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Intermediate-Term Results of Partial Plantar Fascia Release With Microtenotomy Using Bipolar Radiofrequency Microtenotomy

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ABSTRACT

Plantar fasciitis is a common condition, with most patients treated successfully with nonoperative management. Recalcitrant disease has been managed with surgical procedures that vary in design and associated morbidity. The present study sought to determine the intermediate-term results of percutaneous bipolar radiofrequency microtenotomy in recalcitrant plantar fasciitis. The patient medical records were reviewed, and data were gathered for all the patients who met the inclusion criteria. The foot function index and visual analog scale (VAS) pain scale questionnaires were mailed to the 111 patients. Of the 111 patients, 61 (55.0%) returned their questionnaires and were ultimately included in the present analysis. Of the 61 patients, 44 (72.1%) were female and 17 were (27.9%) male, with an average reported follow-up of 33.3 ± 8.6 (range 16.1 to 46.6) months. The median postoperative VAS score was 0.0 (range 0.0 to 10.0), and the median foot function index score was 3.1 (range 0.0 to 97.1). The patients were subdivided into success and failure groups according to their satisfaction. Of the 61 patients, 51 (83.6%) were satisfied and would recommend the procedure to a friend. The median VAS score in the success group was 0.0 (range 0.0 to 5.0), and the median VAS score in the failure group was 6.0 (range 0.0 to 10.0), a significant difference ($p < .001$). A significant difference was also seen in the foot function index score between the success (median 2.4, range 0.0 to 25.7) and failure (median 37.4, range 0.0 to 97.1) groups ($p < .001$). Bipolar radiofrequency microtenotomy appears to be a safe procedure that can provide outcomes equivalent to those with open surgery, with less morbidity, for recalcitrant plantar fasciitis.

Plantar fasciitis is a common condition requiring an estimated 1 million office visits annually (1–6). Although the diagnosis is frequently clear, the etiology has remained controversial, with theories involving fascial degeneration, overuse, mechanical overload, nerve entrapment, inflammation, heel pad degeneration, or a combination of factors (4,6–10). Despite the controversy, 90% to 96% of plantar fasciitis cases will resolve with nonoperative management, and most surgeons will recommend waiting a minimum of 6 to 18 months before considering surgical intervention (1,4,5,8,11–18). Nonoperative management typically consists of nonsteroidal anti-inflammatory drugs, stretching, orthotics, steroid injections, multiple therapy modalities, rest, night splints, and immobilization (4,8,9,12,13,15,16).

When nonoperative management has failed, a myriad of procedures have been described to treat recalcitrant plantar fasciitis. Open treatment has historically focused on either partial or complete release of the plantar fascia, decompression of the first branch of the lateral plantar nerve, resection of an associated heel spur, or abductor hallucis fascia release (1,4,8–14,17). Although some series have demonstrated satisfactory outcomes in most patients, all have documented complications with the procedure, with rates as high as 58%. Other studies have focused on the efficacy of endoscopic release of the plantar fascia; however, the complication rates have still been high, with published rates as high as 41% (2,9,17). Prolonged recovery and difficulty returning to previous levels of activity postoperatively have also been well documented for open procedures (2).

The complications from open procedures for plantar fasciitis have included superficial and deep infections, complex regional pain syndrome, persistent scar pain, and numbness (1,2,11). Open procedures that release the plantar fascia have been shown to have additional morbidity. The release of as little as 25% of the fascia will result in immediate postoperative radiographic changes to the calcaneal

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inclination and loss of both medial and lateral column height (4,12). This structural change can result in lateral column pain postoperatively. A quantitative correlation between fascial resection and postoperative pain has been documented (12).

Historically, investigators have viewed plantar fasciitis as an inflammatory condition, and treatment was based on this theory (3,10). More recent histologic examination of pathologic plantar fascia tissue has failed to show active inflammation but has demonstrated fibrous degeneration, suggesting a more chronic process (4). Therefore, more recent studies have now viewed chronic plantar fasciitis as a noninflammatory condition or fasciosis similar to tendinosis, which has received considerably more attention (5,19). Many investigators have studied tendinosis and identified a lack of active inflammation and histologic changes consistent with disorganized healing and abnormal vascular proliferation (7,20,21).

Bipolar radiofrequency (bRf) microtenotomy is a technique that uses a small probe to debride local tissue and was initially studied for use in damaged myocardium. These studies demonstrated revascularization in the treated areas, with increased levels of vascular endothelial growth factor and fibroblast growth factor and an apparent anesthetic effect from local nerve destruction (22,23). The technology has also been studied for tendinopathy, with promising results. Studies on tendons have demonstrated angiogenic healing with extensive vascular networks in treated areas with apparent degeneration or ablation of nerve fibers (5,21,24,25). Biomechanical studies have demonstrated no change in elastic modulus, stress at failure, or strain at maximal load in tendons treated with this technique (26). An early study by Tasto et al (21) used an open approach to access different tendon sites to perform microtenotomy with a bRf wand and demonstrated pain relief in 77% of patients within 48 hours, with no complications at 12 months. Follow-up magnetic resonance imaging demonstrated healing within 6 to 12 months, and the investigators reported 100% good or excellent outcomes at 2 years (21). Follow-up studies have demonstrated clinical efficacy in several areas throughout the body that develop tendinosis (21,27).

Multiple studies of bRf treatment applied through either an open or percutaneous approach to the plantar fascia have shown promising early results, with an early return to activity, low complication rates, high levels of satisfaction, and improvements in clinical outcomes (5,6,15,18,19). The present study was designed to build on previously published work by our senior author (C.F.H.) and explore the intermediate-term results of a percutaneous technique to perform bRf microtenotomy to the plantar fascia. We hypothesize that short term results will continue to be demonstrated in the intermediate term and that our patients will demonstrate a high level of satisfaction with the procedure.

Patients and Methods

After the institutional review board approved the present study, the patients were identified from the appropriate Current Procedural Terminology code for plantar fascia repair (code 28060). The medical records were reviewed by 2 of the authors (D.E.L., S.R.E.), identifying 479 patients who had previously undergone partial plantar fascia release from March 2008 to August 2010, the date at which the procedure was first used in the senior author's (C.F.H.) practice. The operative reports were reviewed, and only those patients who had undergone percutaneous partial plantar fascia release with bRf microtenotomy were selected. The patients were included if they were >18 years old and had been treated with bRf as an isolated procedure for the diagnosis of recalcitrant plantar fasciitis. The patients were only excluded if they had incomplete follow-up data, had had pre-existing neuropathic pain, or had been treated with additional procedures for their diagnosis. After exclusion, the medical records of 111 patients remained to be investigated.

The patients' medical records were reviewed to identify patient age, body mass index, smoking history, workers' compensation status, and the different nonoperative modalities each patient had attempted. We also identified the nonoperative treatment duration and whether any complications had occurred after the procedure. The foot function index (FFI), visual analog pain scale (VAS), and a satisfaction questionnaire were mailed to each of these patients, with instructions on how to properly complete the questionnaires. One telephone call attempt was made and a second questionnaire set was mailed to those who failed to return the questionnaires. The results of the questionnaires were then compiled into a database. The patients were divided into success and failure subgroups according to their satisfaction with the procedure. Success was defined as satisfaction with the procedure and the patient would recommend the surgery to a friend. Failure was defined as dissatisfaction with the procedure and the patient would not recommend the procedure to a friend. A formal statistical analysis was performed by a biostatistician. These groups were examined to determine whether any of the collected data were unique to either group using the Fisher exact test for categorical variables and 2-sample *t* tests or the Wilcoxon rank sum test, if the data were not normally distributed, for continuous variables. Statistical significance was set at $p < .05$ for all tests.

Operative Technique

All operations were performed by 4 fellowship-trained foot and ankle surgeons from 1 institution. Before the administration of any sedative or peripheral nerve block, the areas of maximal tenderness were manually probed and subsequently marked with an indelible surgical ink marker. The area of tenderness varied slightly with each patient; therefore, the treatment area was modified to target the symptom locale. Anesthesia was accomplished through either general anesthesia or a posterior tibial nerve block accompanied by intravenous conscious sedation. All procedures were performed in the operating room.

With the patient in the supine position, the involved foot, ankle, and leg were scrubbed, prepared, and draped in the standard fashion. After proper patient and site identification, an Esmarch tourniquet was positioned above the ankle to aid in hemostasis. The previously placed markings were used to further template a series of percutaneous microincisions situated at 5-mm intervals throughout the area of tenderness. A grid pattern, ranging from 30 to 55 microincisions, was used to target the underlying proximal plantar fascia (Fig). A smooth, 0.062-in. Kirschner wire was then used to create microincisions through the skin at each specific grid mark. These microincisions were made full thickness through the skin, subcutaneous fat, and the plantar fascia, creating a channel for subsequent placement of the bRf probe. The bRf control unit was set to 175 V, and the activation timer, which was automatically set at 0.5 second (500 ms), was attached to the bRf probe. The bRf probe was then attached to a normal sterile saline drip, set to a drip rate of approximately 1 drop every 2 to 3 seconds. The bRf was then delivered sequentially through each percutaneous microincision previously created using the Kirschner wire. Two applications of bRf were applied through each perforation, one at the junction of the superficial and deep fascia layers and the second through the entire thickness of the deep plantar fascia, as described by Sorenson et al (6) and Weil et al (18). Adhesive skin strips were applied with an overlying nonadherent dressing, followed by application of a modified Jones compression posterior splint with the foot in neutral dorsiflexion.

Postoperatively, the patients were kept non-weightbearing for 5 to 10 days. At the first postoperative appointment, they were placed in a weightbearing cast or boot until 4 weeks postoperatively and allowed to bear weight as tolerated. After 4 weeks, the patients were returned to normal footwear and allowed to resume normal activities, as tolerated, with continuation of stretching exercises.

Results

Of the 111 patients, 61 (55.0%) returned the satisfaction, FFI, and VAS questionnaires. Of the 61 patients who returned the questionnaire, 44 (72.1%) were female and 17 (27.9%) were male (Table). The mean patient age at surgery was 46.9 ± 11.0 (range 19.0 to 74.0) years. The body mass index was missing for 2 patients (n = 59), 1 patient in each group. The mean body mass index for the 59 patients was 30.8 ± 6.3 (range 22.6 to 58.6) kg/m^2. Of the 61 patients, 6 were smokers (9.8%), 2 had diabetes (3.3%), and 1 was a workers' compensation patient (1.6%). The median length of conservative care before surgical intervention was 13.0 (range 4.0 to 178.0) months. The follow-up interval from the surgical procedure to questionnaire completion was a mean of 33.3 ± 8.6 (range 16.1 to 46.6) months. One patient required revision surgery (1.6%), which included open partial plantar fascia release and tarsal tunnel release. No surgical wound complications (0.0%), 1 case of postoperative deep vein thrombosis (1.6%), and 2 ulcers (3.3%) from splint application developed postoperatively. Most patients (80.3%) would have repeated the procedure if needed. Of all 61 patients, the median postoperative VAS score was 0.0 (range 0.0 to 10.0) and the median FFI score was 3.1 (range 0.0 to 97.1).

Overall, 51 patients (83.6%) were satisfied with the procedure and would recommend it to a friend (i.e., the procedure was classified as a success), and 10 patients (16.4%) were dissatisfied with