Extracorporeal Shock Wave Therapy for the Treatment of Plantar Fasciitis

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INTRODUCTION

Plantar fasciitis is a common foot disorder, constituting 15% of all foot complaints.[1] Characterized by pain along the plantar aspect of the heel, this disorder may become chronic and functionally disabling. Although the etiology remains unknown, various predisposing factors have been implicated, including minor trauma, foot pronation, improper fitting shoes, obesity and jobs that require prolonged standing.[2-5] Inflammation, microtears, fibrosis, and/or degeneration may occur at the plantar fascia origin.[6] Both conservative and surgical treatment methods have been employed with variable success.[3,7-10]

Extracorporeal shock wave therapy (ESWT) has evolved as a safe treatment option for plantar fasciitis. Shock waves are high energy sound waves propagating in three-dimensional space which apply mechanical energy to the interface of two substances (tissues) with differing acoustic impedance.[6]

Preliminary ESWT studies have reported success rates between 48% and 82% in eliminating heel pain.[11-16] Both low and high energy protocols, as well as single and multi-treatment regimens, have been utilized.[6,11-16] The purpose of this study was to review the clinical effectiveness of high energy ESWT for the treatment of plantar fasciitis.

MATERIALS AND METHODS

A total of 37 patients underwent ESWT from April 2002 to September 2002. Inclusion criteria were: plantar medial heal pain with activities of daily living; symptoms greater than six months duration; failure to respond to three consecutive treatments including NSAIDS, physical therapy, orthotics, stretching exercises, cortisone injection and casting; and age greater than 18 years. Exclusion criteria included: previous surgery or shock wave therapy for plantar fasciitis; corticosteriod injection within one month of treatment; history of documented autoimmune or systemic inflammatory disorder; coagulation abnormalities; bleeding disorders; peripheral vascular disease; diabetes; neoplasm; calcaneal stress fracture; infections; pregnancy; and peripheral neuropathy.

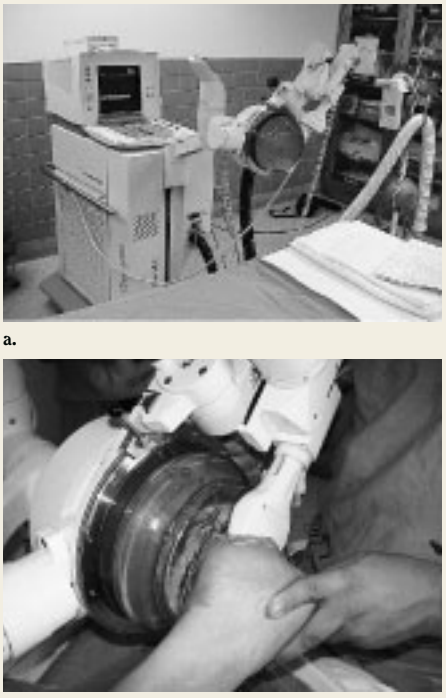

Figure 1. The Dornier Epos Ultra **(a)** and patient position during the procedure **(b)**. The ultrasound transducer can be seen in **(b)**, adjacent to the delivery mechanism.

All patients were given a medial calcaneal nerve block using 10ml of 1% lidocaine 10 minutes prior to the procedure. All patients were placed in the prone position and ultrasound visualization of the proximal plantar fascia origin was performed [Figure 1(b)]. The treatment consisted of 3800 shocks (3500 at 0.36mj/mm^2) for a total of 1300 mj/mm^2. The shock waves were administered using the Dornier Epos Ultra (Dornier MedTech America, Inc., Atlanta, GA) [Figure 1(a)].

The Dornier Epos Ultra is an electromagnetic system, which uses an electromagnetic coil and an opposing metal membrane to produce a magnetic field which compresses the surrounding fluid medium to generate a shock wave. An isocentric ultrasound is included in the Epos Ultra system to allow precise shock wave delivery to the tissues.

After treatment, patients were allowed immediate weight-bearing without any restrictions to their activities. Patients were encouraged to continue daily stretching and icing if they were performing these activities prior to the procedure.

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All patients were evaluated prior to the procedure and at one month, three months, and six months post-treatment. Patients were assessed by history, physical examination, and visual analog pain scale at each visit. Patients were judged based upon the percentage improvement in their pain from baseline. The treatment was considered successful if the patient experienced greater than or equal to 50% improvement in pain compared to the pre-procedure symptoms. Additionally, patients were grouped based on unilateral versus bilateral presenting symptoms. The improvement values were correlated with patient factors including age and BMI. Bivariate correlations and unpaired t tests (statistical significance at $p<0.05$) were performed using SPSS (SPSS Inc., Chicago, Illinois)

RESULTS

Of the 37 patients who underwent ESWT, two received bilateral heel treatments. All patients received only one therapy session per heel. One patient could not be reached for follow-up until six months post-treatment and two patients did not have three-month follow-up examinations. There were 27 women and 10 men with an average age of 50 years (range, 24 to 76). The average BMI was 28 (range, 21 to 38). Fifty-seven percent of patients complained of unilateral pain. Of these patients, the left heel was affected in 15 cases and the right heel in six. The mean duration of symptoms was 18 months.

At one month post-procedure, 47% of patients responded successfully (50% or greater improvement in pain). At three and six month follow-up, 68% (mean improvement of 50%) and 77% (mean improvement of 64%) of patients responded successfully to ESWT, respectively. One patient achieved 100% improvement by one month after therapy. Six patients did not experience any relief of pain by six months post-therapy. No patients experienced worsening of pain following ESWT.

There was no statistically significant difference in the mean BMI of the successful and unsuccessful groups at one month ($p=0.450$). Likewise, there was no difference in the mean age of the two groups ($p=0.888$). Due to a decreasing sample size of the unsuccessful group at the three and six month time points, analysis of BMI and age were conducted using bivariate correlation between these factors and percentage improvement. There was no correlation between BMI and improvement at the three and six month time points ($p=0.995$, $p=0.729$, respectively), but there was a significant positive correlation between age and improvement at these time points ($p=0.006$, $p=0.004$, respectively).

When the patients were grouped according to unilateral versus bilateral presenting symptoms, there was not a statistically significant difference ($p=0.136$, $p=0.860$, $p=0.446$, respectively) in improvement at any of the post-therapy time points. No complications or adverse reactions were noted.

DISCUSSION

When plantar fasciitis fails to respond to conservative treatment over an extended period of time, surgical fasciotomy is often recommended.[7,9,17-19] Surgery may be associated with variable success, complications, prolonged recovery time, and loss of time from work.[20-24] Many patients and physicians will often discount the surgical option entirely because of uncertain results, leading to acceptance of chronic pain and loss of function.

As an alternative to surgery, ESWT has several advantages. First, it is a noninvasive technology without the obvious potential complications associated with surgery. Second, it has a relatively limited recovery time during which the patient may return to employment and normal activities of daily living.[25] Third, it demonstrates a success rate comparable to surgery and even to other conventional therapies for this disorder.[7,20] Finally it has the potential to be utilized earlier in the course of this disorder, which may limit patient suffering and health care costs.

The exact mechanism of extracorporeal shock wave therapy remains undefined. There may be an effect on local pain receptors leading to hyperstimulation of axons and a reflex analgesic effect.[26] Other investigators have shown an increased metabolic response at the area of healing with cellular changes, including release of nitric oxide and growth factors.[27] Additionally, neovascularization has been implicated.[11] It is also apparent that higher energy shock waves (0.28 mj/mm^2—0.6 mj/mm^2) initiate a more effective and quicker clinical response than lower energy waves (0.08 mj/mm^2).[25]

The success of high energy ESWT in this early follow-up study is comparable to previous reports in the literature. We experienced a 77% success rate (64% overall improvement in pain) at six months following ESWT. Rompe et al[16] report a 57% success rate (good or excellent outcome using the Roles and Maudsley scale) at six months in patients who received three applications of 1000 impulses of low-energy shock waves. Similarly, Hammer et al[13] reported a 71% reduction in pain with activities of daily living at six months in patients who received three sessions of ESWT at weekly intervals.

Interestingly, we found no correlation between success and BMI, which has been implicated as a risk factor for plantar fasciitis. We found no correlation between age and success at one month, but older patients had a statistically significant greater improvement at three and six months. This result may be attributable to patient activity level following the therapy. It is possible that older patients, with fewer daily demands, allowed for greater rest and healing of the treated area.

In conclusion, extracorporeal shock wave therapy is a safe treatment option for proximal plantar fasciitis. In this limited follow-up study, a single therapeutic high energy session was effective in relieving painful chronic symptoms. Further studies are needed to elucidate the duration of relief and mechanism of action.

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