Long Term Effectiveness of ESWT in Plantar Fasciitis in Amateur Runners

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Abstract

Background: Shock wave therapy is one of the modern methods of treatment used to treat diseases of muscles, tendons, and entheses in orthopedics, as well as in sports medicine. The therapy is increasingly used in the treatment of plantar fasciitis—a disease that is very difficult and burdensome to treat. Where basic conservative treatment for heel spurs fails, the only alternative consists of excision of the bone outgrowth, and shock wave therapy: a modern, minimally invasive, and relatively safe method. The aim of the study was to determine the long-term effectiveness of extracorporeal shock wave therapy in the treatment of painful ailments occurring in the course of plantar fasciitis in amateur runners. Materials and methods: The study includes a group of 39 men and women, aged 34–64 (mean age 54.05 ± 8.16), suffering from chronic pain in one or both feet, occurring in the course of plantar fasciitis. The patients had to meet five criteria to qualify for the study. The group was divided into two subgroups: those who had not undergone other physiotherapeutic procedures prior to the extracorporeal shock wave therapy (ESWT-alone; 23 people), and those who had received other procedures (ESWT-plus; 16 people). The therapy was performed using extracorporeal shock wave (ESWT). No local anesthesia was used. The effectiveness of the extracorporeal shock wave therapy was evaluated using the visual analogue scale of pain (VAS), Modified Laitinen Pain Index Questionnaire, the AOFAS scale (American Orthopedic Foot and Ankle Society), and a survey questionnaire consisting of 10 questions concerning metrics and subjective assessment of the effects of therapy. The interview was conducted before ESWT, and again five years later. Results: The use of extracorporeal shock wave therapy reduced the intensity and frequency of pain, and improved daily and recreational activity. Moreover, a reduction in the level of pain sensation on the VAS scale and pain symptoms during walking was demonstrated. More favorable results were obtained in the ESWT-plus group; however, the first effects were observed later than in the ESWT-alone group. Conclusions: Extracorporeal shock wave therapy is an effective form of therapy for amateur runners. It reduces pain associated with plantar fasciitis that amateur runners may experience at rest, while walking, and during daily and recreational activity.

Keywords: extracorporeal shock wave, heel spur, plantar fascia, rehabilitation, sports medicine

1. Introduction

Plantar fasciitis with an accompanying heel spur is very burdensome and difficult to treat disease [1,2,3,4,5]. It most often arises as a result of degenerative changes of the proximal plantar fascia

and the tissues surrounding the aponeurosis, occurring due to continuous irritation of the area and resulting micro-injuries [6,7].

The main symptom of plantar fasciitis is pain in the heel area; this worsens over time, increasingly occurring upon loading and eventually, even at rest. Redness and swelling are also observed in the heel. The risk of the disease is increased by being overweight, working a job that requires long periods of standing, lifting heavy objects, intensive running, and practicing jumping sports [6,7,8].

Conservative treatment consists of strengthening the long muscles of the foot, relieving the painful area with special orthopedic insoles that have an opening for the heel in the place corresponding to the presence of bone growth. Appropriate body weight should be maintained and prolonged overloading of the foot should be avoided. While pharmacotherapy, radiation with X-rays [9,10] and physical therapy can be used, this conservative treatment is very frequently insufficient, and the only alternative is surgery consisting of excision of bone spurs. As such, shockwave therapy is becoming increasingly popular among doctors [4,6,7,8,9].

Shock wave therapy is a modern method based on the application of mechanical pressure waves directly to the affected tissues. Although it was initially used for crushing inoperable kidney stones, it is increasingly used in the treatment of lesions located within the musculoskeletal apparatus [1,2,3].

The mechanical waves can be generated by extracorporeal shock wave therapy (ESWT) or radial shock wave therapy (RSWT) [1,2,4]. An extracorporeal shock wave is characterized by deep penetration, a short pulse rise time with the steepness of the wave formed in the tissue, a frequency within the range of 1–22 Hz, as well as a very high energy of generated pulses, reaching even 120 MPa within the treated location [11,12,13,14]. The extracorporeal shock wave treatment has a very intense impact, and therefore local anesthesia is very often necessary during the procedure [12,13,14]. Radial shock wave therapy (RSWT), in contrast, is characterized by lower parameters, lower impact force, and a smaller range of penetration. Despite this, the two wave types have very similar therapeutic effects [1,2,4,15,16].

The mechanism of shockwave functioning is not fully understood. Initially, it was believed that the therapy induced positive therapeutic effects due to a structural breakdown of cells at the microstructural level, resulting in the activation of tissue regeneration processes [3,12,17]. It is now known that, at energy levels below the tissue destruction level, the shock wave also causes a range of other tissue responses and metabolic effects. These changes can increase joint mobility, and result in long-term pain relief and the restoration of normal muscle tone. The principal effects observed during shock wave therapy include reduction of pain, elimination of the source of pain, reduction of muscle tension, and improvement of the function of tissue structures, as well as induction of congestion and activation of regenerative processes [1,4]. However, the shock wave can also cause adverse effects, such as reddening of the skin, hematomas, or local swelling [1,12,17].

The Aim of the Study

The aim of the study was to determine the long-term effectiveness of extracorporeal shock wave therapy in the treatment of painful ailments occurring in the course of plantar fasciitis in amateur runners.

2. Materials and Methods

2.1. Characteristics of the Study Participants

A group of 48 consecutive patients with the diagnosis of plantar fasciitis were identified and examined. Of these, 39 met inclusion criteria and were enrolled in the study.

Inclusion criteria comprised the following: plantar fasciitis (with/without heel spur) confirmed by sonographic examination, prescribed shock wave therapy treatments, no participation in other physical therapy procedures during ESWT therapy, consent given by the subject. The exclusion criteria comprised any lesion or rupture of the plantar fascia found during sonographic examination, systemic inflammatory or autoimmune disorders, previous surgeries of the lower limbs, hereditary deformations of the skeleton, any other contraindications to participating in the study. Patients included in the study did not receive any physical therapy prior to inclusion.

Patient age, sex, involvement side, height, weight, and type of work performed were collected from medical records. The effectiveness of extracorporeal shock wave therapy (ESWT) was determined using the visual analogue scale of pain (VAS), Modified Laitinen Pain Index Questionnaire, AOFAS score (American Orthopedic Foot and Ankle Society) and a questionnaire about the subjective assessment of the effects of therapy.

Prior to participation, the patients were informed of the study objectives and how the study would be conducted, after which they provided their informed consent to participate in the study. The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Bioethics Committee of the Medical University of Lodz, Poland (approval number RNN/879/11/KB).

2.2. Study Program

After the initial qualification of patients for the study, in order to avoid bias, patients were randomly assigned to groups by a person from the research team who had no previous contact with qualified patients. The subjects were divided into two groups: the first group, ESWT-alone (23 people), comprised those who had not participated in other physiotherapeutic procedures before the commencement of ESWT therapy. The second group, ESWT-plus (16 people) comprised those who had participated in ultrasound and laser treatments before ESWT therapy.

All patients in the ESWT-plus group received ultrasound and laser treatments for two weeks before the shockwave therapy was started. The ultrasound was performed daily, for 5 min, using the following parameters: continuous mode, base frequency of 1 MHz to produce a deeper penetration, power of 2 W/cm^2 into the areas of the painful heel and the myofascial junction at the dorsum of the heel. Laser therapy was also performed daily, after the ultrasound treatment, for 5 min. All patients were treated with laser at a power of 50 mW. The laser probe was applied to the areas of the painful heel, on the medial calcaneal area, and at the dorsum of the heel, for a total dose of 8 J/cm^2 for 200 s. The selection of parameters during the study was based on previous studies and available literature [18].

The shock wave therapy was performed using extracorporeal shock wave (ESWT). The patients underwent four treatments separated by weekly breaks. Treatment parameters: applied 1000 beats/min at a power density of 0.25 mJ/mm^2. Local anesthesia was not used during the therapy. When selecting the parameters during the study, previous studies and available literature were taken into account [19].

The extracorporeal shock wave penetrates much deeper than the radial shock wave, and is therefore more suitable for this treatment [20,21].

Laser therapy, ultrasound therapy, and ESWT were performed by using the BTL-5000 SWT Power extended version of device.

The patients were interviewed to determine pain symptoms resulting from the presence of plantar fasciitis and the impact of the disease on the activity of everyday life and motor activity using the VAS scale, Laitinen questionnaire, AOFAS score, and a questionnaire for evaluating the effects of therapy. The interviews took place only at two time points: the first was before the extracorporeal shock wave therapy was performed (December 2015 to March 2016), and the second was five years after the procedure to check whether the pain had reappeared (December 2020 to March 2021). For the second interview, the patients were contacted by telephone. The therapeutic effects of the therapy were analyzed in terms of the parameters studied and the level of satisfaction throughout the period under study.

2.3. Statistical Analysis

The statistical analysis was performed using STATISTICA PL 13.3 software (StatSoft Polska, Krakow, Poland) and the R environment. Variables measured are described based on mean and standard deviation (SD), while those involving positional measurements are given as median (Me), inter-quartile range (IQR), and minimum and maximum (Min–Max). For variables measured, only positional measures are provided. For non-measurable variables, the number of observations with a given feature variant (N) and the corresponding percentage (%) are given.

The normality of the variables was verified using the Shapiro–Wilk test. As their distribution was not normal, the non-parametric Mann–Whitney U test was used to compare the two

independent groups. Two-way order ANOVA with repeated measurements was used to compare the groups with repeated measures (i.e., before and after treatment).

For the qualitative variables, the groups were compared with the chi-square test of independence. Additionally (where it was justified), the effect size was calculated using the form effect size measurement: $r=z/\sqrt{N}$ (where z is the value of the z statistic in the Wilcoxon pairwise test and N is the sample size). The effect is considered weak when $r \in (0.10–0.40)$, average when $r \in (0.40–0.60)$, and too strong when $r \in 0.60$ [22]. Statistically significant results were obtained with $p < 0.05$.

3. Results

Evaluation of Basic Characteristics

Of the 39 patients included in the initial study, all 39 were included in the final follow-up. The group comprised 22 women (56.41%) and 17 men (43.59%), aged 34–64 (mean age 54.05 ± 8.16). Among the patients who underwent shock wave therapy, 23 (58.97%) had not previously undergone any rehabilitation procedures (ESWT-alone), while 16 (41.03%) had previously participated in other rehabilitation procedures (ESWT-plus).

The mean BMI (body mass index) value was 28.46 ± 3.92 kg/m^2 (range 20.05 kg/m^2 to 37.13 kg/m^2). In half of the patients, BMI did not exceed 28.41 kg/m^2 (IQR: 25.89–31.14 kg/m^2). No statistically significant difference in BMI was found between the groups ($p = 0.2925$); however, almost 61% of the study group (ESWT-alone) were overweight, while 37.5% of the comparative group (ESWT-plus) were overweight. The characteristics of both groups in terms of sex, age, and BMI are presented in Table 1, Table 2 and Table 3.