (Griffin, 2003).

Kim and associates, showed that the stimulation of the collateral ligaments of the knee produces a contraction of the surrounding muscles. There is evidence that Proprioceptive training not only reduces potential biomechanical risk factors for joint injuries, but also decreases knee and anterior cruciate ligament injuries, especially in female athletes.

It is not yet clear which of the components (strength, balance, plyometrics, etc.) of such training is the one that induces the protection or if it is a combined benefit of these. Future research should evaluate the relative efficacy of each of these interventions alone or in combination, in order to achieve an optimal effect in preventing injuries (Hewett, 2005a).

The mechanism of anticipation or anterograde (feedforward) plans movement programs and activates the musculature based on the experiences lived previously, also plays an important role in the maintenance of joint stability. This mechanism is characterized by the use of proprioceptive information in preparation for anticipated charges or activities that can be performed.

According to Álvarez Medina and Adalid-Leiva, the prevention programs focused on proprioception applied in sports such as skiing, basketball and football showed a global reduction of serious injuries at the level of the anterior cruciate ligament from 15.2% to 89%. %, that is to say, that the incidence of lesions at the level of the anterior cruciate ligament, and in general of the lesions in the lower limb, can be reduced through general methods of neuromuscular formation.

A recent study by Cancela and Ramos (2014), in which they reviewed the scientific articles related to epidemiology and the risk factors for lower limb injuries in football, highlighted that injuries in the lower limb represent more than 80% of the totals recorded in football, that women and younger age groups have lower injury incidence, but have a higher risk of specific injuries such as ACL tears and developmental injuries and that apparently, the factors of Risk with more weight in the injuries of soccer players are the history of previous injuries and muscle imbalances. Solla and Martínez (2010) citing several authors conclude that most of the injuries suffered by elite players that affect the lower extremities reach 77 to 93%.

The breaks and contractures constitute 10-42% and are located in the area of the quadriceps, hamstrings and abductors musculature. The majority of the injuries of the thigh are breaks or contractures and constitute between 20-22% in elite players. Of these injuries, those that affect the anterior part of the thigh are associated with the anterior rectus and the mechanisms of the ball or sprint, while those that affect the back do so to the biceps femoris, biarticular muscle and sprint mechanisms.

The next step, according to Van Mechelen, (1992) would be to analyze and identify the risk factors and mechanisms of injury that appear in our athlete and our sport. Proprioceptive training with balance tables has been effective in preventing ankle injuries without the aforementioned drawbacks (Verhagen et al., 2004). We begin by identifying the main injuries to analyze the incorporation of measures that from the field of physical preparation have shown evidence of effectiveness in the preventive task, such as: strength training, flexibility and proprioception.

For this, we use the proposal of Van Mechelen (1992) where the first step to follow is the definition of the problem. In order to develop a good analysis of the injury situation of our team, according to Solla and Martínez (2010), a good knowledge of the sport's injury profile must be carried out in the first step and a good knowledge of the epidemiology of the team must be maintained, based on the history injury registered in the club and finally, a knowledge of the player's injury profile and be aware of its pre-disposed characteristics.

**5. FIFA 11+ Program**

The FIFA 11+ injury prevention program was developed by an international group of experts from the FIFA Medical Evaluation and Research Center (F-MARC), the Oslo Injury Research Center and the Orthopedic Medicine Research Foundation and Deportiva de Santa Mónica with the support of the International Federation of Associated Football (FIFA) ® and published in the renowned British Medical Journal in 2008., which focuses on the prevention of injuries and consisted of a complete heating divided into 3 stages based on their practical experience with different injury prevention programs for players over 14 years of age.

The FIFA 11+ program consists of three parts with a total of 15 exercises that should be performed at the beginning of each training session in the order specified, this has a duration of 20 minutes.

1st Part. Duration Career exercises 8 min.		
1. Run in a straight line.	2. Run with hip out.	3. Run with hip inwards.
4. Run in circles.	5. Run contact with the shoulder.	6. Run forward and backward.

**Table 2** First part of the FIFA 11+ program  
*Source: FIFA 11+ Manual*

The FIFA 11+ program mentions that not all football injuries can be prevented, but especially knee injuries, ankle sprains and problems of excessive use can be significantly reduced by performing preventive exercises on a regular basis.



**Figure 1** FIFA 11+ program  
*Source: FIFA 11+ Manual*

2nd Part Force. Duration 10 min	Plyometrics	Balance.
7. Forearm support Static front	7. Support in forearms alternating legs.	7. Forearm support and lift one leg
8. Support in static lateral forearm	8. Support in lateral forearm raise and lower the hip	8. Support in lateral forearm lifting one leg
9. Trainer's beginner	9. Intermediate scissors	9. Advanced Ischiotibial
10. One-leg balance holding the ball	10. One-leg balance throwing the ball	10. Balance in one leg and unbalance the partner
11. Genuflexions to the tip of the feet	11. Stroubling strokes	11. Genuflexions in one leg
12. Vertical jumps	12. Saltos laterales	12. Alternate jumps

**Table 3** Second part of the FIFA 11+ program  
*Source: FIFA 11+ Manual*



3 <sup>o</sup> Parte. 2 Ejercicios de cadera minutos.		
13. Run in all the terrain.	14. Run high jumps.	15. Running change of address.

**Table 4** Third part of the FIFA 11+ program  
Source: FIFA 11+ Manual

Teams that practiced the FIFA11 + program regularly at least twice a week had 37% fewer injuries during training and 29% fewer injuries in games. Serious injuries were reduced by almost 50%.

### Process

A proprioceptive training plan was made in the sub 13 category of the Atlas Bella Airosa Soccer School in the City of Pachuca, Hidalgo. Work was done during 7 months in 2017, of which 3 were observed in June, July, August, the following months September, October, November, and December 2017, proprioceptive training was implemented with the objective of reducing the rate of injuries in the category worked. Based on what Cerulli. G. and Cols proposed in the year 2001 where they say that each player has to have some kind of individual or specific proprioceptive work, they looked for exercises in different difficulties but with the same objective, prevention of injuries with the help of proprioception work and we put them in practice with athletes.

### Proprioceptive training for category 2004.

According to the age, a training was designed which could be done by the players of this category, demanding them but without going beyond the load requirements that a boy of this age can bear.

During 35 minutes every third day the exercises were performed 5 minutes per session, based on balance exercises, on different surfaces, instability platforms, etc., with a minimum frequency of 3 times a week for 4 months which would be sufficient to find results in reducing the incidence of injuries.

Different exercises were carried out between sessions to ensure that all the joints received the benefit of the program, which was to prevent. The exercises were developed based on the principle of individualization and the systematic graduation of the load previously observed in each of the players.

It was worked taking as background the scientific evidences about the general preventive programs of inferior train, which affirm that the preventive programs that obtain the best results, as much for the lower extremity, as for the muscular-tendinous structure and for the joint, are those that present a multifactorial format, which include the combination of different training media.

### Proprioceptive training for Monday

#### 1) Jogging trot.



**Figure 2** The player performs a jog on a bouncy bridge for 40 seconds for 20 seconds of rest

Source: self made. 2448 × 3264 pixels

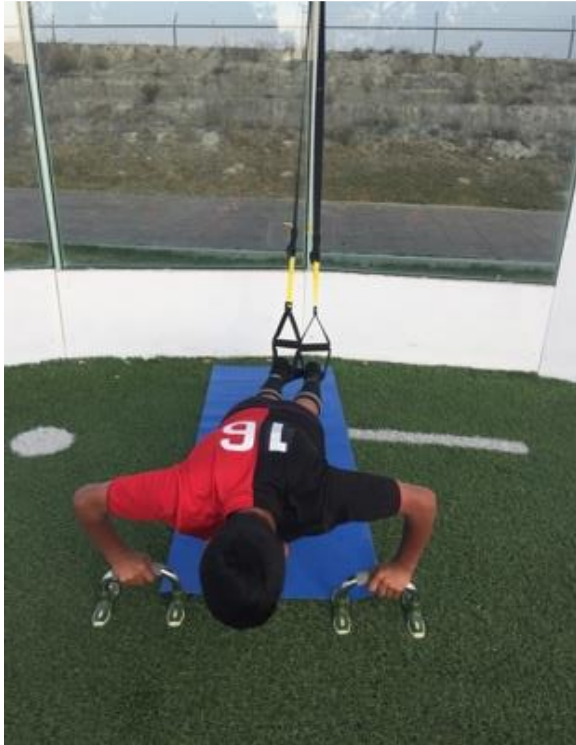
#### 2) Touch tip on unstable base



**Figure 3** Touch the tip of the toe with the opposite hand performing the most amount of repetitions for 2 min, 1 minute of rest and change of leg and hand for 2 min

Source: Self Made. 2448 × 3264 Pixels

## 3) TRX lizard.



**Figure 4** Perform a lizard with handles while your feet are in TRX, take out as many repetitions for 30 seconds and 30 seconds and rest until completing 5 minutes  
Source: Self Made. 2448 × 3264 Pixels

## 4) Stability of 10 to 30 seconds with the foot in bosu.



**Figure 5** Maintain the balance from 10 to 30 seconds in one with 10 seconds of rest until you reach 5 minutes  
Source: Self Made. 2448 × 3264 Pixels

## 5) 2 feet on rocker front-back.



**Figure 6** Swing in front and back in times of 40 seconds for 20 seconds of rest until you reach 5 minutes  
Source: Self Made. 2448 × 3264 Pixels

## 6) Unstable base one foot with ball.



**Figure 7** While the balance is maintained on an unstable base, one foot is placed around it to the side and back. For a time of 5 min  
Source: Self Made. 2448 × 3264 Pixels



7) Touch cones to order



**Figure 8** Player keeps trotting in the middle and a color is indicated, he must touch it and keep trotting. 35 sec. Time for 25 sec. Of rest until completing 5 min  
 Source: Self Made. 2448 × 3264 Pixels

**Proprioceptive training for wednesday**

1) Bosu left-right with garter



**Figure 9** Lateral squat with league goes up and down from bosu right to left and vice versa for times of 40 sec and 20 rest for 5 min  
 Source: Self Made 2448 × 3264 Pixels

2) Trot with a ball.



**Figure 10** Player trots and hits internal part with right, then trots and hits with left inner part in time of 40 seconds and 20 of rest for 5 minutes.  
 Source: Self Made. 2448 × 3264 Pixels

3) Jumper with 1 foot: 2x2 brincos.



**Figure 11** You jump with one foot in two turns with right and two turns with left for 40 seconds, 20 seconds of rest for 5 minutes  
 Source: Self Made. 2448 × 3264 Pixels

4) TRX with unstable base and turn.



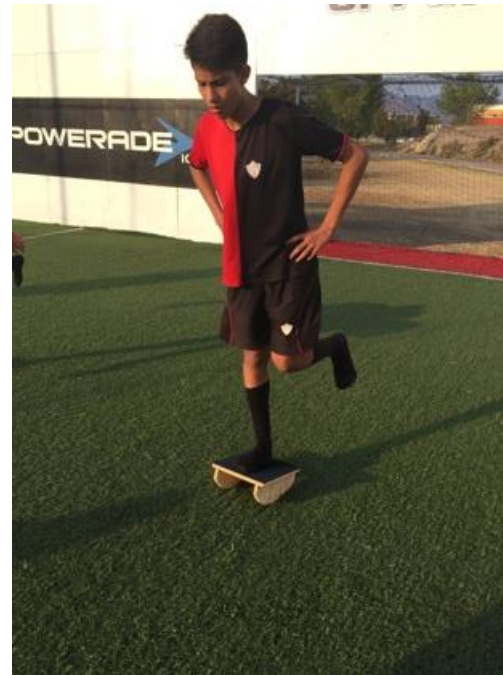
**Figure 12** Semisquat in unstable base with one leg, the other leg in TRX, this turns to one side and the other with weight in hands for 1 minute and 30 seconds of rest, then change leg, to complete min  
 Source: *Self Made. 2448 × 3264 Pixels*

5) Unstable base and arrow with weight.



**Figure 13** Player on an unstable base leans forward maintaining balance in 15 seconds, changes leg to complete 5 min  
 Source: *Self Made. 2448 × 3264 Pixels*

6) Rocker with 1 foot in front- back.



**Figure 14** Maintain balance with one foot balancing in front - back during times of 40 sec times by 20 sec rest until you reach 5 min  
 Source: *Self Made. 2448 × 3264 Pixels*

7) Skip squat cones.



**Figure 15** Semisquat with lateral jump, front and back  
 Source: *self made. 2448 × 3264 pixels*



**Proprioceptive training for Friday**

1) Jumper and header.



**Figure 16** Player performs fast trot with headbutton to the indication for 40 sec, 20 sec of rest for 5 min

Source: Self Made. 2448 × 3264 Pixels

2) Bosu and hip mobility bows with voodoo floss



**Figure 17** Maintain balance while performing ligament flexion, extension and hip abduction. You must repeat it 10 times to rest and change your leg, rest 20 sec and start again, this will be done in a time of 5 min

Source: Self Made. 2448 × 3264 Pixels

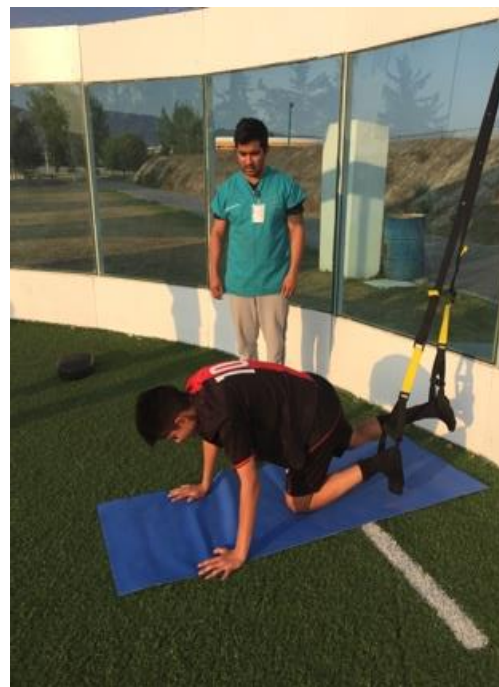
3) TRX performing inclined rowing.



**Figure 18** Player holds the TRX and performs rowing pull to dorsals, perform more repetitions for 35 seconds to rest 25 seconds and perform it for 5 minutes

Source: Self Made. 2448 × 3264 Pixels

4) TRX in position lizard simulating running



**Figure 19** Player in position of lizard is placed TRX with help in feet and simulates running this at higher speed and for 35 sec, rest 25 and will do so for 5 min

Source: self made. 2448 × 3264 pixels

## 5) Bosu skipping with head



**Figure 20** Player performs skipping in Bosu and is asked to head straight, this for 35 seconds, 25 seconds of rest and is performed for 5 minutes

Source: Self Made. 2448 × 3264 Pixels

## 6) Left-right rocker with squat



**Figure 21** Semisquat with swinging right to left - left right for 5 min

Source: Self Made. 2448 × 3264 Pixels

## 7) TRX squat with bosu



**Figure 22** Player performs squat in Bosu holding TRX by getting up and down this he must do it for 35 sec. Achieve the highest number of repetitions and rest 25 sec for 5 min.

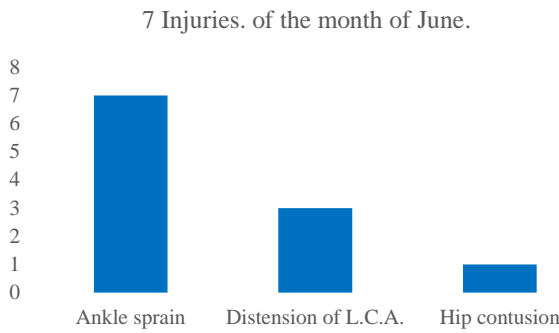
Source: Self Made. 2448 × 3264 Pixels

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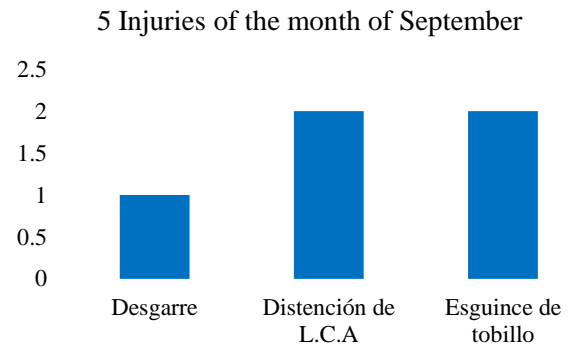
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During the 7 months 36 lesions were found, 27 of them were presented during the first 3 months leaving the other 9 for the 4 months in which the proprioceptive training work was implemented.

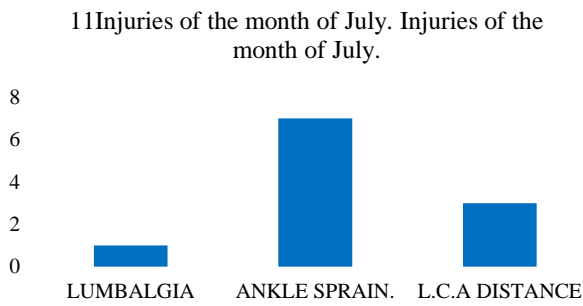
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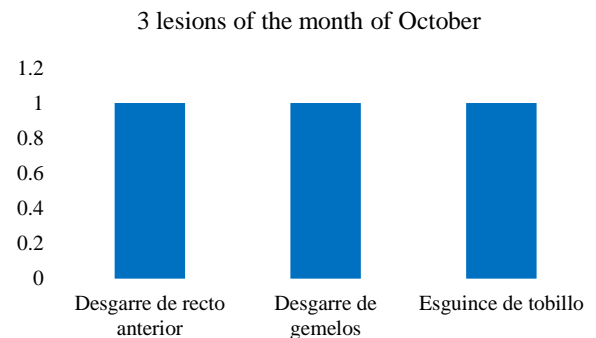
**Graphic 2** In June there were 7 injuries, 4 ankle sprains, 3 with distension of L.C.A and 1 hip contusion  
Source: Self Made



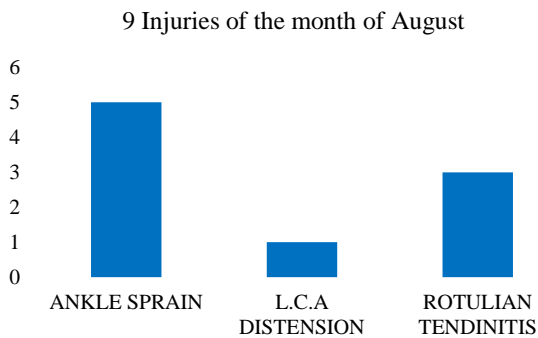
**Graphic 5** In the month of September lesions decreased in the previous months, there was only one tear of hamstrings, 2 ankle sprains and 2 distensions of L.C.A  
Source: Self Made



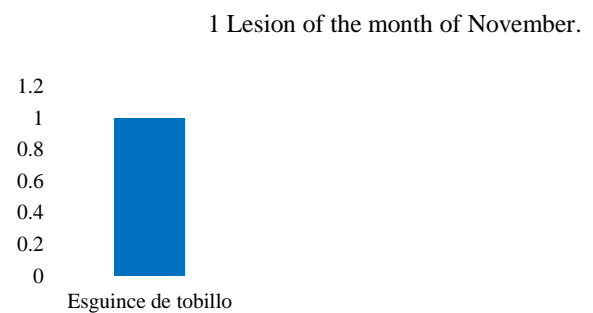
**Graphic 3** Injuries in July: 11 injuries 1 of low back pain, 7 with ankle sprains and 3 distension of L.C.A  
Source: Self Made



**Graphic 6** In October, 3 lesions were recorded, 2 of them were tears in one in twins and one in the anterior rectum. The third lesion was a first-degree ankle sprain  
Source: Self Made



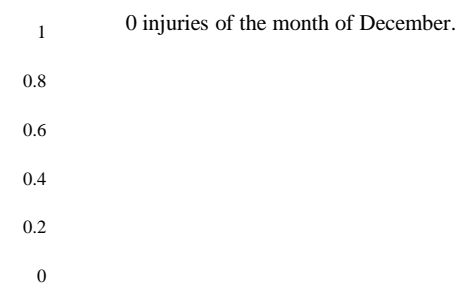
**Graphic 4** In August: 9, of which were, 5 ankle sprains, 1 distension of L.C.A and 3 patellar tendonitis  
Source: Self Made



**Graphic 7** At the end of the season in November a sprained ankle was registered due to a strong entry in the last game of the regular season. Source: Self Made

27 injuries in the first 3 months.	18 injuries avoided.	9 injuries in the last 4 months.
100%	67%	33%

**Table 5** Decrease in lesions from the first 3 to the last 4 months  
Source: Self Made



**Graphic 8** No injuries in December  
Source: Self Made



A lo largo de los primeros 3 meses se registraron 27 lesiones un índice lesional elevado para la edad de 13 años con los que contaban los deportistas, en base a esto ,se tomo como población a los 22 futbolistas de la edad de 13 años de la categoría 2004.Los 22 deportistas realizaron el trabajo de prevención de lesiones.



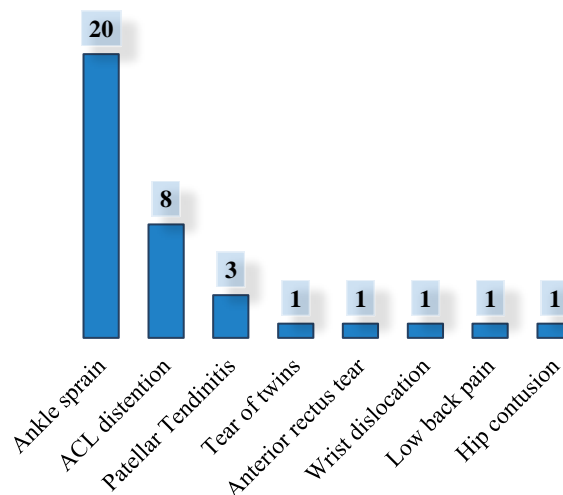
**Figure 23** Ultimo día de aplicación del entrenamiento propioceptivo

Source: Self Made. 2448 × 3264 Pixeles

El esguince de tobillo es el mas frecuente abarcando el 55% del total de lesiones, la incidencia de la distensión de LCA tiene el 22% del total, esta lesión fue frecuente debido a causas extrínsecas ya que se entrenaba en un terreno irregular , asi como en una cancha sintética la cual tenia bordes y producía una mala pisada al jugador, el 8% corresponde a la tendinitis rotuliana , y 15% esta dividido en desgarre de gemelos, desgarre de recto anterior , luxación de muñeca , lumbalgia y contusión de cadera.

Injuries detected during the 7 month investigation work.

■ Injuries detected during the 7-month research work



**Graphic 9** Total injuries that occurred during 7 months of investigation

Source: Self Made

## Methodology

The investigation was Longitudinal, Experimental, Prospective and Quantitative. A proprioceptive training plan was made in the sub 13 category of the Atlas Bella Airosa Soccer School in the city of Pachuca, Hidalgo, where it was worked for 7 months in 2017, of which 3 were for observation June, July, August, the following months September, October, November, and December 2017, the proprioceptive training was implemented with the objective of reducing the rate of injuries in the category worked.

The investigation consisted in detecting the type and number of injuries in 13-year-old soccer players based on a group of 22 soccer players of 13 years of age where we related the extrinsic factors such as a bad court, inadequate footwear, weather, bad entries by opponents or partners etc; and the intrinsic-biomechanical factors such as postural defects which were scoliosis, flat feet, shortening and muscular weaknesses which produced knee or ankles in varus and valgus etc; all of them were related together to result in a high injury rate.

**Inclusion criteria:**

- Have the age established for the prevention program
- Accept informed consent for such research

**Exclusion criteria:**

- Players with a link less than a month of the football sports club.
- Not counting the corresponding age.

**Elimination criteria:**

- Missing trainings on Monday-Wednesday and Friday, which are the days where the investigation is carried out.

**Results**

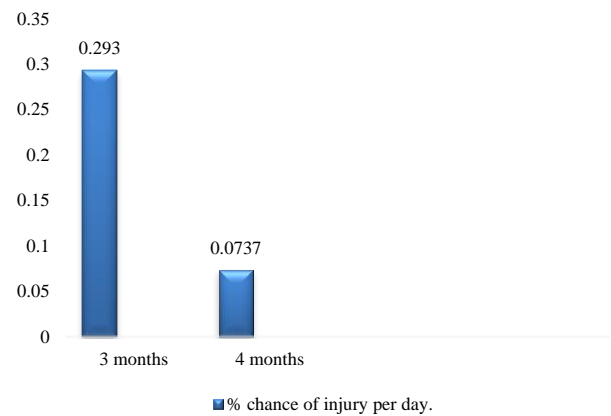
The index of low injuries in the last 4 months in which the proprioception work was implemented, of 27 injuries that occurred and that corresponds to 100% of the total injuries found during the first 3 months of observation, we were able to go down to the number of 9 injuries occurred in 4 months, which corresponds to 33%, so it was possible to reduce a 67% injury probability based on what happened in the first months.

During the first trimester 27 lesions were detected which we took as our 100% of injuries detected in the period, these injuries occurred during 92 days so the probability of injury per day was of .293%, which I manage to lower in the second period that lasted 4 months at .0737% chance of injury per day in 122 days in which they could cause an injury.



**Figure 24** Group of some players who underwent proprioceptive training during the months of work  
 Source: Self Made. 2448 × 3264 Pixels

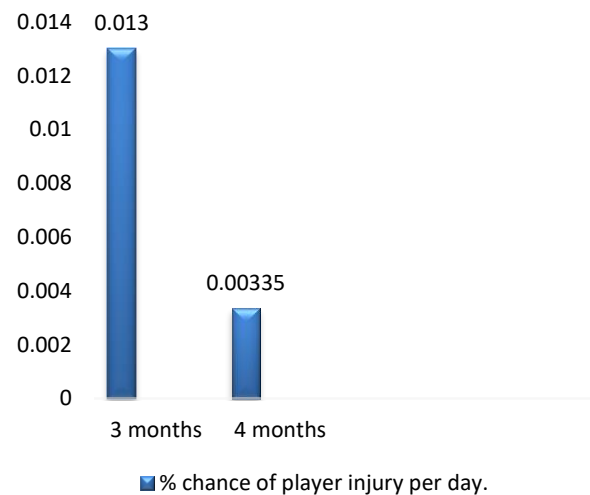
**% Probability of injury per day.**



**Graphic 10** Probability of injuries per day  
 Source: Self Made

Based on the previous results, the probability of injuries per athlete per day was calculated, which was .013% per day per player in the first 3-month period, and in the period in which the proprioceptive training was performed. 0.00335% chance of injury per player per day.

**% Probability of player injury per day**



**Graphic 11** Probability of injuries per player per day  
 Source: Self Made

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## Conclusions

Proprioceptive training is a very important support for the prevention of injuries, because it aims to avoid injuries rather than rehabilitate them. We must achieve optimal functioning in all areas covered by proprioception and auditory, visual, joint, muscle receptors to achieve an almost perfect benefit in the athlete.

The work done by FIFA 11+ has inspired the development of different types of training that have been implemented to the physical preparation of football players in recent times. By applying the proprioceptive training program we confirm the effectiveness of an injury prevention training.

According to the results, the injury prevention training conducted in a period of 4 months, 3 times a week focused on proprioception, helped significantly to prevent injuries in soccer players of 13 years of the Atlas Bella Airosa Soccer School since it decreased 67% of injuries.

After the effectiveness of proprioceptive training was proven, it is our job to convince coaches, coaches and athletes of the importance of preventing injuries to maintain good performance.

It is suggested the application of a protocol or training of injury prevention in different categories, as well as in the feminine category.

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