

Plantar Fasciitis Treatments: A Review

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Abstract

The continuous advance of technology provides necessary tools to undoubtedly provide improvements in the quality of life of people who have access to it, however, the degree of improvement of a patient depends not only on a proper diagnosis from a doctor, but also the efficiency and quality of the equipment used to provide the treatment as well as the adequate use of these. This is why, in this article, a descriptive study is carried out not only from the medical but also the technological perspective of the pathology known as plantar fasciitis; which in a brief description is one of the most common causes of pain in the heel and consists of inflammation in the origin of the plantar fascia at the level of the tuberosity of the calcaneus. This produces an immense pain located in the heel, which can radiate towards the sole of the foot and furthermore affecting approximately 10% of the population throughout its life. This study allows to identify and to thoroughly perceive the characteristics of this pathology from a medicine perspective and to identify the treatments and possible solutions offered from an engineering perspective, since throughout history many studies used for the treatment of any disease are usually used and complemented with advanced knowledge to approach the solution from a broader perspective, which allows obtaining better results.

Keywords: Plantar fasciitis, Biomechanics, Biomechatronic.

INTRODUCTION

Plantar fasciitis is one of the most common soft tissue disorders in feet, however, little is known about its etiology [1] - [34], this pathology is characterized by the sensation of pain located in the antero-internal area of the calcaneus that can radiate towards the inner edge of the foot [7], this is considered the most common cause of lower pain in adults, a condition that affects the lives of millions of people in the world [2] - [7].

The foot acts as a static support of the body and the motor of the march, it's the part most prone to damage by micro-trauma. This pathology can produce such intense pain that sometimes it manages to cause the immobilization of the affected region. Conventional medical treatments usually use analgesics, anti-inflammatories, heel stretch exercises and appropriate footwear for walking. For the treatments corresponding to this pathology, a great variety of modalities found have been evaluated, among these you can find the use of ultrasounds, silicone insoles, bandages, shock waves, lasers, magnetotherapies or acupuncture, as well as orthoses and plantar arches which are structures that aid the support in the middle of the foot. One of the alternatives proposed to show improvement is the practice of skiing, since the boot acts as a splint that constantly stretches the plantar fascia [34].

Some studies estimate that approximately 10% of people suffering from these pathologies, between 80% - 90% of the cases, the symptoms disappear within the first 10 months [7].

However, this time interval is extensive for most patients since the recovery depends on carrying out an adequate and continuous treatment until the pain has disappeared for at least 3 months, however, according to the article "*Risk factors for plantar Fasciitis a matched case-control study*" it can be inferred that approximately 5% of patients who are diagnosed with plantar fasciitis undergo surgery to improve this condition. It is well known that plantar fasciitis can occur in association with various arthritis, but in approximately 85% of cases the etiology is unknown [8].

In the present work, a detailed compilation of information about the pathology known as plantar fasciitis is carried out in order to determine and characterize some of the particularities of this condition as well as to demonstrate the techniques of people suffering from this disorder. This article is divided according to the relevance and adequacy of the subjects to be treated, in section (I) there is a brief introduction of the pathology known as plantar fasciitis, in section (II) some conditions are evaluated such as: biomechanics, anatomy, pathology and prognosis of this condition, in section (III) therapies, methods and solutions for the rehabilitation of this pathology are presented and some treatments or studies carried out in investigations concerning the study of plantar fasciitis are described in section (IV) several statistics are presented referring to plantar fasciitis and finally in the section (V) there is a discussion about the causes and methods of rehabilitation for plantar fasciitis, models or treatments used for the rehabilitation of foot.

BIOMECHANICAL

The plantar fascia has inelastic properties, which is why high tension forces are concentrated in the calcaneal tuberosity during the standing phase prior to the swing of the march. Activities such as running and prolonged standing states concentrate forces in the plantar fascia, which increases the risk of injury.

According to Hicks in the article "*The plantar aponeurosis and the arch*" the fascia performs a function similar to that of a lathe, in such a way that the ALI of the foot rises with the turn of the fascia around the head of the metatarsals when extending the fingers. It is considered a passive mechanism that depends on ligamentous stability and bone structure. [9]

During walking, hyperextension of the fingers and metatarsophalangeal joints causes the PA to tense, elevating the ALI, reversing the rear of the foot+ and rotating the leg externally. However, other authors indicate that the fascia acts as an energy store in the foot, playing a cushioning function in front of the forces that appear in the takeoff phase of the walking foot, creating a framework under the metatarsal heads thanks to the tension of the soft tissues [10] - [15]. Figure 1 shows the section of the foot where the pain is most intense.

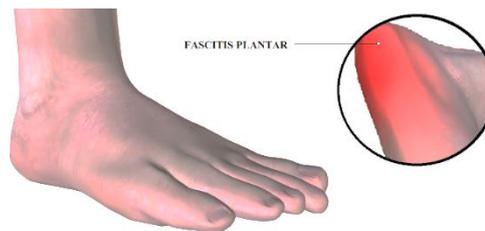


Figure 1. Location of pain.

The foot has elements specifically designed to withstand excessive arc deployment at the moment of support. Figure 2 shows the phases that the foot has at the time of performing some action [11].

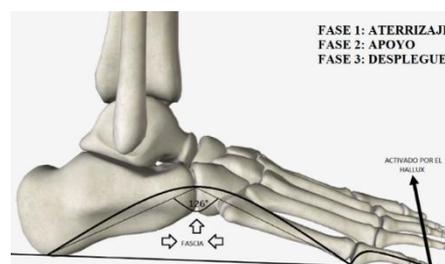


Figure 2. Foot arch design.

The Windlass mechanism consists of tension in the fascia when the hallux is dorsiflexed, achieving an elevation of the plantar arch. It goes from a position where the foot is able to absorb the impact to a position where the foot is capable of propelling itself.

As the big toe dorsiflexes, the Windlass mechanism kicks in by tightening the plantar fascia and raising the arch of the foot. This mechanism is very important, as it allows the foot to become an efficient lever.

Anatomy

The anatomy of the human being has an essential equilibrium system for stability. The foot is within this system. Which acts as a motor of the march, when submitting the foot to an excessive effort repeatedly it will be prone to suffer damages either by not using the right footwear, by being overweight or by standing for long periods of time.

Anatomically, the plantar fascia consists of a plantar aponeurosis (PA) or tendon aponeurosis formed by longitudinally organized white fibers. It is an inelastic aponeurosis with a maximum elongation of 4% [9].

A person usually stays on average 4 hours a day standing and gives between 8000 and 10000 steps. In relation to the body the feet are very small, this generates that the impact on them at each step is very great. Approximately 50% more than body weight [10]. During the day, the foot supports a large amount of accumulated effort, being an impact support. Reason why approximately 75% of people suffer from foot pain once in their lives [10].

The bone anatomy of the foot and the dorsal surface can thereof be observed in Figures 3 and 4 correspondingly, while in Tables 1 and 2 the composition of each figure mentioned above is found [11].

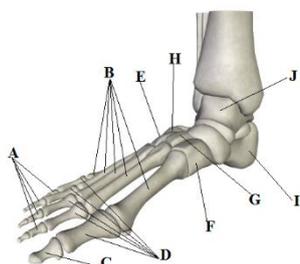


Figure 3. Bone Anatomy



Figure 4. Dorsal Surface.

Table 1. Bone types

A	Medium phalanx
B	Metatarsal bones
C	Falange disc
D	Proximal phalanx
E	III cuneiform
F	I cuneiform
G	II cuneiform
H	Cuboides
I	Calcaneus
J	Astragalus

Table 2. Dorsal surface muscles

A	Dorsal interosseous
B	Big toe short extensor
C	Short extensor of the fingers
D	Big toe long extensor
E	Long and peroneal extensor

Pathology

Plantar fasciitis is an affectation that attacks the plantar fascia of the foot, which supports great efforts both in compression and tension. There are several treatments to suppress this pathology, this is the case of the traditional method (common therapies), usually shows results of total improvement in about 6 months, solving up to 95% cases of plantar fasciitis, although there are cases where they have to resort to more drastic measures such as infiltrations and in more extreme cases appeal to surgery [16] - [25].

According to the graduation project "*Differential diagnosis of plantar fasciitis*" PF (plantar Fasciitis) is favored by intrinsic and extrinsic risk factors, understanding that from a biomechanical point of view all of them result in an increase of stress of the plantar fascia. The intrinsic are those biological and anatomical characteristics that predispose to suffer the pathology, such as age and sex, with a higher incidence in women between 40 and 60 years and young runners, overweight, especially in body mass index values (BMI) greater than 30 kg/m², flat feet, cavus foot, limitation of the

dorsal flexion of the ankle and limitation of the dorsal flexion of the first metatarsophalangeal joint. Extrinsic factors are those that depend on characteristics external to the organism, such as inadequate footwear, walking on hard surfaces and prolonged standing.

However, the risk factors suggested in general literature are based on the theories or hypotheses that arise from the associations found in the case-control studies or series of cases. These study designs cannot establish causality because the cases are evaluated after the diagnosis of the pathology, so they can identify the associated factors, but not risk factors.

Below are some of the alternatives for the rehabilitation of the plantar fascia:

- The neuromuscular bandage or kinetic taping has as main objective the preservation of movement and muscular activity. The preservation of the movement for the recovery of any plantar injury, and it is precisely the maintenance of the amplitudes of movement that differentiates this technique from the rest of the bandages. The kinesiotape ribbons are made of fine and porous cotton, with an elastic and adhesive texture. As the temperature of the skin increases and the band heats up, it becomes active. One way to classify treatments would be in cryotherapy, electrotherapy treatments, insoles, manual therapies, bandages and electrotherapy [12] - [16].
- Shock waves which consists of an acoustic pressure wave that is produced and propagated through an elastic medium, such as air, water and even a solid substance [12] - [16].
- Dry needling consists in the use of the mechanical stimulus of a needle as a physical agent for the treatment of myofascial pain syndrome (MPS) [12] - [16]. An application in the TENS (transcutaneous electrical nerve stimulation) uses low frequency analgesic current, helps break the pain circle. Bandages, thick and soft sole shoe, plantar supports, anti-inflammatories, infiltration and physical therapy are used [12] - [16].

Forecast

Plantar fasciitis can be identified because it produces an inflammation of connective tissue thickness which is in the sole and which is fixed to the heel, as can be seen in figure 5 [11].

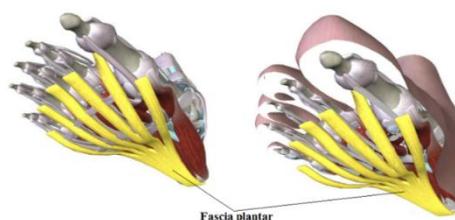


Figure 5. Planta fasciitis

This affection results in pain located in the rear part of the heel. Scientific evidence says that fasciitis has an inflammatory process, but histopathological evidence does not show this [31] [32]. It can be caused by micro-tears in the fascia, myxoid degeneration, collagen necrosis and hyperplasia, hyperplastic hyperplasia, which makes it somewhat more linked to a degenerative process that does not show inflammation [32].

In the literature the pathology is classified by different symptoms such as [33] - [36]:

- Pain in the heel, especially when getting up in the morning or after a period of rest.
- Increased pain when standing
- Pain in the heel after exercising.

Table 3. Pathology types and characteristics

ETIOLOGY	PATHOLOGY	ASSOCIATED CHARACTERISTICS
NEUROLOGOLY	<ul style="list-style-type: none"> - Trapping of the medical calcaneal nerve and the abductor of the fifth finger - Neuropathy - Tarsal tunnel syndrome 	<ul style="list-style-type: none"> - Pain and burning in the medical plantar region - Diabetes mellitus, alcohol abuse and vitamin deficiency - Burning sensation in teh median plantar region
OSSEUS	<ul style="list-style-type: none"> - Acute calcaneal fracture - Calcaneal apofisitits (Sever's disease) - Calcaneal stress fracture - Calcaneal tumor - Systemic arthritis (Rheumatoid arthritis, Reiter syndrome, psoriatic arthritis) 	<ul style="list-style-type: none"> - Direct trauma, inability to support due to weight. - Typical in adolescent age, pain in the posterior area of the calcaneus. - Start of insidious pain, repetitive loading. - Pain in the depth of the bone. - Pain of multiple joints, bilateral pain in the heel.
P	<ul style="list-style-type: none"> - Fracture of the plantar fascia - Tibial tendonitis posterior - Retrocalcaneal bursitis 	<ul style="list-style-type: none"> - Rough pain in the plantar area of the heel, ecchymosis. - Pain in the medial area of the ankle. - Pain in the posterior region of the calcaneus.

According to Janet M, at the time of reviewing the foot to define if it really is plantar fasciitis, it is necessary to perform a blood test with rheumatic and uric acid tests. Radiographs must also be made of the foot to see the state of the plantar arch and discard the fact that it is a calcaneal spur (osseous protuberances in the heel) and also an MRI which can show how the plantar fascia is [37].

In conclusion, for a correct diagnosis of plantar fasciitis we must know the clinical pathologies. For this we will classify them according to their etiology, being these of neurological, bone and soft tissue type and we will portray them in the following Table 3, this information was taken from different articles [38] - [43].

METHODS AND TREATMENTS

Systems for the detection of plantar pressure and treatment for fasciitis.

The systems of plantar detection are mechanisms used to determine the force made by the foot in specific points of the plant in resting or running state, this is useful since it allows to determine concrete patterns of support as well as to describe the model of march of the patient. This technique can make it possible to approach the treatment of the pathology in a singular way, since in determining which are the usual pressure points of a patient, specific postures or exercises can be established that benefit the user, this is due to the treatment being performed for the specific conditions.

Among the systems of plant detection we find a great diversity of sensors as well as application models; Four articles that use systems for the detection of pressure in the sole of the foot will be mentioned. The information presented in Table 4 was obtained through articles [44] - [47] respectively.

Table 4. Plantar detection methods.

TABLE OF METHODS AND DESCRIPTIVE SYSTEMS FOR PLANTAR PRESSURE DETECTION			
METHODS	TITLE	AUTHORS	DESCRIPTION
Multiple points of plantar pressure detection	Multi-point Sensing System for Plantar Pressure Measurement	Venugopal G, Biren J. Parmar y K. Rajanna	A system of plantar detection based on multiple detection points was developed, having the function to measure the distribution of the pressure in the sole of the foot.
Plantar pressure detection at specific points	In-Shoe Plantar Pressure Measurement and Analysis System Based on Fabric Pressure Sensing Array	Lin Shu, Tao Hua, Yangyong Wang, Qiao Li, David Dagan Feng	A system of measurement and analysis of the plantar pressure based on a textile fabric of sensors is presented in order to reduce the complexity of the system six positions sensors were incorporated and selected in the heel and metatarsus.

Plantar pressure detection at a specific point	An Insole Point Pressure Monitoring System	Apisit Numchaichanakij, Kitiphol Chitsakul, Suradej Tretriluxana	A system of quantitative measurement of plantar pressure in real time of a specific point or place of interest was developed using a model sensor A201™.
Plantar pressure detection at specific points	A Gait Monitoring System Based on Air Pressure Sensors Embedded in a Shoe	Kyoungchul Kong, and Masayoshi Tomizuka	A method is proposed through difused logic for the detection of the phases of march in continuous form using sensors of GCF, in this article algorithms are presented that quantitatively monitor the quantity of anomalies in the human march.

Studies carried out in the treatment and rehabilitation of plantar fasciitis

In this section we will describe some of the most relevant investigations carried out in the study of plantar fasciitis. Among these the generalities, consequences and studies used for the description and characterization of this disease can be seen, according to the literature little is known of the causes since it is probably due to a variety of factors.

In the article "A gait monitoring system based on air pressure sensors embedded in a shoe", have been identified some causes that can generate this disease, among these are: obesity, occupations that require standing, flat feet (excessive pronation of the foot), reduced dorsal flexion of the ankle, and inferior calcaneal exostosis or calcaneal spur [47]. In this same article, information is found showing that plantar fasciitis represents approximately 10% of the injuries that occur in relation to running, in addition to being common among military personnel. The incidence of plantar fasciitis reportedly occurs in people between the ages of 40 and 60 years in general population and in younger people among the runners, in the latter group plantar fasciitis usually has a high incidence which allows us to suppose that one of the causes of the generation of this disease is due to repetitive micro-trauma [47].

Among other investigations carried out, it has been identified that orthoses reduce the symptoms of plantar fasciitis by reducing tension in the fascia [48]. In the article "Effectiveness of Foot Orthoses to Treat Plantar Fasciitis" it was identified that foot orthoses produce small short-term benefits and can also produce small reductions in pain for people with plantar fasciitis, in addition the use of orthopedic devices is recommended, night splints, and immobilization with casts or other devices for patients in whom the condition does not improve [49].

On the other hand, an investigation was carried out which determines the benefits of orthotics, insoles or pads established for the treatment of plantar fasciitis, since in the article "Comparative Trial of the Foot Pressure Patterns between Corrective Orthotics, Formthotics, Bone Spur Pads and Flat Insoles in Patients with Chronic Plantar Fasciitis " a study was conducted which compares the efficiency of the aforementioned elements to determine the reduction of the plantar contact pressure, for which a pressure sensor system was used, that collects the information and establishes the data obtained in real time.

In Table 6 presented below, the results obtained from the evaluation of some orthopedic elements obtained from the aforementioned article are described [50]

Table 6. Orthotic treatments

EVALUATION OF SOME ORTHOPEDIC ELEMENTS FOR THE TREATMENT OF PLANT FASCITIS	
Element	Results
Pads	The pads on the bone spur offer no support for the longitudinal arch of the foot, therefore, it cannot reduce the tension forces on the fascia, as the pad is softly compressed during vertical loading, the pressure remains concentrated in the heel region.
Custom orthotics	The use of custom orthotics provides a greater contact area with the sole allowing the plantar forces to be more evenly distributed
Orthopedic prefabricated and orthotic insoles	These elements reduce the maximum forces of the rear of the foot on both sides, while the bone pads of the heel increase the maximum pressures on the rear of the foot

Hereafter, two descriptive tables identified as Table 7 and Table 8 are presented based on two studies carried out for the treatment and rehabilitation of plantar fasciitis, information obtained from the article "Plantar Fasciitis" [48]. The use of the heel (7 of 23 patients, or 30%) obtained good results.

§ For anti-inflammatory treatment (9 of 27 patients, or 33%) obtained good results.

Table 7. Treatments for plantar fasciitis study N ° 1.

Study N°1	
N° of patients involved	Description
103	A comparison was done between mechanical treatments with respect to the use of a cup in the heel and anti-inflammatory treatments.
Treatments	Results
Tratamiento mecánico (encintado y ortesis)	<ul style="list-style-type: none"> ▪ Among the 77 patients who completed the trial, the mechanical treatment was more effective as it achieved a result rated "excellent" or "regular" at three months (for 19 of 27 patients, or 70%). ▪ The use of the heel (7 of 23 patients, or 30%) obtained good results. ▪ For anti-inflammatory treatment (9 of 27 patients, or 33%) obtained good results.
Uso de una copa en el talón	
Tratamiento antiinflamatorio (tres inyecciones de corticosteroides administradas a intervalos semanales, más terapia no esteroidea).	

Table 8. Percentages of recovery according to the treatment used..

Study N°2	
N° of patients involved	Description
236	A study which determined the improvement of the patients who used the rehabilitation treatments at the eighth week of use was conducted
Treatments	Improvement percentage
Silicone cone insert	95%
Felt	88%
Rubber Heel	81%
Orthopedic devices	68%
Stretching	72%

Description, assistance and rehabilitation treatments for plantar fasciitis

The mechanism of Windlass describes the way in which the plantar fascia supports the foot during loading activities, and also provides information about the orientation of the same. In the article "*Plantar Fasciitis and the Windlass Mechanism: A Biomechanical Link to Clinical Practice*" a detailed description of the support structure of the foot with respect to the load of the body is made, where the plantar tension that the fascia in response to applied load forces in addition to visualize the length of the plantar fascia in different positions of the foot (upper arch (supinated) or lower arch (pronation), likewise you can find evidence demonstrating that plantar fasciitis results of the tension increase of the plantar fascia, reason for which, successful management depends on reversing the factors that lead to excessive tension [51].

As mentioned in some sections of the document the most common treatments to treat plantar fasciitis consist of the implementation of orthosis or the realization of exercises or routines for the rehabilitation of the fascia, however there are exercises that must be performed with detail provided by the orthopedist, in the article "*mHealth Musculoskeletal Applications: Bluetooth Low-Energy Devices and Android*" describes an accompanying application which analyzes sensor data providing actionable information for users and clinicians; allowing the combination of data collection, report generation, analysis and communication. The sensors used are stretching, curving, internal acceleration of the system, which were attached to a sock. The system determines if the repetition of the exercises for the stretching of the fascia is complete, if the repetition is counted as insufficient the user receives a notification indicating why the repetition is not valid, in addition, the user can observe the progress in an interface graphic, this application is a useful tool to help the patient to comply with their rehabilitation routine as effectively as possible [52].

Plantar fasciitis can be classified as a syndrome resulting from the repetitive overload of the plantar fascia in its insertion in the calcaneus, according to the article "*A Biomechanical Approach to the Prevention, Treatment and Rehabilitation of Plantar Fasciitis*" there are five separate areas that can contribute to the production or continuation of the symptoms of plantar fasciitis which are:

1. Tissue Overload
2. Wound injury
3. Clinical symptoms
4. Biomechanical functional deficit
5. Functional adaptation complex.

For the rehabilitation of plantar fasciitis, several phases must be taken into account, which deal with certain aspects of the total lesion, among which the acute phase can be found (Pain treatment, non-steroidal anti-inflammatory drugs (NSAIDs) and physical therapy).), recovery phase (The most attention is placed on the proper load of the tendon and its strength, to allow adequate stimulation for healing), maintenance phase (The resumption of normality of athletic activity to ensure that the

overload does not generate affection in the plantar fascia again). The diagnosis of plantar fasciitis is common among athletes, the pain is usually worse at dawn. Usually there is an alteration in the pattern of the feet, the treatment protocols include orthopedic devices and counter-force devices [52].

COMPILATION

It is said that men have used their footwear to protect their feet from the external environment, and to be able to adapt as best they can to the ground they pass through.

Nowadays the diversity of footwear is very wide allowing to choose a type of footwear for each type of terrain and for each activity in particular. This is why the type of sole and cushioning will determine the impact against the ground as well as the heel will provide a different load on the calcaneus, depending on its height.

For this, the information of the "A biomechanical approach to the prevention, treatment and rehabilitation of plantar fasciitis" [53] was collected, which shows us a statistic about the type of footwear that is currently used (Figure 6), which allows us to visualize a greater amount of percentage in people who wear shoes, footwear that generally does not meet the requirements necessary to prevent this type of pathology. This usually has a very low or very high heel, and offers little restraint for foot movements that may cause an injury.



Figure 6. Inappropriate footwear

The type of footwear, as mentioned previously, plays an important role in the positioning of the foot with respect to the floor and in the distribution of the load that it suffers. Based on another statistic taken in "Plantar fasciitis in amateur runners" the high-heeled shoe can be very harmful for body support and posture [38], as shown in Figure 7.

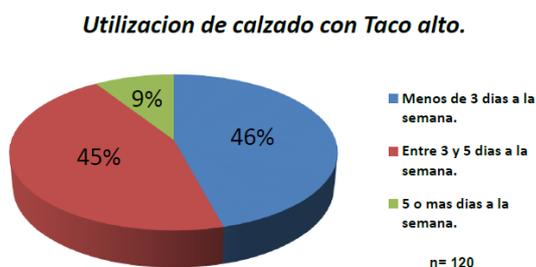


Figure 7. High heeled footwear.

Women who wear high heels during the day and then change to flatter shoes produce a very important structural change in the arch of the foot, while they are wearing heels, the fascia shrinks and tenses; When changing to flatter shoes or slippers, stress occurs in the fascia that is shrunken and tense.

On the other hand, a statistic was found which shows the position adopted during most of the working days. The results show that almost half of the sample works standing up, that is, with a constant load of body weight on their feet (Figure 8) and a study of the ages in which they are more prone to suffer this pathology is presented (Figure 9).

Postura en el trabajo

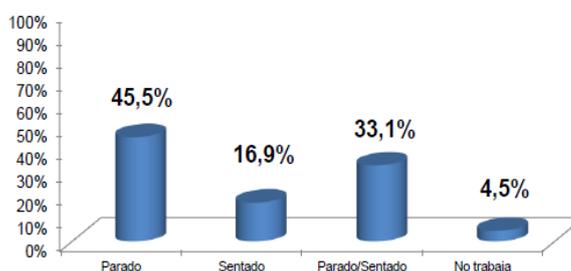


Figure 8. Posture on the job

Edad en la que se produjo la lesion.

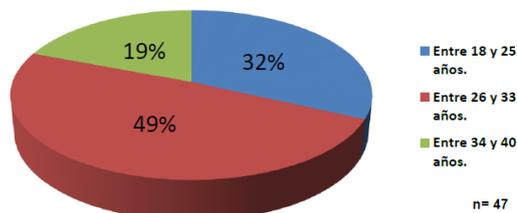


Figure 9. Ages prone to injury.

This means, the appearance of plantar fasciitis does not depend on a single specific factor, despite the fact that the use of high heels is related to fasciitis and different types of footwear. You have to know how to prevent this pathology, this is why the compilation of a state of the art was done, reviewing different solutions, therapies and recovery methods.

CONCLUSIONS

Knowing the causes and symptoms of plantar fasciitis, you can have a clear vision of the factors to take into account when treating it. The points of involvement such as the heel, for example, is a point where there is significant pain when standing or when starting the march, so based on traditional treatments you can use a heel in silicone which helps to reduce the pressure in the heel, in addition to correct possible wrong postures of the same.

The above is an example of how different therapy alternatives can be applied to alleviate the load on the foot and help its recovery. Having the necessary information about the pathology and types of treatment, we can study the possible development of a new type of therapy that helps with the recovery of the patient.

According to studies, plantar fasciitis is observed in both men and women; however, it almost always affects active women between 40 and 70 years old and is one of the most common orthopedic complaints of the foot. It was often thought that plantar fasciitis was caused by a spur in the heel; however, research has determined that this is not the case [31] - [55].

It can be inferred that plantar fasciitis is very common to see in athletes and runners of all levels, affecting approximately 10% of them during their sporting career. In the general population, it also occurs in a similar percentage, especially in people where their profession requires them to be standing for long periods of time and / or bearing weight bearing [32]. This is why plantar fasciitis is a pathology that can be acquired by different causes that can be generated by activities of daily life.

According to the literature it is shown that plantar fasciitis occurs more frequently between the fourth and sixth decade of age, and this has been attributed to atrophy of the heel fat pad among other values. However, there is controversy regarding the change in the thickness of a complex multi-lobed fat structure found in the plantar area of the rear of the foot, specially designed to absorb the impact during walking. It has HFP as a factor that would lead to a painful heel syndrome. Yoon in his article [40] proposes a mechanism to decrease the thickness of HFP that would cause a loss of cushioning in the rear of the foot, while in "*Long-term ultrasonographic follow-up of plantar fasciitis patients treated with steroid injection*" [41] found an association between increased thickness of the plantar fascia and increased thickness of HFP measured by ultrasonography and attributed to an inflammatory process in the area as a result of high vertical forces. Other authors do not report any difference between the thickness of the fat pad of the heel, in the "*Three-dimensional morphology of heel fat pad: an in vivo computed tomography study*" explain the previous findings due to the comorbidity of the planar fasciitis and the painful syndrome of the adipose heel pack [54].

Based on the theory, different types of therapies were studied for the recovery treatment of a foot affected by plantar fasciitis, such as the neuromuscular or kinesics taping bandage, whose main objective is the preservation of movement and muscular activity, the preservation of movement for the recovery of any plantar lesion, and it is precisely the maintenance of the amplitudes of movement that differentiates this technique from the rest of the bandages.

Skiing is proposed as a therapy to combat plantar fasciitis, since the boot acts as a splint that keeps the plantar fascia in a constant stretch, which is usually constant almost all the time during the sports activity, which in average lasts about 5 hours a day and is performed at least for a week, it would achieve approximately 35 hours of continuous treatment. Which would effectively help the solution in the plantar affectation.

One of the methods that presents the most information on the behavior of the foot are the mechanisms used to measure plantar pressure. Two different techniques were evaluated using different methodologies, one of them is based on the use of a variety of sensors located in specific points of the foot which are known by studies carried out in the article "*In-shoe plantar pressure measurement and analysis system based on fabric pressure sensing array*" which are sectors where greater activity is presented and therefore greater pressure is applied, the second methodology that was evaluated was the implementation of a sensor matrix which allows obtaining information in a greater foot section. Both methodologies are efficient for the acquisition of the desired pressure variables, however from an objective point of view the methodology to be employed must be subject to the tests that are desired and the added value of the implementation of the sensors, since the first methodology is determined to reduce the number of sensors to be used and evaluate specific sectors of the foot while the second methodology provides us with more information about the distribution of pressure around the sole of the foot which allows a more detailed analysis about this, however, the implementation of this model requires the use of a greater number of sensors, in addition to which, in many of them, the pressure variation will not be a significant cost that can be saved using the first methodology.

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