

One-year treatment follow-up of plantar fasciitis: radial shockwaves vs. conventional physiotherapy

Marcus Vinicius Grecco, Guilherme Carlos Brech, Júlia Maria D'Andrea Greve

Faculdade de Medicina da Universidade de São Paulo, Instituto de Ortopedia e Traumatologia (IOT/FMUSP), São Paulo/SP, Brazil.

OBJECTIVE: To compare radial shockwave treatment with conventional physiotherapy for plantar fasciitis after 12 months of follow-up.

METHOD: This was a randomized, prospective, comparative clinical study. Forty patients with a diagnosis of plantar fasciitis were divided randomly into two treatment groups: group 1, with 20 patients who underwent ten physiotherapy sessions comprising ultrasound, kinesiotherapy and guidance for home-based stretching; and group 2, with 20 patients who underwent three applications of radial shockwaves, once a week, and guidance for home-based stretching. All patients were assessed regarding pain and functional abilities before treatment, immediately after and 12 months after treatment. The mean age was 49.6 ± 11.8 years (range: 25-68 years), 85% were female, 88% were overweight, 63% were affected bilaterally, and 83% used analgesics regularly.

RESULTS: At the 12-month follow-up, both treatments were effective for improving pain and functional ability among the patients with plantar fasciitis. The improvement with shockwaves was faster.

CONCLUSION: Shockwave treatment was not more effective than conventional physiotherapy treatment 12 months after the end of the treatment.

KEYWORDS: Plantar Fasciitis; Shockwave Therapy; Physiotherapy.

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E-mail: guibrech@gmail.com

Tel.: 55 11 2661-7812

INTRODUCTION

Shockwaves are mechanical acoustic waves transmitted through fluid and gaseous media (1-3). They have been used for more than 15 years for treating musculoskeletal conditions (2). The biological effect of shockwaves is produced through the mechanical action of the ultrasonic vibrations of tissues (2-4). Shockwaves can be focal or radial. Focal shockwaves have great tissue penetration power (10 cm) and impact force ($0.28-0.6 \text{ mJ/mm}^2$). These shockwaves produce mechanical and biological effects, such as the destruction of fibroses and stimulation of neovascularization in treated tissues (1-3,5,6). Radial shockwaves are pneumatic waves generated by air compressors, which are transmitted radially with shorter penetration (3 cm), lower impact ($0.02-0.08 \text{ mJ/mm}^2$) and limited biological effect (5-6). These shockwaves are effective in treating

musculoskeletal conditions that are more superficial, with clinical results similar to those of focal shockwaves. The effect of radial shockwaves is less intense, but they cause disintegration of fibroses and calcifications and increase the blood circulation at the treated site (6-9).

Radial shockwaves make use of Newton's third law (action and reaction) and are generated through the action of an air compressor. These waves are transmitted radially, with the greatest energy in the surface region of the skin and progressive diminution in the deeper regions. The biological effects (cavitation, neovascularization and analgesia) are similar to those of other wave generators, but the physical characteristics are different. Stronger ballistic pressure is produced at the point of impact, which is the most superficial area of application. Radial waves are used preferentially in cases of plantar fasciitis, lateral epicondylitis (tennis elbow), patellar tendinitis, trochanteric bursitis, calcareous tendinitis of the shoulder, tendinitis of the calcaneus and, most recently, tendinitis at the trigger points in myofascial syndromes. Radial shockwaves are used in cases of soft-tissue diseases and in more superficial locations. Focal shockwaves are used preferentially in cases of deeper lesions, such as unconsolidated fractures (1,6-12).

Plantar fasciitis is a degenerative alteration of the plantar fascia that affects up to 10% of the population (10-12). The preferred treatment is physiotherapy, which has the aims of

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suppressing the pain, restoring the mechanical function of the plantar fascia and improving gait. The use of ultrasound to promote analgesia, in association with stretching of the plantar fascia and the posterior muscles of the lower limb, is one of the most commonly indicated therapeutic alternatives for plantar fasciitis (10,13-16). Treatments for plantar fasciitis using focal and radial shockwaves have shown good results with regard to pain relief and functional improvement with a small number of applications (three to six applications) (1,3,6-9,11,17-19).

The aim of the present pilot study was to compare the pain-reducing effects of two standard interventions on the calcaneus one year after the intervention. Thus, a program of three sessions of radial extracorporeal shockwaves along with recommendations to perform therapeutic exercises was compared with a program of ten sessions of physiotherapy comprising ultrasound and a standardized comprehensive therapeutic exercise regimen.

■ METHODS

This was a randomized, prospective, comparative clinical study. The research project was approved by the Ethics Committee of the University of São Paulo under the number 259/05.

Sample

Forty patients with plantar fasciitis were treated at the Laboratory for the Study of Movement, Institute of Orthopedics and Traumatology, Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo, between 2005 and 2009. All the patients came from the institution's emergency service. At the time of presentation, the patients were randomized by means of a draw to receive one of the treatments (20 slips of paper with group 1 typed on them and 20 with group 2). This draw was conducted in the order of inclusion of the patients in this study.

The cases were diagnosed by anamnesis, physical examination and ultrasonography. All the patients agreed to participate in the study and signed a free and informed consent statement.

The inclusion criteria were as follows:

- Diagnosis of plantar fasciitis, with plantar fascia thickness greater than 4 mm, as assessed using ultrasonography;
- Age between 20 and 68 years;
- Painful symptoms for three months or more;
- Literate;
- Not using a heart pacemaker or anticoagulant medication;
- Absence of coagulopathy and other musculoskeletal conditions of any etiology with clinical manifestations in the lower limbs and spine;
- Absence of central or peripheral neuropathy, systemic inflammatory disease, associated metabolic and endocrine diseases and psychiatric disorders;
- Ability to come to the hospital for evaluation and treatment.

The exclusion criterion was as follows:

- Any need for physical intervention to treat plantar fasciitis after the proposed treatment.

The patients' mean age was 49.6 ± 11.8 years (range: 25-68). Thirty-four patients (85%) were women, and six (15%) were men. Twenty-five patients (63%) were affected bilaterally, 33 patients (83%) were using analgesic medication, and 29 (73%) had not undergone previous treatments. Twenty-eight patients (88%) were above the ideal weight, and only 16 patients (40%) practiced any physical activity regularly. There was no difference between groups 1 and 2 with regard to the distribution of gender ($p=0.661$), age ($p=0.369$), physical activity habits ($p=0.333$) or body mass index ($p=0.528$).

Evaluation protocol

The same evaluations were made before and immediately after the treatment, three months after the end of the treatment and 12 months after the end of the treatment. The evaluations were conducted by the same therapist on all occasions and consisted of the following:

- Pain assessment;
- Periodicity of the pain: number of times per week that pain was experienced;
- Duration of the pain: number of hours per day with pain;
- Visual analog scale (VAS) for morning pain, gait and standing upright;
- Fischer's algometer to quantify the painful pressure at the insertion of the plantar fascia in the calcaneus and the middle third of the medial gastrocnemius;
- Use of analgesics before and during the treatment.

Treatment protocol

Group 1 – Conventional physiotherapy: These patients were treated with ultrasound in continuous mode at a frequency of 1.0 Hz and an intensity of 1.2 W/cm^2 for 5 minutes in dynamic mode. Ten sessions were held at a frequency of twice a week. All the patients did exercises after the ultrasound application to stretch all the posterior muscles of the lower limbs (three sets of 30 seconds for each exercise) and strengthen the anterior tibial muscle (four sets of ten repetitions, with weights of 3 to 5 kg). All the patients were monitored and guided by the same physiotherapist in all sessions. All the patients were advised to actively stretch the gastrocnemius and plantar fascia at home (10,20).

Group 2 – Radial shockwave therapy: These patients were treated with applications of radial shockwave therapy, always administered by the same physician. The Swiss Dolorclast® equipment was used with a low-intensity applicator. Two thousand impulses were applied at a frequency of 6 Hz and pressure of 3 bar. The patients were treated in the ventral decubitus position, with the dorsum of the foot supported on the edge of the bed. The applicator was placed perpendicularly over the insertion of the plantar fascia in the calcaneus, and gel was used to keep the applicator in contact with the skin. The sessions were held once a week, with a total of three sessions. All the patients were advised to actively stretch the gastrocnemius and plantar fascia at home, the same advice given by the same physiotherapist as in group 1 (20).



Table 1 - Distribution of weekly periodicity of pain symptoms in groups 1 and 2 before and after the treatment (immediately, three months and one year after the treatment).

Weekly frequency of pain	Group 1				p-value*
	Evaluation 1	Evaluation 2	Evaluation 3	Evaluation 4	
No pain	0 (0%)	9 (45%)	10 (50%)	9 (45%)	0.000
Pain once a week	0 (0%)	2 (10%)	3 (15%)	2 (10%)	
Pain twice a week or more	20 (100%)	9 (45%)	7 (35%)	9 (45%)	
Weekly frequency of pain	Group 2				p-value*
	Evaluation 1	Evaluation 2	Evaluation 3	Evaluation 4	
No pain	0 (0%)	8 (40%)	9 (45%)	14 (70%)	0.000
Pain once a week	0 (0%)	0 (0%)	1 (5%)	0 (0%)	
Pain twice a week or more	20 (100%)	12 (60%)	10 (50%)	6 (30%)	

No significant difference was detected (Mann-Whitney test) between the two groups (p>0.05).

*Friedman test comparing the four evaluations within each group.

Group 1 – ten physiotherapy sessions (ultrasound and kinesiotherapy); Group 2 – three shockwave therapy sessions; Evaluation 1 – before treatment; Evaluation 2 – immediately after treatment; Evaluation 3 – three months after treatment; Evaluation 4 – one year after treatment.

The patients were allowed to use analgesics during the treatment if the pain worsened during the rehabilitation process. The therapist responsible for the treatment not only conducted pain and function evaluations in person but also followed up with all the patients by telephone once a month to ensure that the patients were not undergoing other treatments, and this contact was maintained throughout the follow-up year.

Statistical analysis

First, descriptive statistics were used to evaluate the patients’ characteristics. The categorical data are presented as frequencies and percentages (%) and the quantitative data as the means and standard deviations.

The variables sex, medical diagnosis, previous treatments, physical activity and use of analgesics were compared between the groups by Fisher’s exact test. The continuous variables age and body mass index were compared by the non-paired t test.

The pain variables were classified as categories that are represented as frequencies and percentages (%). Comparisons of the results between the evaluations were made by the nonparametric Friedman test. The nonpara-

metric Mann-Whitney test was used to compare the effect of the two treatments on pain intensity.

All the tests were performed under a hypothesis of bilaterality and assuming a significance level of $\alpha = 5\%$.

RESULTS

Thirty-two feet were treated in group 1 and 33 feet in group 2. No patients were lost or needed to receive any other type of treatment during the follow-up.

We showed in a previous study that shockwave treatment was no more effective than conventional physiotherapy treatment three months after the end of treatment (20), but we did not know what the effects would be after one year. Both groups showed improvements in pain symptoms between three months and one year, including fewer episodes of pain per week (Table 1) and fewer hours of pain per day. There were decreases in the intensity of morning pain (Table 2), gait pain (Table 3) and pain while standing upright, all assessed using a VAS for pain.

There was a decrease in the intensity of pain in the calcaneus region (Table 4) and in the gastrocnemius (Table 5), as measured using Fischer’s algometer. Most of

Table 2 - Distribution of intensity of morning pain in groups 1 and 2 before and after the treatment (immediately, three months and one year after the treatment).

VAS	Group 1				p-value*
	Evaluation 1	Evaluation 2	Evaluation 3	Evaluation 4	
Good (0-1)	0 (0%)	11 (55%)	13 (65%)	16 (80%)	0.000
Fair (2-5)	1 (5%)	5 (25%)	5 (25%)	2 (10%)	
Poor (6-10)	19 (95%)	4 (20%)	2 (10%)	2 (10%)	
VAS	Group 2				p-value*
	Evaluation 1	Evaluation 2	Evaluation 3	Evaluation 4	
Good (0-1)	2 (10%)	10 (50%)	14 (70%)	17 (85%)	0.000
Fair (2-5)	4 (20%)	5 (25%)	4 (20%)	2 (10%)	
Poor (6-10)	14 (70%)	5 (25%)	2 (10%)	1 (5%)	

No significant difference was detected (Mann-Whitney test) between the two groups (p>0.05).

*Friedman test comparing the four evaluations within each group.

VAS: visual analog scale

Group 1 - ten physiotherapy sessions (ultrasound and kinesiotherapy); Group 2 - three shockwave therapy sessions; Evaluation 1 - before treatment; Evaluation 2 - immediately after treatment; Evaluation 3 - three months after treatment; Evaluation 4 - one year after treatment.



Table 3 - Distribution of intensity of gait pain in groups 1 and 2 before and after the treatment (immediately, three months and one year after the treatment).

VAS	Group 1				p-value*
	Evaluation 1	Evaluation 2	Evaluation 3	Evaluation 4	
Good (0-1)	2 (10%)	14 (70%)	15 (75%)	19 (95%)	0.000
Fair (2-5)	4 (20%)	3 (15%)	3 (15%)	0 (0%)	
Poor (6-10)	14 (70%)	3 (15%)	2 (10%)	1 (5%)	
VAS	Group 2				p-value*
	Evaluation 1	Evaluation 2	Evaluation 3	Evaluation 4	
Good (0-1)	2 (10%)	11 (55%)	14 (70%)	15 (75%)	0.000
Fair (2-5)	4 (20%)	3 (15%)	3 (15%)	2 (10%)	
Poor (6-10)	14 (70%)	6 (30%)	3 (15%)	3 (15%)	

No significant difference was detected (Mann-Whitney test) between the two groups ($p > 0.05$).

VAS: visual analog scale

*Friedman test comparing the four evaluations within each group.

Group 1 - ten physiotherapy sessions (ultrasound and kinesiotherapy); Group 2 - three shockwave therapy sessions; Evaluation 1 - before treatment; Evaluation 2 - immediately after treatment; Evaluation 3 - three months after treatment; Evaluation 4 - one year after treatment.

the patients had reduced their intake of analgesic medication at 12 months after the treatment (Table 6).

Comparison between the groups showed that there was no statistically significant difference in any of the parameters used for the evaluation.

DISCUSSION

The plantar fascia is one of the most important static support structures of the medial longitudinal arch. Plantar fasciitis consists of inflammation of this structure and occurs through repeated microtrauma at the origin of the medial tuberosity of the calcaneus. The traction forces during weight-bearing lead to an inflammatory process that results in fibrosis and degeneration (11,14). Calcaneal spurs and plantar nerve incarceration may be associated with the inflammatory process (15,16,18,21). Women are affected more than men. Plantar fasciitis is associated with obesity and the climacteric syndrome (11,16,22,23).

In the present study, women were more affected: 34 female patients (85%) *vs.* six male patients (15%). Thirty-five of the patients (88%) were overweight, and the mean age of the group was 49.6 ± 11.8 years. Thirty-three patients (83%) were using analgesics prior to the treatment, and 73% of the patients in this study had not undergone any previous treatments.

The presence of plantar fasciitis is related to professional and leisure activities that require weight-bearing (16), without any relationship with loss of strength, muscle trophism or range of motion. The majority of the patients in the present study (66%) worked standing up, and 40% of them habitually performed some type of physical activity that involved impact. These findings demonstrate the importance of mechanical factors in the etiopathogenesis of this disease. None of the patients in this study presented any loss of strength or diminished range of motion. Ninety-five percent of these patients reported having morning pain, 90% during gait and 92.5% while standing upright.

Table 4 - Distribution of patients according to Fischer's algometer (calcaneus) in groups 1 and 2 before and after the treatment (immediately, three months and one year after the treatment).

Fischer's algometer (calcaneus)	Group 1				p-value*
	Evaluation 1	Evaluation 2	Evaluation 3	Evaluation 4	
Up to 4 kg	5 (16%)	0 (0%)	0 (0%)	0 (0%)	0.000
More than 4 and up to 6 kg	8 (25%)	1 (3%)	0 (0%)	0 (0%)	
More than 6 and up to 8 kg	14 (44%)	5 (16%)	3 (9%)	2 (6%)	
More than 8 and up to 10 kg	3 (9%)	9 (28%)	1 (3%)	5 (16%)	
No pain	2 (6%)	17 (53%)	28 (88%)	25 (78%)	
Fischer's algometer (calcaneus)	Group 2				p-value*
	Evaluation 1	Evaluation 2	Evaluation 3	Evaluation 4	
Up to 4 kg	6 (18%)	1 (3%)	0 (0%)	0 (0%)	0.000
More than 4 and up to 6 kg	14 (42%)	0 (0%)	0 (0%)	0 (0%)	
More than 6 and up to 8 kg	10 (30%)	4 (12%)	0 (0%)	1 (3%)	
More than 8 and up to 10 kg	3 (9%)	6 (18%)	5 (15%)	5 (15%)	
No pain	0 (0%)	22 (67%)	28 (85%)	27 (82%)	

No significant difference was detected (Mann-Whitney test) between the two groups ($p > 0.05$).

*Friedman test comparing the four evaluations within each group.

Group 1 - ten physiotherapy sessions (ultrasound and kinesiotherapy); Group 2 - three shockwave therapy sessions; Evaluation 1 - before treatment; Evaluation 2 - immediately after treatment; Evaluation 3 - three months after treatment; Evaluation 4 - one year after treatment.



Table 5 - Distribution of patients according to Fischer’s algometer (gastrocnemius) in groups 1 and 2 before and after the treatment (immediately, three months and one year after the treatment).

Fischer’s algometer (gastrocnemius)	Group 1				p-value*
	Evaluation 1	Evaluation 2	Evaluation 3	Evaluation 4	
Up to 4 kg	9 (28%)	2 (6%)	3 (9%)	2 (6%)	0.000
More than 4 and up to 6 kg	8 (25%)	4 (13%)	5 (16%)	13 (41%)	
More than 6 and up to 8 kg	2 (6%)	7 (22%)	4 (13%)	9 (28%)	
More than 8 and up to 10 kg	0 (0%)	4 (13%)	3 (9%)	3 (9%)	
No pain	13 (41%)	15 (47%)	17 (53%)	5 (16%)	
	Group 2				p-value*
	Evaluation 1	Evaluation 2	Evaluation 3	Evaluation 4	
Up to 4 kg	16 (48%)	5 (15%)	4 (12%)	0 (0%)	0.000
More than 4 and up to 6 kg	7 (21%)	6 (18%)	7 (21%)	10 (30%)	
More than 6 and up to 8 kg	1 (3%)	3 (9%)	7 (31%)	16 (48%)	
More than 8 and up to 10 kg	0 (0%)	2 (6%)	0 (0%)	5 (15%)	
No pain	9 (27%)	17 (52%)	15 (45%)	2 (6%)	

No significant difference was detected (Mann-Whitney test) between the two groups (p>0.05).

*Friedman test comparing the four evaluations within each group.

Group 1 - ten physiotherapy sessions (ultrasound and kinesiotherapy); Group 2 - three shockwave therapy sessions; Evaluation 1 - before treatment; Evaluation 2 - immediately after treatment; Evaluation 3 - three months after treatment; Evaluation 4 - one year after treatment.

Morning pain is an important assessment criterion of plantar fasciitis (6,7,17). In the present study, morning pain measured using a VAS for pain before the treatment showed scores greater than or equal to 5 for all the patients. After the treatment, 33 of the 40 patients had VAS scores of less than 2, showing that both treatments were effective for pain reduction.

Plantar fasciitis leads to a gait in which weight is borne on the side of the foot or on the forefoot (toes) because of pain in the medial region of the calcaneus or at the proximal insertion of the plantar fascia. This altered gait causes a shortening of the Achilles tendon and pain in the medial portion of the calcaneus and gastrocnemius (11,14,15). The use of Fischer’s algometer provided a simple and reproducible means of quantifying the pain in the medial tuberosity of the calcaneus and medial portion of the gastrocnemius. At the first evaluation, 17% of the treated feet presented intense pain in the calcaneus (up to 4 kg in Fischer’s algometer), and 34% of the patients did not have any significant pain in the gastrocnemius. These findings differ from the literature, which reports intense pain at these two sites in the majority of patients (11,14). In the present study, the patients had greater pain in the gastrocnemius than in the calcaneus, showing the importance of muscle shortening in maintaining pain.

Plantar fasciitis is often bilateral (1,14,24), and in the present study, 63% of the cases had this condition in both feet. The use of shockwaves in cases of acute inflammatory processes (present for less than three months)

is contraindicated because it may lead to a worsening of the symptoms (18). The present sample only included chronic plantar fasciitis cases.

Thickening of the plantar fascia beyond 4 mm is related to intense pain and functional limitation (21,23,25), but this relationship was not observed in the present study sample. The thickness of the plantar fascia ranged from 4 to 9 mm in our sample. There was no decrease in the range of motion of the ankle joint, in contrast to other reports, which have hypothesized that amplitude reductions occurred as a consequence of the disease (24).

Surgical treatment for plantar fasciitis is exceptional and does not always produce good results, with recurrence in up to 30% of the cases (25-27). Conservative treatment is always the first choice (10,11,14). The application of therapeutic ultrasound, accompanied by stretching exercises, is one of the physiotherapeutic procedures most indicated for plantar fasciitis (10,13,14,28-30). In the present study, the continuous form of ultrasound was used, with constant wave intensity at a dose of 1.2 W/cm². The doses that have been used and described in the literature range from 0.1 to 4.0 W/cm² (31,32). The use of higher doses in cases of plantar fasciitis is justified by the thickness of the corneal layer in the calcaneal region (31,32). We chose to use a lower dose with continuous flow for greater safety.

Radial shockwave therapy has shown good results without side effects, but it is still a relatively new and expensive technology, and it needs to be evaluated comparatively with other types of conservative treatment (6-12,19,33). In the

Table 6 - Frequencies and percentages of patients who had ceased using analgesics within one year after the treatment.

	Patients who ceased using analgesics within one year after the treatment		Patients who were using analgesics before the treatment†	p-value*
	Yes	No		
Treatment 1	14 (82.4%)	3 (17.6%)	17 (100%)	1.000
Treatment 2	13 (81.3%)	3 (18.8%)	16 (100%)	

†Three patients in Group 1 and four in Group 2 were not using analgesics before the treatment.

*Fisher’s exact test.



present study, no complications resulting from the use of radial shockwaves were observed.

The aim of this study was to evaluate the use of shockwaves in comparison with conventional physiotherapy treatment for plantar fasciitis. All the patients were advised to perform active stretching exercises on the gastrocnemius and plantar fascia twice a day to improve their ankle flexibility, but only group 1 underwent a kinesiotherapy program, under the guidance of a physiotherapist, at all the treatment sessions. The consistency of the advice, which was repeated in all the sessions, may have been one of the factors that contributed most to their adherence to the exercise program and change of habits. When this treatment is applied with care and discernment, it produces good results, even if it depends on the guidance and coaching of a physiotherapist. The present study also showed that there was no need for high doses of ultrasound to achieve pain improvements.

In group 2, the patients were advised individually to actively stretch the gastrocnemius and plantar fascia, but they did not undergo any specific kinesiotherapy program during the treatment sessions and did not have any subsequent follow-up. All the guidance was given in the three treatment sessions and during the evaluations. It is possible that the shockwave therapy was more efficient (with a faster effect) in dealing with pain than a conventional physiotherapy program would have been, but a wide-ranging rehabilitation program carried out carefully and in a well-guided manner increases patient adherence and is capable of promoting pain relief and functional improvements among patients with plantar fasciitis.

After 12 months of follow-up, both groups maintained their alleviation of morning pain, gait pain and pain when standing upright. The number of hours per day with pain and number of pain crises per week decreased, and the use of analgesics likewise decreased. There was no difference in the efficacy of the two treatments, but shockwave therapy provided faster pain relief. Active stretching of the gastrocnemius muscle and the plantar fascia may improve the painful symptoms of plantar fasciitis (11,29,30,33). This advice, given in all the treatment sessions, may have been decisive in maintaining the improvement in the two groups. The improvement in foot and ankle functional ability, particularly regarding gait, is a major factor in maintaining the improvement achieved (1,11,14).

Correctly making a clinical diagnosis of plantar fasciitis, combined with the provision of a simple but well-implemented rehabilitation program, was the determining factor in achieving good results, demonstrating that sophisticated resources or technologies are not always necessary (33-35). However, some results (4,22,36) have been discordant from those of Ogden (37), who showed that shockwaves were superior for treating plantar fasciitis, with disappearance of the symptoms in 90% of the cases treated. The long clinical evolution of plantar fasciitis, together with difficulties in changing habits (weight loss, use of appropriate footwear and adherence to an exercise program), which are necessary for maintaining the improvements, means that many cases of plantar fasciitis evolve with increasing pain and incapacity that may persist for many months or even years. The use of shockwaves in these specific cases may produce better results because of the type of physiological effect they have on the thick tissues of the plantar fascia and calcaneal tendon (37,38). The present

study on chronic patients did not show any difference between the two therapeutic methods used, indicating that good physiotherapeutic guidance, even if simple, may have equivalent success to shockwaves.

The use of shockwaves should be considered in treating plantar fasciitis (7,37,38). There are indications that this treatment is better than other treatments and diminishes the progression of the disease. The best indication might be plantar fasciitis of a more chronic nature that has not responded to conventional physiotherapeutic treatments. However, conventional physiotherapy associated with appropriate guidance for stretching exercises can also be considered in early cases, especially those that have not been treated previously.

This study has some important limitations. First, it showed that the best indication for shockwave treatment of plantar fasciitis would not be chronic cases that did not respond well to conventional physiotherapy treatments. No assessments were made regarding the thickness of the plantar fascia, but it would also be important to assess the existence of a correlation between this thickness and pain. Unfortunately, we could not provide a standardized shoe/footbed for the volunteers, but it would be important to control for this variable because it may correlate with improvements in symptoms.

The two treatments evaluated here were effective for maintaining the improvements in pain and functional ability among the patients with plantar fasciitis until the follow-up 12 months after the treatment.

■ AUTHOR CONTRIBUTIONS

Grecco MV collected and analyzed the data and prepared the manuscript. Brech GC analyzed the data and prepared the manuscript. Greve JM supervised the study and revised the manuscript.

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