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Endoscopic Plantar Fasciotomy; Deep Fascial Versus Superficial Fascial Approach: A Prospective Randomized Study

Bilgehan Çatal, MD [1], Mert Keskinbora, MD [2], Mehmet Ali Uysal, MD [3], Mustafa Şahin, MD [4], Deniz Gulabi, MD [5], Bahtiyar Demiralp, MD [6]

[1] *Orthopedic Surgeon, Department of Orthopedic Surgery, Medipol Koşuyolu Hospital, Kadıköy/İstanbul, Turkey*
[2] *Orthopedic Surgeon, Department of Orthopedic Surgery, Medipol Koşuyolu Hospital, İstanbul, Turkey*
[3] *Orthopedic Surgeon, Department of Orthopedic Surgery, Kartal Lütfi Kırdar Education and Research Hospital, Sağlık Bilimleri University, İstanbul, Turkey*
[4] *Asstistant Professor, Department of Orthopeadic Surgery, Medipol University Medical School, Kadıköy/İstanbul, Turkey*
[5] *Associate Professor, Department of Orthopedic Surgery, Kartal Lütfi Kırdar Education and Research Hospital, Sağlık Bilimleri University, İstanbul, Turkey*
[6] *Professor, Department of Orthopedic Surgery, Güven Hospital, Ankara, Turkey*

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ABSTRACT

In the present randomized prospective study, 2 different surgical techniques of endoscopic plantar fascia release were compared. Of 547 patients with a diagnosis of plantar fasciitis, 46 with no response to conservative treatment for ≥6 months were included. Of the 46 patients, 5 were lost to follow-up. In group 1 (n = 21), plantar fascia release was performed using a deep fascial approach (DFA), and in group 2 (n = 20), the superficial fascial approach (SFA) with a slotted cannula technique was used. Patients were evaluated using the American Orthopaedic Foot and Ankle Society Ankle Hindfoot scale and visual analog scale at baseline and 3 weeks and 3, 6, and 12 months after the initial surgery. At the final follow-up appointment, the Roles-Maudsley score was used to determine patient satisfaction. At the final follow-up examination, the mean American Orthopaedic Foot and Ankle Society Ankle-Hindfoot scale scores had increased from 53.12 to 83.68, with a decrease in the mean visual analog scale score from 7.95 to 1.65 noted. According to the Roles-Maudsley score, the success rate after 1 year was 90.47% for DFA group, 95% for the SFA group, and 92.68% for all patients. Although no significant difference was found between the final functional scores, better early postoperative scores were found in the SFA group. The mean duration of the procedure was measured as 27.22 ± 9.41 minutes overall, 35 ± 5.62 minutes in the DFA group, and 19.05 ± 4.01 minutes in the SFA group. Two early and two late complications occurred in the DFA group with none reported in the SFA group. In conclusion, the SFA is a faster and safer method of endoscopic plantar fascia release with better early postoperative scores.

Plantar fasciitis is a common orthopedic problem that affects approximately 10% of the population (1–3). Repetitive trauma over the calcaneal medial tubercle can lead to degenerative painful changes at the origin of the plantar fascia (4). Conservative therapies such as nonsteroidal antiinflammatory drugs, strapping, corticosteroid injections, platelet-rich plasma injection, botulinum toxin injection, orthotics, heel cups, night splints, and shock wave therapy have been used to treat this condition (5–24). In ≤90% of cases, plantar fasciitis can be successfully treated using these conservative measures (25). Surgical intervention might be indicated for patients for whom conservative measures have failed (26,27). The surgical techniques include open plantar fasciotomy, endoscopic fasciotomy, and percutaneous techniques (28–30).

Endoscopic methods are well established and widely used in orthopedic surgery, as well as in sports medicine, spinal surgery, and foot and ankle surgery. The main advantages of endoscopic surgery include its outpatient nature, which allows for a minimal hospital stay and facilitates an earlier return to regular activity. Endoscopic plantar fascia release (EPFR) is a minimally invasive procedure for partial plantar fasciotomy. First described and recommended by Barrett and Day (31) in 1991 as an alternative to the traditional open technique, EPFR significantly minimizes the surgical trauma and allows patients to return to regular daily activities more quickly and with less pain and discomfort (31). Although the traditional and most preferred method for EPFR is the superficial fascial approach

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Address correspondence to: Bilgehan Çatal, MD, Department of Orthopaedic Surgery, Medipol Koşuyolu Hospital, Koşuyolu Lambacı Sokak No.1, Kadıköy/İstanbul, Turkey.
E-mail address: bilgehan.catal@medipol.com.tr (B. Çatal).

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(SFA), the deep fascial approach (DFA) was also described by some investigators (32–34).

To the best of our knowledge, no published studies have compared the clinical outcomes between the deep fascial and superficial fascial endoscopic plantar fasciotomy methods. The present prospective randomized study was designed to assess the effectiveness of deep fascial and superficial fascial endoscopic fasciotomy for recalcitrant plantar fasciopathy and compare their clinical outcomes. Our main hypothesis was that no difference in treatment outcomes would be found between the 2 methods.

Patients and Methods

Basic Anatomic Study

A percutaneous guide needle was used to pinpoint the plantar fascia midline for both endoscopic approaches to prevent exceeding 50% of the total plantar fascia width during fasciotomy. Before the study, 5 different healthy below-the-knee amputated fresh-frozen cadaver foot and ankle samples were examined to determine the percutaneous landmarks that would correctly indicate the midline. In all samples, the plantar fascia was removed using an extensile calcaneal U approach. The width of the plantar fascia was measured in the cutoff area. For this, the line, which passes from posteriorly to the medial malleolus intersection and the midpoint of the line was determined. Another line that passes parallel to the axis of the plantar fascia was drawn from the determined midpoint. The anterior and posterior passing points of this line were recorded.

Patients

Our institution's centralized institutional review board approved the present prospective randomized study (study no. 80576354-050-99/21). Of 547 patients with a diagnosis of plantar fasciitis, 46 underwent EPFR from December 2012 to January 2015 by the senior author (B.D.). The patients included in the study had all presented with single site heel pain with local pressure at the origin of the proximal plantar fascia on the medial calcaneal tuberosity and failure of $\geq$3 lines of conservative treatment during the previous 6 months. Conservative treatment included nonsteroidal antiinflammatory drugs, corticosteroid injections, physical therapy, an exercise program (Achilles tendon and plantar fascia stretching exercises), and orthotic devices (heel cup, molded shoe insert, night splint, or cast). The exclusion criteria were systemic diseases, neuromuscular disorders, anatomic deformities, and previous surgery on the affected foot and ankle. In addition, patients lost during the follow-up period were excluded from the study. The patients agreed to undergo EPFR and then underwent the informed consent process and agreed to the 1 of 2 choices. Pretreatment heel radiographs and magnetic resonance imaging studies were obtained to exclude the presence of any intraosseous lesions, such as a calcaneal cyst, subtalar arthritis, or fracture. At enrollment, the same foot and ankle surgeon (B.Ç.) clinically confirmed the diagnosis by palpation to reveal the characteristic location of pain and tenderness in the hindfoot. Five patients did not complete the 1-year follow-up examination (3 in group 1 and 2 in group 2). Thus, the study group included 41 patients. All patients were informed in detail with an oral presentation of the endoscope and procedures of the study and provided written informed consent. The patients were randomly allocated to the SFA or DFA group using a computer-generated randomization list. Of the 41 patients, 12 were male and 29 were female. The mean patient age was 51.87 $\pm$ 7.35 (range 34 to 68) years. Patient age, body mass index, length of symptomatic period, and operation time were recorded.

Surgical Technique

Group 1 (DFA)

The patients were prepared in the supine position under spinal anesthesia with the affected foot raised out from the table in an upright fashion. A pneumatic tourniquet applied to the thigh was inflated to a pressure of 250 mm Hg. Under fluoroscopic guidance, a deep medial portal was made 5 mm deep to the line that links the medial calcaneal tubercle to the plantar side of metatarsal head and 10 mm anterior to the medial calcaneal tubercle. The incision was made only in the skin, and blunt dissection was performed to only the deep-medial aspect of the plantar fascia. After palpation of the plantar fascia, a trocar was passed bluntly from medially to laterally, deep to the fascia and perpendicular to the plantar axis of the foot. The lateral endoscopic portal was created using another 7-mm skin incision, and the tip of trocar was palpated. A 30° 4.0-mm endoscope inserted from the lateral portal was directed medially to remain below the plantar fascia, and water flow was provided by gravity. To improve visualization, a motorized shaver was used to prepare a working space to excise the soft tissue and a plantar portion of the flexor digitorum brevis muscle as minimally as possible. Next, a guide needle was inserted vertically through the skin to the calcaneus according to the predetermined landmarks to define the exact midpoint of the plantar fascia. After the guide needle was seen, the plantar fascia portion that remained medial to the needle was cut completely using a no. 11 hook scalpel. The remaining posterior portion of the medial half of the plantar fascia and periosteum of the fascia origin were debrided using a shaver. The tunnel was irrigated, and both portals were closed with no. 3 Prolene sutures (Fig. 1).

Group 2 (SFA)

The patients were positioned as described for group 1. The medial portal was formed using a 7-mm incision at the intersection between the vertical line drawn from the posterior border of the medial malleolus and the plantar skin line. After palpation of the plantar fascia, a trocar was passed bluntly from medially to laterally under the fascia, perpendicular to the plantar axis of the foot. The lateral endoscopic portal was created using another 7-mm skin incision, and the tip of the trocar was palpated. Both sides of a slotted cannula were passed from laterally to medially. A 30° 4.0-mm endoscope was inserted into the cannula from the lateral portal, with water flow provided by gravity. Only the small amount of soft tissue that entered the cannula was removed with a shaver. Next, the medial half of the plantar fascia was cut with a no. 11 scalpel with guidance from the midline needle, giving attention to not damage the flexor digitorum brevis muscle fibers. No additional debridement was performed. Portal incisions were closed with no. 3 Prolene sutures (Fig. 2).

Postoperative Care

The same postoperative follow-up protocol was used for both groups. A bulky dressing with a crepe bandage and limb elevation were used for the first 24 hours to decrease the formation of postoperative edema. Active range-of-motion exercises of the foot and ankle were started 1 day after surgery. Postoperative analgesia was obtained with 100 mg/dL diclofenac sodium. The patients were allowed to start weightbearing as tolerated. The stitches were removed after 10 days. The patients were encouraged to perform plantar fascia-stretching exercises at home. None of the patients were allowed to participate in sport activities or excessive walking before 2 weeks postoperatively.

Follow-Up Protocol

The outcomes were measured using the American Orthopaedic Foot and Ankle Society Ankle-Hindfoot scale (AOFAS-AHS) (35,36). The AOFAS-AHS score (primary outcome measure; range, 0 to 100) was determined before surgery and at 3 weeks and 3, 6, and 12 months after surgery. The secondary outcome measure was the visual analog scale (VAS; range 0 to 10), which was also completed before surgery and at 3 weeks and 3, 6, and 12 months after surgery. Patient satisfaction was determined using the Roles-Maudsley (R-M) scores at the final follow-up visit (37). According to the R-M score, "excellent" and "good" results were considered satisfactory and "fair" and "poor" unsatisfactory outcomes. The assessor (M.K.) was unaware of the surgical technique and performed all assessments twice in 1 day. The mean value of each score was used in the statistical analysis. All patients continued with their previous conservative treatment, including nonsteroidal antiinflammatory drugs, as needed and stretching exercises. Using the VAS, the patients were evaluated for preprocedure pain and pain at each postoperative visit. All patients in the study completed the AOFAS-AHS questionnaire before surgery and at 3 weeks and 3, 6, and 12 months after surgery. Early complications that developed immediately after the procedure and delayed complications that developed during the follow-up period were recorded.

Statistical Analysis

Sample size analysis was prospectively performed. From pilot study data, we estimated an AOFAS-AHS score standard deviation of 3.2. By assuming that the minimum clinically significant difference between the treatment group scores would be 5, we determined, using iterative methods, that a minimum of 10 samples would be necessary for each treatment group, with decisional criteria equaling 5% and error equaling 20%.

Statistical analysis was performed using SPSS for Windows, version 15.0, software (IBM Corp., Armonk, NY). The Kolmogorov-Smirnov test was used to verify the normal distribution and homogeneity of variances of the scales used. Within-group differences of the parameters between the baseline and study end measurements were tested using Student's *t* test for paired samples (for normally distributed data) or the Wilcoxon signed rank test (for data without a normal distribution). For intergroup differences, analysis of variance or the Kruskal-Wallis test was used, depending of the normality of the distribution. For pairwise comparisons, adjusted *p* values were used. The Pearson χ^2 test was used to compare the categorical variables. A p value $\leq$ .05 was considered to indicate statistical significance.

Results

Basic Anatomic Study

The mean average width of the plantar fascia in the cutoff area in the 5 cadavers was calculated as 21.02 (range 17.44 to 24.72) mm.