

Clinical Application of Extracorporeal Shock Wave Therapy in the Treatment of Plantar Fasciitis

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Purpose. Plantar fasciitis is a common disorder. Several non-operative treatments have been advocated for the management of this condition. Extracorporeal shock wave therapy (ESWT) has been used in the treatment of this disorder since the early 1990's. We present the results of a one-year clinical application of ESWT to treat plantar fasciitis.

Methods. We enrolled 37 patients (45 heels) who had suffered from plantar fasciitis for more than 6 months from July 2002 to March 2003. Under local anesthesia, all patients received one to three sessions of ESWT. Each session consisted of 1000 acoustic shock wave pulses with an energy density of 0.55 mJ/mm². Follow-up examinations were conducted at 6 weeks, 12 weeks, 6 months, and 12 months. Patients' general data, visual analog pain scales, satisfaction, and functional scores were measured and analyzed pre-treatment and at 6 weeks, 12 weeks, 6 months, and 12 months post-treatment.

Results. A total of two patients (2 heels) were lost to follow-up. Among the remaining 35 patients (43 heels), there were no systemic or local complications. Pain scales decreased from 6.87 ± 2.00 pre-ESWT to 1.05 ± 1.73 at 12 months post-ESWT. The pain-relief rate was 67.4% at 12 months post-ESWT. Functional scores increased from 40.5 ± 15.4 pre-ESWT to 86.9 ± 18.2 at 12 months post-ESWT. The good to excellent result rate was 85.7% at 12 months post-ESWT. The satisfaction rate was 72.1% at 12 months post-ESWT.

Conclusions. ESWT is safe and effective for the treatment of chronic plantar fasciitis. It should be considered before any surgical treatment. (Mid Taiwan J Med 2006;11:230-5)

Key words

extracorporeal shock wave therapy, plantar fasciitis

INTRODUCTION

Plantar fasciitis, also known as chronic heel pain syndrome, is a common disorder. About 10% of the population complains of heel pain at some point in life. More than 80% of them have a mechanical cause for their heel pain, mainly proximal plantar fasciitis [1-4]. Several non-operative treatments have been advocated for the management of this disorder, including rest, physical therapy, splinting, oral NSAIDs, and corticosteroid injections. Surgical treatment with

an open or an endoscopic release of proximal plantar fascia has been recommended in severe cases who fail to respond to at least 6 months conservative treatment [1-4]. Extracorporeal shock wave therapy (ESWT) is a long-established technique in urology and has been used to treat plantar fasciitis since the mid 1990's [5,6]. We present the results of a one-year clinical application of ESWT in the treatment of plantar fasciitis.

MATERIALS AND METHODS

From July 2002 to March 2003, 37 patients (19 men, 18 women; average age, 49 yr; range, 23 to 73 yr) who had suffered from plantar fasciitis for more than 6 months were included in this

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study. The average duration of plantar fasciitis was 20 months (range, 6 to 72 mo). Eight patients had bilateral heel pain; therefore the total number of painful heels was 45 (right heel, $n = 23$; left heel, $n = 22$).

The inclusion criteria included proximal plantar fasciitis which could not be cured after 6 months of conservative treatment. Patients were excluded if they were younger than 18 years, if they had less than 6 months of symptoms, if they had systemic or local infection, malignancy, diabetes mellitus, gout, neurologic abnormalities, peripheral vascular disease, implanted plates or screws in the area, or a cardiac pacemaker, and if they were pregnant or taking anti-coagulants.

Under local anesthesia, 6 patients received one session of ESWT, 30 patients received two sessions of ESWT, and 1 patient received three sessions of ESWT. Each session consisted of 1000 acoustic shock wave pulses with an energy density of 0.55 mJ/mm^2 (MTS OrthoWave[®], at level 5). After treatment, the patients were instructed to ice the heel. Full weight bearing was allowed immediately after treatment. Follow-up

examinations were completed at 6 weeks, 12 weeks, 6 months, and 12 months.

Patients' general data, pain assessment with a visual analog pain scale and satisfaction and a functional score (The Mayo Clinical Scoring System [7], Table 1) were measured and analyzed pre-treatment and at 6 weeks, 12 weeks, 6 months, and 12 months post-treatment. Data were analyzed by Excel 2003 software (Microsoft Office). Comparison of pre-treatment status with outcome was made by Student's *t* test with a level of significance at $p < 0.05$.

RESULTS

The body weights of the 37 patients ranged from 45 to 87.5 kg (average, $66.5 \pm 10.6 \text{ kg}$). The body heights of the 37 patients ranged from 140 to 180 cm (average, $161.9 \pm 9.4 \text{ cm}$). The body mass index (BMI) ranged from 18.7 to 32.6 kg/m^2 (average, $25.4 \pm 5.4 \text{ kg/m}^2$). Nineteen heels (42%) had heel spurs on X-ray, ranging in length from 1 to 7 mm (average, $3.6 \pm 1.9 \text{ mm}$). All of the spurs were found incidentally on X-ray. There was no relationship between the heel spurs and the degree or duration of heel pain.

Table 1. The Mayo clinical scoring system (Total 100 points) [7]

Characteristic	Points
Pain	
None	50
Mild, occasional	40
Moderate, frequent	30
Severe, constant	0
Activity limitations	
None	10
Minor, no limitation of daily activities	5
limitation of daily and recreational activities	0
Footwear or orthotic requirement	
No footwear limitations, orthosis not required	10
Minor limits of footwear, orthosis occasionally used	5
Modified shoes required, orthosis	0
Plantar heel tenderness	
Absent	10
Present	0
Neuropathy	
None, sensation intact	10
Present, hyperthesia, Tinel's sign	0
Antalgic gait	
Absent	10
Present	0

Excellent results 90-100 points, good results 80-89, fair results 70-79, poor results < 70 .

Two patients (2 heels) were lost to follow-up. Among the remaining 35 patients (43 heels), there were no systemic or local complications such as redness, bruising, swelling or hematoma formation. There were significant statistical differences ($p < 0.05$) between pre-ESWT and post-ESWT as early as 6 weeks. The visual analog pain scales, functional scores and overall results are listed in Figs. 1, 2 and Table 2.

DISCUSSION

The etiology of plantar fasciitis is multifactorial but most commonly involves inflammation and degeneration of the proximal plantar fascia caused by overloading. The development of plantar fasciitis is associated with overweight patients, female gender, increased activity levels, and inappropriate shoe wear [1-4,8,9]. In our study, females represented 48.6% (18/37) of the study population. The BMI data revealed 14 normal weight (BMI = 18.5 to 24.9), 20 overweight (BMI = 25.0 to 29.9), and 3 obese patients (BMI ≥ 30.0); the average BMI was 25.5 ± 3.3 . Therefore, 23 patients (62%) were overweight or obese in our study. About 50% to 70% of patients have heel spurs on X-ray films

[1,2]. However, many times they are incidental radiographic findings and are asymptomatic. The relationship between heel spurs and heel pain is still unclear, but it may be a secondary consequence of chronic plantar fasciitis. In our study, heel spurs were found in 19 heels (42%), but they were not related to the symptoms of the disorders. However, the goal of ESWT is relief of pain not fragmentation of heel spurs.

Rompe et al used visual analog scales and satisfaction rates to measure outcome in a single-blind study of 30 patients with chronic plantar fasciitis. The patients were divided equally into an ESWT treatment group and a control group. They noted that there was a significant alleviation of pain and improvement of function at all follow-ups in the treatment group [10]. Ogden et al evaluated the effectiveness of extracorporeal shock wave treatment in 297 patients with plantar fasciitis who had failed to respond to conservative measures. The authors noted that 76% of the patients in the treatment group reported pain relief and were satisfied with the outcome of the procedure [6]. Wang et al, in a one-year follow-up study of 79 patients with 85 painful heels, reported that 75.3% were complaint-free and

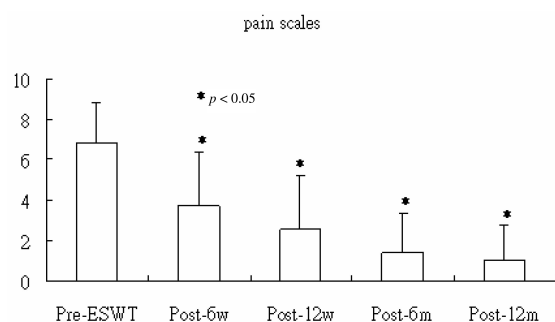


Fig. 1. VAS for pain scale decreased from 6.87 ± 2.00 pre-ESWT to 3.73 ± 2.68 (6 wk, $p < 0.001$), 2.59 ± 2.57 (12 wk, $p < 0.001$), 1.43 ± 1.89 (6 mo, $p < 0.001$) and 1.05 ± 1.73 (12 mo, $p < 0.001$) post-ESWT.

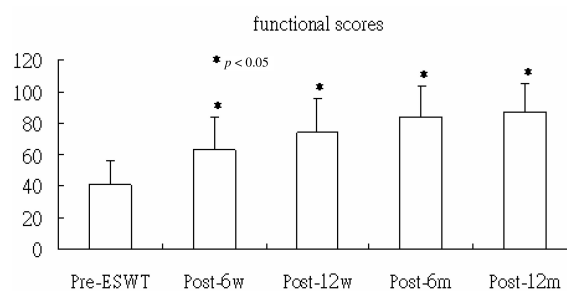


Fig. 2. Functional scores (MCSS) increased from 40.5 ± 15.4 pre-ESWT to 62.7 ± 21.0 (6 wk, $p < 0.001$), 73.4 ± 22.6 (12 wk, $p < 0.001$), 84.3 ± 19.1 (6 mo, $p < 0.001$) and 86.9 ± 18.2 (12 mo, $p < 0.001$) post-ESWT.

Table 2. Overall results (post-ESWT)

	6 wk	12 wk	6 mo	12 mo
Pain relief (VAS decreased ≥ 5), %	27.9	46.5	65.1	67.4
Good or excellent result (MCSS ≥ 80), %	20.0	48.6	74.3	85.7
Satisfaction rate, %	72.1	74.4	81.4	72.1

VAS = visual analog scale; MCSS = Mayo clinic scoring system.

18.8% were significantly better. They noted that shockwave therapy seemed to have positive cumulative effects in treating plantar fasciitis [11-13]. In our study, there was a 67.4% reduction of pain relief, 85.7% good or excellent results in functional scores and 72.1% of patients were satisfied with the treatment at one-year follow-up. The symptoms seemed to continue improving past 12 months; therefore, the effects of shockwaves may be time-dependent. The results were similar to those reported in the literature [11-13].

Wang et al reported that shock wave therapy relieved pain symptoms by alternating focal circulation and regeneration. They demonstrated that shock wave therapy enhanced neovascularization at the tendon-bone junction in dog and rabbit models [14,15]. Their studies also revealed that shock waves cause neovascularization at the tendon junction by inducing early release of angiogenesis-mediating growth and proliferating factors, including endothelial nitric oxide synthase, vascular endothelial growth factor, and proliferating cell antinuclear antigen; all of these hormones are known to improve blood supply and tissue regeneration [16,17]. Therefore, they concluded that shock wave therapy relieved pain symptoms by alternating focal circulation and regeneration.

Rompe et al, in an animal study, noted dose-dependent changes in the tendon and paratenon after ESWT, and they concluded that energy flux densities over 0.28 mJ/mm^2 should not be used in the treatment of tendon disorders [18]. However, we used an energy flux density of 0.55 mJ/mm^2 , which was between the medium and high range (0.28 to 0.60 mJ/mm^2) and there were no complications. Rompe et al also reported that repetitive lower-energy shock waves were successful in treating chronic plantar fasciitis [19,20]. Recently they used repetitive lower-energy shock waves without local anesthesia to treat the chronic plantar fasciitis, and the result seemed better than that with local anesthesia [21]. In our study, we used the medium energy (0.55 mJ/mm^2) shock wave in 1 to 3 sessions of

treatment for each patient. All the patients needed local anesthesia. To achieve better results, we should try the repetitive lower energy level shock waves without local anesthesia.

Local steroid injection may have a negative effect on ESWT. In our study, ESWT failed to relieve pain in 14 heels at 12-month follow-up. Ten of the 14 heels had had local steroid injection before ESWT. A total of 19 heels had had local steroid injection before ESWT. The pain was relieved in 47.4% (9/19) of heels with local steroid injection, and 83.3% (20/24) in those without local steroid injection.

In conclusion, ESWT is safe and effective for the treatment of chronic plantar fasciitis. It is a non-invasive therapy with a low complication rate and a high success rate. It should be considered before any surgical treatment for intractable pain. Long-term investigation is necessary for further clinical applications.

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體外震波治療在足底筋膜炎之臨床應用

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目的 足底筋膜炎是常見之疾病，其治療方法有數種非手術治療，自1990年代起體外震波治療亦用於治療此疾病，本文報告臨床應用體外震波治療足底筋膜炎一年之結果。

方法 從2002年7月到2003年3月，37位病人(45足跟)患有足底筋膜炎症狀超過6個月，在局部麻醉下，每處患足接受1至3次體外震波治療，每次治療包含能量密度 0.55 mJ/mm^2 之震波1000次。病人之基本資料、治療前和治療後之疼痛指數、滿意度和功能分數在治療後6週、12週、6個月和12個月作分析比較。

結果 除了2位病人(2足跟)失去追蹤，其餘35位病人(43足跟)皆無併發症。於治療後12個月疼痛指數從 6.87 ± 2.00 降至 1.05 ± 1.73 ，疼痛緩解率為67.4%，功能分數從 40.5 ± 15.4 增至 86.9 ± 18.2 ，功能優良率為85.7%，滿意率為72.1%。

結論 體外震波治療對於慢性足底筋膜炎是安全且有效的，在頑強疼痛的慢性足底筋膜炎考慮手術治療前應先考慮體外震波治療。(中台灣醫誌 2006;11:230-5)

關鍵詞

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