

Research Progress in Diagnosis and Treatment of Plantar Fasciitis

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Abstract

Plantar fasciitis (PF) is a chronic degenerative disease. Its etiology is complex and its pathological mechanism is not completely clear. It has attracted more and more attention because of its high incidence rate and easy recovery. There are many kinds of diagnosis and treatment methods of PF, and new methods emerge in endlessly, but there is a lack of systematic induction and summary. This paper intends to collect and sort out the diagnosis and treatment methods of PF at home and abroad by means of novelty search, in order to provide reference and basis for clinical selection.

Keywords

Plantar Fasciitis; Diagnosis; Treatment; Review.

1. Introduction

Plantar fasciitis is a chronic degenerative disease, and is one of the most common causes of heel pain. The lifetime incidence rate is about 10%, which has a major impact on daily function. US research estimates that the annual cost for PF treatment is about US \$284 million [1]. Its etiology is complex. Known high-risk factors include obesity, long-term static standing and limited ankle dorsiflexion. This disease can affect adults of almost all ages, but most of them are middle-aged and elderly people. The mechanism of injury is mainly aseptic inflammatory reaction caused by repeated micro injury of plantar fascia caused by structural or mechanical abnormalities of foot arch caused by various reasons. The new view is that it is a degenerative fascial disease without inflammation. In recent years, with the development of science and technology and the improvement of medical level, more and more diagnosis and treatment methods of PF are gradually presented. Therefore, this paper systematically summarizes the diagnosis and treatment methods of PF in recent years, in order to provide reference for clinical selection.

2. Diagnosis

The diagnosis of PF is relatively simple. Generally, it can be obtained by clinicians according to the patient's medical history and symptoms combined with local physical examination, but it is easy to be affected by doctors' subjective factors. Therefore, sometimes it is necessary to identify and evaluate the severity of the disease in combination with imaging diagnosis, such as X-ray, nuclear magnetic resonance and ultrasound. Therefore, it will be carried out from two aspects: clinical diagnosis and imaging diagnosis.

2.1 Clinical Diagnosis

Symptoms, signs and epidemiological characteristics are the most important and basic ways for clinicians to diagnose and screen diseases, and the preliminary diagnosis of PF is also based on this method. Patients often complain of heel or arch pain when getting out of bed in the morning. Pain can be induced after long-term or excessive foot exercise. In severe cases, severe foot pain can be

caused by slight weight-bearing. The nature of pain is often tingling, blunt and radioactive pain. Tenderness points can often be touched on the medial side of the sole. The disease mostly occurs in the middle-aged and elderly aged 40-60. The occurrence of the disease is related to foot overload, which is easy to lead to heel pain, limited movement of foot and ankle, contracture and sclerosis of myofascia, change of force line of hip, knee and ankle of lower limbs, resulting in pain and even gait change. In addition, the incidence rate of PF is high, which is a common disease in the ankle and pain department. Especially in the poor medical condition, the clinical diagnosis has strong practicability. But relying solely on the clinical symptoms and history of the patient is the main diagnostic basis, and is easily influenced by the subjective experience of clinical medical students. Therefore, clinical diagnosis is often combined with imaging.

2.2 Imaging Diagnosis

2.2.1 Clinical Often Includes X-Ray, MRI and Muscle Bone Ultrasound.

(1) X-ray has unique advantages in calcification, hyperosteoecy and foot arch morphology. X-ray can be used to diagnose whether there is heel calcification and calcaneal bone spur in patients with newly diagnosed heel pain. (2) Magnetic resonance imaging (MRI) has the unique advantages of noninvasive, safe, green, radiation-free and high resolution in observing soft tissue because of its wide field of vision. Therefore, MRI can clearly show the thickness of plantar fascia, soft tissue swelling and bone marrow edema. However, MRI has the following shortcomings: the examination cost is more expensive. Because it is mainly through magnetic field imaging, it is not suitable for patients with metal foreign bodies in adjacent parts, and it is also not suitable for patients undergoing cardiac pacemaker surgery and patients with serious cardiopulmonary diseases. When there is no obvious abnormality in X-ray and ultrasound examination and intractable heel pain that cannot be diagnosed clinically, MRI examination of foot and ankle should be considered to exclude early neoplastic diseases such as plantar fascia rupture, senile fat pad atrophy or difficult to be found by X-ray and ultrasound.

2.2.2 Musculoskeletal Ultrasound

After nearly 50 years of development, ultrasound has been widely used in the diagnosis of urinary, endocrine, sports and other system diseases. Compared with CT and MRI, musculoskeletal ultrasound (MUS) has the characteristics of simple, cheap and real-time display of bone and fascia. The shape and structure of plantar fascia can be clearly observed by muscle bone ultrasound. Usually, the thickness of plantar fascia is greater than 4mm, or the thickness of plantar fascia of affected foot is significantly higher than that of healthy side, and shows hypoechoic changes, which can indicate the existence of PF. There may also be gender differences in plantar fascia thickness, which is related to occupation. In their research, Jing Wu [2] et al. Concluded that the average plantar fascia thickness of male pf patients was higher than that of women. At the same time, they also concluded that the fascia thickness alone could not be used as an index for the diagnosis of PF. Due to the decrease of echo and the increase of fascia blood flow, it may lead to misdiagnosis. The fascia thickness under ultrasound is the main imaging diagnosis basis, but Enkmütlu [3] showed in his research that the fascia thickness may not be positively correlated with the improvement of foot function, and the fascia thickness can not be used as an index to judge the curative effect at least in the short term. The hardness of muscle tissue can be accurately reflected by ultrasonic elastography. Shear wave elastography (SWE) is different from the qualitative measurement of hard elastic imaging and the indirect imaging of acoustic radiation force pulse imaging. It is a quantitative measurement of tissue hardness by shear wave, which can reflect the elasticity of local tissue in real time, so that it plays a more and more important role in the evaluation of myofascial efficacy. Xu Lei [4] and others measured the plantar fascia thickness and elastic hardness of PF patients before and after manual treatment by using shear wave imaging technology, and concluded that it can well reflect the elasticity of plantar fascia tissue in a short time. It shows that shear wave elastic imaging can effectively quantify the recovery of PF in treatment, has strong sensitivity to the changes of plantar fascia, and has a certain reference significance for the evaluation of curative effect.

3. Treatment

The treatment of PF can be divided into two categories: non-surgical treatment and surgical treatment.

3.1 Non Operative Treatment

Non operative treatment includes physical therapy, drug therapy and traditional Chinese medicine.

3.1.1 Physical Therapy

Physiotherapy plays an important role in clinical intervention of plantar fasciitis, mainly including rest, ice compress, exercise therapy, impact wave and orthopedic devices.

1) Rest and ice compress

As the most basic treatment for PF, rest and ice compress often have good effects on mild PF. Even for more severe PF, rest can avoid weight-bearing and reduce the stimulation to plantar fascia, so as to reduce symptoms. Ice compress can reduce and slow down the release of histamine, inhibit nerve conduction, reduce the sensitivity of tissue to pain, improve the pain threshold, and reduce pain. It may be more suitable for the acute attack of early PF and chronic pf clinically.

2) exercise therapy

Exercise therapy refers to the extension of plantar fascia, Achilles tendon and gastrocnemius muscle through self-training or assisted by instruments. Tong [5] concluded that intensive exercise or stretching exercise (2-3 times a day, VAS score and temporal pat gait parameters after 4 and 8 weeks respectively) can significantly reduce the pain and improve the gait of PF patients. At the same time, the effect of stretching Achilles tendon and plantar fascia is better than simple plantar fascia stretching, and the tension of gastrocnemius muscle is positively correlated with the degree of PF pain. Considering that the fascia system is a complete whole, the gastrocnemius muscle, Achilles tendon and plantar fascia are physiologically and anatomically connected and pathologically related. Combined stretching can better relax the muscles as a whole, reduce the tension of the muscles and achieve better curative effect. At present, there is low-quality evidence that stretching is effective in intervening PF, but there is a lack of high-quality evidence for the time being. In addition, the long-term efficacy of stretching in the treatment of PF is promising, but there is no consensus on the stretching frequency and strength.

3) extracorporeal shock wave therapy

Extracorporeal shock wave treatment of PF has the advantages of good curative effect, non-invasive and no adverse reactions. It has been widely recognized at home and abroad and has been recommended as a guide. It directly acts on the focus, destroys harmful chemicals and inhibits nerve endings through the positioning and movement of the therapeutic probe, so as to reduce the sensitivity of receptors and achieve analgesic effect. Shock waves have three different energy levels: high, medium and low, and focused and divergent transmission waveforms. On the premise of considering both safety and efficacy, it is recommended to treat PF with low-energy and divergent energy transfer shock wave in the range of $0.06 \sim 0.25 \text{ mJ} / \text{mm}^2$ [6]. Studies have shown that shock wave therapy can effectively improve the pain symptoms of patients with chronic intractable PF. At present, the observation and research at home and abroad are focused on the medium and short term, so the long-term efficacy of shock wave treatment of PF needs to be verified.

4) orthopedic devices

The orthopedic device designed according to foot biomechanics mainly plays a protective role by supporting the foot arch, redistributing the plantar pressure and reducing the plantar friction. It is mainly aimed at pf patients with acquired flexible arch changes, which can effectively relieve pain, improve foot function and disability. Gandalf [7] treated PF with customized orthopedic insoles, the pain was alleviated at 1 month, the pain and ankle function were significantly improved at 3 months, and the abnormal plantar pressure and gait were significantly improved. It is suggested that orthopedic devices have good medium and long-term efficacy in the treatment of PF, which is consistent with

the results of another study [8]. It is related to the mechanism of adjusting abnormal biomechanics, so as to avoid further damage of fascia and reduce local inflammatory stimulation.

3.1.2 Drug Therapy

Drug therapy is the most basic and common choice for PF. In view of the clinical efficacy and frequency of use, this paper mainly introduces the common oral drug therapy and drug injection therapy.

1) non steroidal drugs

Nonsteroidal drugs mainly reduce the production of prostaglandins by inhibiting cyclooxygenase. They play the role of antipyretic, analgesic and anti-inflammatory. Clinically, they are mainly used to alleviate the pain caused by various muscles, joints and fibers. A study in the United States [9] shows that almost 70% of patients with plantar fasciitis use over-the-counter analgesic drugs to improve pain symptoms, of which about 50% choose non steroidal anti-inflammatory drugs, which suggests that non steroidal anti-inflammatory drugs play an important role in pain in PF patients. Although they can reduce pain in a short time, they can induce gastrointestinal reactions Renal toxicity and other risks, long-term use is not recommended.

2) corticosteroid injection

Local injection of cortisol drugs is the most frequently used injectable drugs in the treatment of PF. Clinical studies have shown that local injection of corticosteroids can effectively reduce pain and improve its function. David [10] concluded in his study that corticosteroid injection was effective in the treatment of PF in a short term (one month). In addition, studies have also shown that its short-term efficacy is accurate [11]. Compared with blind acupuncture, ultrasound-guided injection of cortisol steroids can increase safety or improve clinical efficacy. In addition, compared with superficial injection of cortisol, deep injection may be more effective in improving function, reducing pain and plantar fascia thickness. However, the longest follow-up time of the study was only 6 weeks, and the longest effective time was not evaluated. Although it is widely reported that its curative effect is good, repeated injection is not recommended to avoid tendon rupture and osteoporosis.

3) botulinum toxin treatment

Botulinum toxin (ibta) is a neurotoxin produced by *Clostridium botulinum*. Its main mechanism is to inhibit the release of presynaptic neurotransmitters at the neuromuscular junction (NMJ) and to block the information transmission between motor nerve and muscle. A prospective, randomized, double-blind, 1-year follow-up study showed that botulinum toxin could significantly alleviate the pain and dysfunction caused by plantar fasciitis compared with normal saline injection [12]. Compared with previous studies, the evidence level of this study is high (Level 1), but there are also deficiencies in the number of cases and longer follow-up time.

3.1.3 Traditional Chinese Medicine treatment

Bone setting and tendon regulating manipulation and small needle knife of traditional Chinese medicine are important components of traditional Chinese medicine. They play a unique advantage in the treatment of PF. They have good clinical efficacy and no obvious adverse reactions.

1) Bone setting and tendon regulating manipulation

As the most important part of orthopedics and traumatology of traditional Chinese medicine, bone setting and tendon regulation is widely praised by patients for its simplicity and effectiveness. Clinical studies have confirmed that bone setting and tendon regulation can effectively treat PF. It mainly carries out fundamental treatment from the aspects of relieving muscle spasm, restoring muscle group coordination and restoring joint disorder. Wu Guohao [13] and others used the joint tendon manipulation of Li's bone injury school in Guanzhong to treat PF. Compared with the shock wave control treatment, its overall curative effect is equivalent, and the immediate curative effect is better than that of the shock wave group. Bone setting and tendon regulating manipulation in the treatment of PF has the advantages of safety, comfort, strong flexibility and simple operation. However, the current relevant research and sample size are small. We hope to have a larger sample size of clinical

research and basic research to further clarify the mechanism of bone setting and tendon regulating manipulation in the treatment of PF from the perspective of evidence-based medicine.

2) Traditional Chinese medicine needle knife treatment

Traditional Chinese medicine needle knife is a new therapeutic instrument combining acupuncture and blade. It can not only acupuncture acupoints, stimulate their own regulation of healthy qi and resist external pathogens, but also have the effect of surgical cutting and separation. Since the appearance of needle knife in the 1970s, after continuous practice and improvement, needle knife therapy has been widely accepted in clinic, especially in the treatment of intractable muscle and bone pain. Clinically, there are two ways to treat PF with needle knife: closed operation and ultrasound-guided needle knife to release the diseased fascia. Professor Liu Jun [14] treated PF with needle knife through local joint meridian seeking and acupoint selection, which stimulated healthy qi and cleared local pathological products. Duan Hua [15] and others used ultrasound-induced needle knife to treat plantar fasciitis, which was significantly better than the traditional needle knife treatment in the control group in improving pain and function. Under the guidance of ultrasound, the treatment of PF with needle knife can not only accurately treat the focus and improve the clinical efficacy, but also reduce the accidental injury that may be induced by blind acupuncture.

3.1.4 Others

In addition, the treatment methods of plantar fasciitis include platelet rich plasma treatment, hyaluronic acid, laser treatment with different frequencies, traditional Chinese medicine acupuncture and traditional Chinese medicine. At the same time, reasonable combination therapy can improve the clinical efficacy, such as extracorporeal shock wave combined with dry acupuncture in the treatment of PF, which can significantly improve the pain improvement rate, and Shujin Huoxue Decoction Combined with scraping both inside and outside can achieve good results.

3.2 Surgical Treatment

Clinically, although most people can achieve good results through conservative treatment, surgical intervention should be considered for stubborn PF with ineffective conservative treatment. At present, it includes open fasciotomy, osteotomy and orthopedics, minimally invasive radiofrequency nerve ablation, endoscopic therapy and so on. With the development of science and technology and the continuous improvement of medical level, minimally invasive has gradually become the mainstream way of surgical treatment of PF. Minimally invasive not only shortens the postoperative rehabilitation time, reduces the risk of infection, but also improves the cure rate. For example, if PF is treated under endoscope, it can not only effectively clean up the lesions under the premise of visualization, but also ensure the integrity of plantar fascia and avoid further damage to fascia. Johansen [16] observed that 30 patients with chronic plantar fasciitis were treated with endoscopy, corticosteroid injection and equivalent strength training for 30 months. The foot function was followed up for 1 year ($P < 0.05$), vas and activity index at 2 years. The surgical treatment was better than the rehabilitative conservative treatment.

4. Conclusion

PF is a clinical syndrome that is associated with inflammation and degeneration. The etiology is not yet fully understood. But combining the known causes, controlling body weight reasonably and avoiding standing static for a long time will help reduce the incidence rate of PF. Clinical diagnosis is still the most basic way of diagnosis, and it can be differentiated with auxiliary examination when necessary. Musculoskeletal ultrasound is suitable for those who still have symptoms after conservative treatment for more than 1 month, and has the advantages of low price, excellent effect and non-invasive. It may be the main objective tool to replace MRI to evaluate the short-term efficacy of PF. For PF treatment, rest and self exercise can be the first choice; Extracorporeal shock wave is safe and effective in the treatment of PF. Considering the safety, overall efficacy and convenience, it is recommended to use low-energy divergent shock wave in the treatment of PF; Anti inflammatory

drugs can effectively relieve pain in the short term, which is estimated to be related to inhibiting the local inflammation caused by repeated micro injury of PF, and can be used as a short-term choice for intractable PF (within one month); Orthopedic devices and bone setting and tendon regulating manipulation play a fundamental therapeutic role by correcting the abnormal biomechanics of the foot, which can be optimized for the medium and long term. At the same time, traditional Chinese medicine bone setting and tendon regulating manipulation can also be used as a short-term treatment or a treatment that needs to alleviate symptoms immediately, with strong flexibility and high safety. For invasive treatment such as corticosteroid injection and botulinum toxin injection, it is recommended to combine them under ultrasound guidance, which can not only improve the curative effect, but also reduce accidental injury. For intractable PF with more than three conservative treatments that are ineffective for more than 6 months, surgical treatment is recommended clinically. Endoscopic plantar fascia lysis is recommended for the selection of surgical methods, which is not only as effective as open surgery, but also shortens the postoperative rehabilitation time. Finally, it is suggested that ladder therapy, personalized penetration therapy and combined traditional Chinese and Western medicine are helpful to reduce medical costs, reduce side effects and improve the overall curative effect.

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