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〈 Clinical Research 〉

Treatment of Plantar Fasciitis in Recreational Athletes

Two Different Therapeutic Protocols

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Abstract: *Plantar fasciitis (PF) commonly causes inferior heel pain and occurs in up to 10% of the US population. Treatment protocols in most studies include the use of ice therapy, nonsteroidal anti-inflammatory drugs (NSAIDs), and stretching and strengthening protocols. The aim of the current study was to examine the effectiveness of 2 different therapeutic approaches on the treatment of PF in recreational athletes using the Pain and Disability Scale for the evaluation. A total of 38 participants with PF were randomly allocated to 2 different groups of 19 male participants in each group. Group 1 was treated with ice, nonsteroidal anti-inflammatory medication, and a stretching and a strengthening program. Group 2 received the same therapeutic procedures as group 1, reinforced by acupuncture treatment. The primary outcomes, nominated a priori, were pain description and mobility-function at 1 and 2 months. Outcomes were measured with the pain scale for PF. The mean total score of the acupuncture group at the third measurement was statistically minor compared with the mean total score of the first group. Acupuncture should be considered as a major therapeutic instrument for the decrease of heel pain, combined with traditional medical approaches.*

Keywords: age-related problems; physical therapy; plantar fasciitis; ankle; pain management; sports podiatry

> "Treatment protocols in most studies include the use of ice therapy and nonsteroidal anti-inflammatory drugs (NSAIDs)."

Introduction

Plantar fasciitis (PF) commonly causes inferior heel pain and occurs in up to 10% of the US population.[1] Approximately 600 000 outpatients visit various medical centers in the United States annually to receive treatment for PF.[2] Both active and sedentary adults of all ages suffer from this pathological condition.[1] It is more likely to occur in people who are obese, spend most of the day on their feet, or have limited ankle flexion.[3] Current investigation discloses that the pain is caused by acute or chronic injury to the origin of the plantar fascia from cumulative and excessive stress.[1-3]

Diagnosis of PF is based on the patient's medical history and on physical examination test results.[4] Patients typically present with persistent inferior heel pain on weight bearing for months or even years.[5] Pain is labeled as throbbing, searing, or piercing, particularly in the morning or after periods of inactivity.[6] Although discomfort ameliorates after ambulation, it worsens with continuous activity, often causing serious disruptions in daily activities.[6] Patients commonly have tenderness around the medial

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Table 1.

Differential Diagnoses in Plantar Fasciitis

Abductor digiti quintri nerve entrapment
Tarsal tunnel syndrome
Medial calcaneal branch of the posterior tibial nerve entrapment
Calcaneal stress fracture
Calcaneal apophysitis (Sever disease)
Paget disease
Tumor
Reiter syndrome
Fat pad atrophy
Bursitis
Sickle cell disease
S1 radiculopathy
Psoriatic arthritis
Bone bruise
Heel contusion

Figure 1.

Area of maximum tenderness in patients with PF.

calcaneal tuberosity at the plantar aponeurosis (Figure 1).[7] Numerous other pathological conditions cause heel pain, which can be distinguished from PF by monitoring the medical history of the patient together with his or her physical examination (Table 1).[5] Diagnostic imaging is not a preferred test evaluation in diagnosing PF; however, it should be considered if another diagnosis is strongly suspected.[8] According to several studies, thicker heel aponeurosis, identified by ultrasonography, is associated with PF.[9,10] Radiography may display calcifications in the soft tissues around the heel or osteophytes on the anterior calcaneus (ie, heel spurs).[11] Bibliographical evidence suggests that 50% of patients with PF and up to 19% of patients without PF have heel spurs.[11] The presence or absence of heel spurs may not be associated with PF. Bone scans may present increased uptake at the calcaneus, and magnetic resonance imaging may show thickening of the plantar fascia, but the accuracy of these tests remains inconclusive.[11]

In general, PF is a self-limiting condition.[12] Healing time varies from 6 to 18 months, delimiting patients and frustrating physicians.[13] Treatment protocols in most studies include the use of ice therapy and nonsteroidal anti-inflammatory drugs (NSAIDs).[14] Other research supports the use of night splints to treat patients with pain lasting more than 6 months.[15,16] Stretching protocols often focus on the calf muscles and Achilles tendon or on the plantar fascia itself (Figures 2, 3, and 4).[17,18] In addition, limited evidence supports the use of corticosteroid injections and steroid iontophoresis to manage PF.[19] However, physicians should be cautious when administering corticosteroid injections because it is associated with plantar fascia rupture, which may bring about long-term discomfort.[20] Further research focused on the effectiveness of extracorporeal shock wave therapy (ESWT) in the management of heel pain, with inconclusive results.[21]

Acupuncture has gained increasing attention in relation to the treatment of acute and chronic pain.[22] Different mechanisms explain its effects. Piercing the skin activates different pain modulating systems to a nonquantified degree. Local effects on healing by electrical effects of skin injury,[23] release of vasoactive substances,[24] and trigger point effects[25,26] as well as distant factors such as activation of a pain-suppressing system in the spinal cord (diffuse noxious inhibitory controls)[27,28] have been described.

The aim of the current study is to examine the effectiveness of 2 different therapeutic approaches on the treatment of PF in recreational athletes, using the Pain and Disability Scale (PFPS) of Willis et al[29] for the evaluation of the participants.

This research suggests that one of the most commonly treated injuries in athletes may be resolved more successfully by combining traditional therapeutic procedures with acupuncture.

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Figure 2.

Stretching exercise focused on gastrocnemius muscle.

Figure 3.

Stretching exercise focused on soleus muscle.

Materials and Methods

The current study examines 38 male patients who visited the Laboratory of Functional Anatomy and Sports Medicine (University of Athens) from May 2008 to February 2010, experiencing heel pain. Initially, a total of 45 patients with foot symptoms visited our laboratory. Of the 45 patients, 41 agreed to participate in the study. After signing an informed consent, participants were screened for PF. Only those who reported pain and tenderness over the medial aspect of the heel/foot were included in the study (38 participants).All participants were clinically examined (with complementary tests, such as radiography, ultrasonography, and bone scan, where necessary, to exclude other causes of heel pain) to diagnose and categorize PF versus other heel pain conditions, such as calcaneal bursitis or calcaneal fractures (Table 1).

Participants were randomized using computer-generated numbers into 2 treatment groups. Both the participants and the researcher who obtained the completion of the recordings were blinded to the group status of the participants. Participants were randomly allocated to 2 different (as far as the therapeutic treatment is concerned) groups of 19 male participants in each group. Group 1 was treated with ice, nonsteroidal anti-inflammatory medication (diclofenac 75 mg, twice per day for 15 days), a stretching program focusing on calf muscles, the Achilles tendon, and the plantar fascia itself (Figures 2, 3, and 4), and a strengthening program (consisting of towel curls, toe taps, and picking up marbles and coins with the toes) for minimizing functional risk factors such as weakness of the intrinsic foot muscles. The ice therapy and the stretching and strengthening protocols were conducted for the whole period of treatment. Group 2 received the same therapeutic procedures as group 1, reinforced by acupuncture treatment (a total of 16 sessions, 2 sessions per week). All procedures described in the current study were performed after approval had been granted by the School of Health and Social Care Ethics Committee with participants being informed about the research procedures and potential risks. All participants provided written informed consent prior to recruitment. The procedure was conducted at the Laboratory of Functional Anatomy and Sports Medicine, University of Athens. Patients who had a clinical diagnosis of PF and experienced symptoms for at least 2 weeks were invited to participate. They were excluded if they displayed a history of a major orthopedic

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Figure 4.

Plantar fascia–specific stretch.

Table 2.

Acupoints Used for the Treatment

Trigger Points
Bladder 31, 54, 58, 60, 62
Stomach 36
Large intestine 4
Daling-PC 7
Spleen 5
Kidney 7,8
Triple Burner 5
Liver 2,3
Gallbladder 30, 34, 37, 38

or medical condition (eg, inflammatory arthritis or diabetes) that may have influenced their condition. In all, 41 patients with heel pain were screened; 38 were diagnosed with PF.

The primary outcomes, nominated a priori, were pain description and mobility-function at 1 and 2 months (3 repeated validations for each participant, 1 before the treatment, 1 at the completion of 4 weeks of treatment, and 1 at 8 weeks of treatment). Outcomes were measured with the pain scale for PF used by Willis et al.[29] The PFPS includes unique symptomatic questions in differentiating PF and control questions as well, which makes scores of 0 to 100 points. All patients completed the PFPS before the beginning, at 4 weeks, and at 8 weeks after the initiation of the treatment protocol.

In our laboratory, patients received 16 acupuncture sessions in 8 weeks (2 sessions per week, with an interval time of 2 to 3 days in between sessions). The acupuncturist (KP) is a well-trained and experienced professional. Before the opening session, acupoints were checked to determine pain on pressure. Painful points were chosen as well as others (local and distal points) according to the symptoms and the final diagnosis (Figure 5). A combination of up to 12 points was used out of a list of around 20 (Table 2), which have been described as being effective.[30-32] This first combination of acupoints was used for 6 consecutive sessions. If no improvement was reported, another clinical examination was performed to choose alternative points for the next 10 sessions. Treatment was initiated by disinfecting the area with alcohol, and the sterile, 1-use needles (size 0.26 × 25 mm^2, Ener-Qi, China) were inserted perpendicularly through plaster and skin into deeper tissue layers, using slight rotation and thrusting movements to obtain the Deqi sensation, which was characterized by the participants as a dull ache, numbness, or heaviness. Needles were retained for 20 to 30 minutes, with periodical manual stimulation.

After PFPS questionnaires were collected from patients a 1-way analysis of variance (ANOVA) was used to determine differences between baseline measurements and the first and second measurements of the 2 groups during treatment. All statistical tests were performed at an α level of .05 using SPSS software.

Results

All participants were active amateur recreational athletes, who practiced their preferred sport 2 to 3 times/wk; 20 (53%) of the participants were recreational runners, 12 (32%) were recreational basketball players, and 6 (15%) were tennis players. The mean value of training hours was 6 h/wk for both groups.

No statistically significant difference was found between the 2 groups considering the interval of time between initial manifestation of heel pain and the beginning of the therapeutic treatment (the average length of time that the patients experienced the PF symptoms before receiving treatment was as follows: group 1, 15.8 days versus group 2, 16.3 days of pain. Also, 3 participants (1 from group 1 and 2 from group 2) reported previous episodes of heel pain, which were resolved only with rest. None of the participants received previous treatments for the PF. None of the participants presented pes

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Figure 5.

Acupoint large intestine 4 (L.I. 4).

Table 3.

Participant Anthropometric and Training Characteristics

Group 1 (n = 19)	Group 2 (n = 19)
Mean age = 37.4 (±4.3) years	Mean age = 36.8 (±3.9) years
BMI = 23.74	BMI = 23.21
Training (h/wk): 6.3	Training (h/wk): 6.5
Sports: 12 runners, 7 basketball players, 4 tennis players	Sports: 8 runners, 5 basketball players, 2 tennis players

planus (low arch of the feet), pes cavus (high arch), or other anatomical malformations (overpronation, discrepancy in leg length, excessive lateral tibial torsion, and/or excessive femoral anteversion).

Nonsevere side effects were reported during the treatment protocols. Three participants (16%) of group 2 (with acupuncture treatment) complained of headaches and dizziness. Additionally, 1 participant (5%) of the acupuncture group reported loss of strength in the legs and mild local edema around the area of needling. No side effects (ie, gastric pain) were reported from the participants that resulted from the use of diclofenac.

Baseline anthropometric characteristics (age and BMI) of the 2 different groups have been subjected to statistical analysis and revealed no significant differences (Table 3). Regarding baseline measurement scores of the PFPS (before treatment), no statistically significant differences were found between the 2 groups (Table 4).

The first group presented a statistically significant ($P < .05$) decrease of the mean total score values (55.1 vs 62.6) of PFPS on the second measurement (after 4 weeks of treatment) compared with the first validation, with additional significant decrease of the mean total score (46.2) on the third measurement (after 8 weeks of treatment).

The second group (including acupuncture treatment) showed a statistically significant ($P < .05$) decrease of the mean total score values (54.2 vs 64.8) of PFPS on the second measurement (after 4 weeks of treatment) compared with the first validation, with an additional significant decrease of the mean total score (34.3) on the third measurement (after 8 weeks of treatment).

No statistically significant difference ($P > .05$) was reported between the mean total score of the 2 groups at the second measurement (group 1 mean total score of 55.1 vs group 2 mean total score 54.2). In contrast, the mean total score of the acupuncture group at the third measurement was statistically minor compared with the mean total score of the first group (group 1 mean total score of 46.2 vs group 2 mean total score of 34.3).

Discussion

Although plantar heel pain generally affects older adults, some other groups are also vulnerable. Furthermore, it is common among the athletic population, being estimated to contribute to 25% of all foot injuries related to running.[33] Evidently there are numerous interventions used to treat plantar heel pain; however, the Clinical Practice Guidelines for plantar heel pain proposed by the Orthopaedic Section of the American Physical Therapy Association do not pinpoint to one treatment over another.[34]

A complementary treatment for plantar heel pain involves dry needling and/or injections (local anesthetics, steroids, botulinum toxin A, and/or saline) of myofascial trigger points within the lower limb and foot areas.[35,36] However, the bibliography consulted does not identify any clinical trials that have investigated extensively the effectiveness of dry needling and/or injections of myofascial trigger points.

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Table 4.

Mean Total Score Values of PFPS Questionnaire in the 3 Measurements

Participants	First Measurement (Before Treatment)	Second Measurement (4 Weeks of Treatment)	Third Measurement (8 Weeks of Treatment)
Group 1	62.6 (±11.2)	55.1(±10.7)	46.2(±10.3)
Group 2	64.8(±11.4)	54.2(±10.9)	34.3(±10.8)

PF often produces heel pain in adults.[4] The pain is mostly caused by collagen degeneration at the origin of the plantar fascia at the medial tubercle of the calcaneus.[4] This degeneration is similar to the chronic necrosis of tendonosis, which features loss of collagen continuity, increases in ground substance (matrix of connective tissue) and vascularity, and the presence of fibroblasts rather than the inflammatory cells that usually coexist with the acute inflammation of tendonitis.[37]

The main cause of the degeneration is repetitive microtears of the plantar fascia that overcome the body's ability to repair itself.[4] The plantar fascia is a thickened fibrous aponeurosis that originates from the medial tubercle of the calcaneus and runs forward to form the longitudinal foot arch. The principal function of the plantar fascia is to provide static support of the longitudinal arch and dynamic shock absorption.[4] Overuse rather than anatomy is the most common cause of PF in athletes.[4] A training history of an increase in weight-bearing activities is common, especially those involving running, which causes microtrauma to the plantar fascia and exceeds the body's capacity to recover.[4]

Treatment protocols in most studies include the use of ice therapy and NSAIDs.[14,38] However, none has thoroughly examined the effectiveness of these treatments alone and assessed the effectiveness of taping or strapping for managing PF.

An alternative treatment for the management of PF is the use of shoe inserts.[39] The results of randomized controlled trials showed that magnet-embedded insoles were less effective than placebo insoles in alleviating heel pain.[39] Another study[40] that compared custom orthotics and prefabricated shoe inserts combined with a stretching activity showed that the use of prefabricated insoles plus stretching was significantly more effective than custom orthotics plus stretching activity.

Furthermore, the use of posterior-tension night splints maintains ankle dorsiflexion and toe extension, creating a stable mild stretch of the plantar fascia that allows it to heal at a functional length.[41] According to a review,[41] limited evidence supports the use of night splints to treat patients with pain lasting more than 6 months. Patients treated with custom-made night splints exhibited considerable improvement, but patients treated with prefabricated night splints did not.

Physicians favor stretching protocols focusing on the calf muscles and Achilles tendon or on the plantar fascia itself.[18] Evidence related to the comparison of these 2 similar stretching protocols concludes that patients who stretched the plantar fascia showed a greater decrease in maximum pain levels and a similar pain decrease in morning activities.[18] Both protocols present an overall decrease in pain.

There is little evidence supporting the use of corticosteroid injections to treat PF. Study[41] results show that corticosteroid injections improved PF symptoms at 1 month after injection but not at 6 months once compared with control groups. However, physicians should be alert when administering this treatment because corticosteroid injections are strongly associated with plantar fascia rupture, which may cause long-term discomfort.[42]

Other reviews[41,43] concentrate on the effectiveness of ESWT in the management of acute and chronic heel pain. The overall estimate pinpoints that the quality of the studies is poor and that no conclusive evidence supports the effectiveness of ESWT in reducing night pain, resting pain, and pressure pain short term (ie, within 6 and 12 weeks).

Concerning surgical treatment, 5 retrospective case series,[44-48] which included 278 patients who experienced heel pain for an average duration of 14 months before surgery, showed that 75% to 95% of patients had long-term improvement as measured by various criteria. Up to 27% of patients still manifested significant pain, up to 20% had some activity restriction, and up to 12% had moderate pain that impaired foot function. Recovery time ranged from 4 to 8 months.

No evidence strongly supports the effectiveness of any treatment for PF, and most patients show improvement without specific therapy or by using conservative measures.[12] If conservative measures fail, physicians have to consider surgical treatment. The American College of Foot and Ankle Surgeons recommends[49] surgery if pain persists after 3 consecutive months of treatment. The effectiveness of surgery compared with conservative measures remains unproved, but many patients who have not benefited from conservative treatment report long-term improvement following surgery.

The current study uses the PFPS[29] for the evaluation of heel pain. It was selected because it can be administered in any setting and effectively illustrates the difference between PF patients versus patients with other pathologies causing heel pain. The PFPS allows physicians a more descriptive and exclusive analysis of PF pain for the evaluation of therapeutic treatment than the 100-point Visual Analog Scale (VAS) scale.

In China acupuncture has been used in the treatment of several diseases for at least 5200 years.[50] In Europe and the

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United States, acupuncture has increasingly become a complementary component of the health delivery system and has steadily claimed its usefulness assisting Western traditional medicine.[50] The extensive application of acupuncture includes the treatment of infections, inflammatory diseases such as rheumatoid arthritis, neurological diseases like migraine, pain, cardiovascular diseases, pulmonary diseases like asthma, drug and alcohol abuse, psychological disorders, and numerous other illnesses.[51] Improvement of local blood circulation, distribution, and bloodletting could be the main aspects to which acupuncture-derived effects on inflammatory diseases could be attributed.[52] In acupuncture, the insertion of a needle induces various changes close to the needle in all the different tissues that are penetrated.[50] These peripheral events may improve tissue function through vasodilation in the skin as a result of axon reflexes, which cause an immediate flare reaction.[53] This vasodilative effect is generated by the release of calcitonin gene-related peptide on stimulation of Ad or C fibers.[54,55] As bibliographical evidence[50] suggests, the local release of b-endorphin is responsible for the short-term analgesic effect, whereas the neuropeptide-induced release of anti-inflammatory cytokines derives from lymphocytes and secondary activating cells, such as macrophages. In addition, substance P is not likely to contribute to this biological phenomenon but plays a regulating role in calcitonin gene-related peptide release from nerve endings.[56,57]

Four major contributing factors improve the symptoms once acupuncture treatment is followed: the impulsive resolution of the condition; the placebo or psychological effect; a general, nonspecific physiological reaction to needling irrespective of site; and finally, a definite effect of needling at an appropriate location.[58]

Two treatment approaches are commonly used in acupuncture: local and distal acupoints.[32] In our current study, treatment acupuncture is considered as a principle therapeutic tool for the management of PF. In our laboratory, we frequently use acupuncture for the treatment of various musculoskeletal diseases, such as tennis elbow, ankle sprains, rotator cuff injuries, and low back pain, with satisfying short- and long-term results. The acupuncture impact was statistically significant after 8 weeks of treatment, with no differences between the 2 groups of participants in 4 weeks. The improvement of the analysis of the conclusive impact of acupuncture on PF should be considered in future approaches with a focus on the differences in time resolution of PF pain using the acupuncture technique.

In 2009, Zhang et al[32] assessed the specificity of the acupoint Daling (PC 7) for heel pain using a nearby acupoint Hegu (LI 4) as control. The dominant purpose of this study was to determine the efficacy and specificity of acupuncture treatment for PF. Participants were randomly assigned to the treatment group (n = 28) or control group (n = 25). The treatment group received needling at the acupoint PC 7, which is considered to have a specific impact on heel pain. The control group received needling at the acupoint Hegu (LI 4), which has analgesic properties. Acupuncture treatment was administered 5 times per week for 2 weeks, with an identical method of manual dry needling applied to the 2 acupoints. The primary outcome measure was morning pain on a 100-point VAS at 1 month posttreatment. Secondary outcome measures included a VAS for activity pain, overall pain rating, and pressure pain threshold using algometry. Statistically significant differences in the reduction of pain scores, favoring the treatment group of PC 7, were recorded at 1 month posttreatment for morning pain (22.6 ± 4.0 vs 12.0 ± 3.0), overall pain (20.3 ± 3.7 vs 9.5 ± 3.6), and pressure pain threshold (145.5 ± 32.9 vs −15.5 ± 39.4). Similar to our research conclusions, these results indicate that acupuncture can provide pain relief to patients with PF; according to the authors, PC 7 is a relatively specific acupoint for heel pain.

The statistical power of our study was 81% (estimates based on means and SD of morning pain, overall pain, and pressure pain threshold at 8 weeks of follow-up). A limitation of the current study is that it does not include a control group because it is practically difficult to sustain patients without any medication and/or acupuncture treatment. Therefore, no assessment of the efficacy of the intended acupuncture treatment compared with placebo can be found. In a future study, a control group is suggested to include follow-up measurements for the impact of acupuncture treatment on the resolution of pain.

In conclusion, acupuncture should be considered as a major and nonalternative therapeutic instrument for the decrease of heel pain as early as possible during the first sessions, combined with the traditional medical approaches. We recommend that acupuncture sessions should last a minimum of 4 weeks, with a maximum of 20 sessions for each patient. FAS

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