Retrospective Review of Endoscopic Plantar Fasciotomy– 1992 through 1994

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Endoscopic plantar fasciotomy is a rewarding procedure for both patient and surgeon. A vast majority of the patients have complete or near-complete resolution of heel pain at 6 months postoperatively. The procedure, however, is not without side effects and complications. This retrospective statistical study describes the postoperative side effects and complications of endoscopic plantar fasciotomy from 1992 to 1994. The procedure has been modified in an attempt to reduce several of the more commonly reported side effects.

The purpose of this study is to report on the early success of the endoscopic plantar fasciotomy procedure proposed and taught by Barrett and Day[1]. Endoscopic plantar fasciotomy has become a popular alternative to the surgical treatment of chronic unremitting plantar fasciitis and heel spur syndrome. The authors relate their experiences with the endoscopic plantar fasciotomy since its inception in 1992. Since first performing the procedure in August 1992, the procedure has undergone several modifications in an attempt to mitigate postoperative complications or surgical failures.

Endoscopic plantar fasciotomy is an alternative method to the surgical treatment of recalcitrant insertional plantar fasciitis. It is not intended as an alternative conservative treatment prior to resection of inferior calcaneal exostosis. Indications for endoscopic plantar fasciotomy are clearly outlined in the educational design course manual for the Barrett-Day endoscopic plantar fasciotomy. Indications include failure to respond to conservative treatment including; corticosteroid injections, orthotic devices, orthopedic taping and padding, rest, immobilization, nonsteroidal anti-inflammatory medication, cessation of activity, and physical therapy. Patients who fail to respond to a reasonable course of conservative therapy, usually for at least 3 to 6 months, may be candidates for endoscopic release of the plantar fascia.

Endoscopic fasciotomy is not a panacea for the treatment of heel pain. Certain etiologic factors must be thoroughly evaluated prior to subjecting a patient to surgical fasciotomy. The etiologic causes of heel pain are still under considerable controversy. Etiologic factors described in the podiatric and orthopedic literature include: subcalcaneal fat pad atrophy, fibrotic response similar to plantar fibromatosis, medial calcaneal neuritis, fibrosis of the plantar fascia anterior to the calcaneal tuberosity, entrapment neuropathy of the motor branch to the abductor digiti quinti, gonorrhea, entrapment neuropathy of the lateral plantar nerve, systemic disease, tarsal tunnel syndrome, bursitis, periostitis, tumor, vascular insufficiency, rheumatoid arthritis, gout, osteomyelitis, radiculopathy, and the spondyloarthropathies, such as ankylosing spondylitis, psoriatic arthritis, and Reiter's syndrome.[2]

Factors that cause failure of conservative management for heel pain include: inflammatory soft tissue disorders such as fibromyalgia and fibromyositis, stress fracture of the calcaneus, tarsal tunnel syndrome, chronic periostitis, and flabby heel syndrome with asteatosis of the calcaneal fat pad.

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Untreated biomechanical deformities such as tibia varum, ankle equinus, anterior or pseudoequinus, limb length discrepancy, hallux limitus with hypermobile first ray, fully compensated forefoot valgus and forefoot varus, and posterior tibial insufficiency syndrome can complicate heel pain and often render it resistant to standard therapeutic modalities.

Since Hauser[3] attributed the spur to the constant pull of the plantar fascia, there is general agreement in both the podiatric and orthopedic literature that the bony exostosis is reactive, secondary to the chronic inflammation at the calcaneal tubercle enthesis. McCarthy and Gorecki[4], in a cryomicroscopic anatomical dissection, confirmed that the exostosis of heel spur syndrome lies in the area near the attachment of the flexor digitorum brevis, quadratus plantae, and the long plantar ligament, rather than within the plantar fascia itself.[5]

Historically, a multitude of surgical approaches to the treatment of chronic heel pain has been published. Drilling decompression of the calcaneus as described by Hassab and El-Sherif[6], Baerg[7], and Baoxing and Zumou[8] revealed a combined success rate of 91% (95 out of 104 heels).

Additionally, Garoufalis and Kessler[9] reported 85% with significant relief from calcaneal decompression osteotomy.

Furey[2] and Lester and Buchanan[10] used Steindler stripping on 14 heels with no poor or fair results reported. Kulthanan[11] reported a mean resolution of pain of 11.75 months on 12 patients with complete severing of the plantar aponeurosis, abductor hallucis, flexor digitorum brevis, and abductor digiti quinti from the plantar calcaneal tubercle and removal of the bone spur.

From 1937 to 1987, plantar fasciotomy has been used by various authors with a success combined ratio of 199 out of 223.[12, 13] Simple spur excision has been reported as providing only fair or poor results on 14 of 164 heels.[12-17]

Gromley and Kuwada[17] reported an average time of 3.2 months for return to desired or previous level of activity after plantar fasciotomy. Steindler and Smith[15] had success with six of eight heels in which their rotational osteotomy was performed. Michele and Krueger[18] reported no failures on two procedures using the countersinking osteotomy.

Neurolysis of the nerve to the abductor digiti quinti revealed 38 out of 40 excellent or good results according to Baxter and Thigpen[19] and Kenzora[20]. Helfrey and Sammarco[21] reported a 92% success rate with fasciotomy and neurolysis of the abductor digiti quinti muscle. Henrieson and Westlin[22] reported success on ten of 11 heels with calcaneal neurolysis. Grimes and Garner[23] and Savastano[24] reported three failures with 23 attempted calcaneal neurolysis procedures. Przylucki and Jones[25], Bordelon[26], and Lutter[27] report nerve decompression being successful in 12 of 14 cases.

Barrett and Day[28] reported 100% success on seven heels treated by endoscopic plantar fasciotomy. Schepsis et al[29] used plantar fasciotomy with spur resection and calcaneal decortication. In their results, 24 of 27 patients were able to return to full activity within 6 months. Tomczak and Haverstock[30] compared traditional plantar fasciotomy with heel spur resection with endoscopic plantar fasciotomy on a combined 68 patients. Total days incapacitated were 28.65 for the endoscopic plantar fasciotomy compared to 83.85 days for the traditional surgery.

Surgical Procedure

Patients are placed supine on the operating table with their feet everted. The fascial insertion is palpated and marked with a surgical marking pen prior to inducing anesthesia. The fascia is marked preoperatively with the patient's assistance prior to inducing anesthesia. This mark is correlated with the measurements obtained on a nonweightbearing lateral x-ray of the heel.

Local anesthetic or intravenous sedation is used consistently. General anesthetic is not necessary. A posterior tibial nerve block, medial calcaneal nerve block, and a sural nerve block are performed with the anesthetic of choice. The patient is administered prophylactic antibiotics prior to the preparation and tourniquet inflation. Following the preparation, the foot is completely exsanguinated with an Esmarch's bandage and a sterile tourniquet at the supramalleolar area is inflated. A vertical incision is made medially at the fascial insertion 1 to 2 mm anterior to the inferior calcaneal exostosis. The cannula is inserted from medial to lateral. The scope is inserted lateralward and the fascial width is measured and marked at 50%. A large globule of fat that bulges superiorly at the juncture of the medial and lateral portions of the plantar fascia has been consistently noted. This fat marks the central portion of the fascia, which is used as a landmark for the fascial release. This fatty globule corresponds to the transition between the thicker medial fascia and thinner lateral fascia. There is a slight concavity in the fascia, which allows the central fat plug to bulge superiorly, which is noted on the endoscopic visualization of the fascia. The authors have consistently located this fatty globule at 50% of the fascial width.

The traditional approach to endoscopic plantar

fasciotomy includes a one-half to two-thirds medial to lateral fascial release. Initially, the endoscope is placed medially and the fascia is released from the medial investment lateralward. Patients are allowed to walk immediately in a surgical shoe. Patients return to normal shoes within 10 to 14 days from the time when sutures are removed.

The authors have modified the procedure in an attempt to reduce several of the postoperative complications and side effects noted in the earlier procedures. Currently, no more than one half of the fascia is released from a central to medial approach. The endoscope is placed lateralward and the fascia is released from the central portion toward the medial investment. One half ml of dexamethasone phosphate is instilled from a plantar medial approach to reduce postoperative edema. Following the release, the patient is placed in a short leg walking cast for 4 to 6 weeks and allowed to walk without crutches.

Materials and Methods

Seventy-five subjects were surveyed by mail following endoscopic plantar fasciotomy as described by Barrett et al from May 1992 through December 1993 (Fig. 1). Of the 75 responses, 40 were received for a total response rate of 53%. Patients were not surveyed by telephone or invited for a clinical examination. A minimum of 12 months of postoperative time was required for inclusion in the study.

The following parameters were measured in this study: duration of heel pain, type of preoperative conservative care, amount of time postoperatively to resolve heel pain, amount of time postoperatively to return to normal activity, postoperative complications, patients' willingness to recommend the procedure, patients' willingness to repeat the procedure, and other comments.

Incomplete surveys were included for statistical analysis. Response level for each question is included in the results section. Parameters not measured included age, sex, postoperative duration at time of survey, duration of time before seeking medical treatment for heel pain, biomechanical abnormalities such as equinus, metatarsus primus elevatus, and hypermobile first ray, collapsing pes valgus, postoperative casting, postoperative physical therapy, traditional or modified endoscopic fasciotomy procedure, weight, occupation, sports and other activity level before and after the operation, and type of shoes worn.

The results of the mail-in survey are examined in Table 1. All responses were made by the patients themselves. No attempt was made to modify the responses according to clinical findings. Postoperative complications are reported as "patient perception" and not by physician acknowledgment of clinical correlation.

1. Duration of heel pain prior to surgery.

2. Type of conservative therapy prior to surgery. (Circle appropriate modalities).
   (a) Oral medication
   (b) Taping and padding
   (c) Orthotic arch supports
   (d) Cortisone injections
   (e) Physical therapy
   (f) Walking cast
   (g) Other

3. Amount of time postoperatively for heel pain to resolve.

4. Amount of time to return to normal activity.

5. Any postoperative complications. (Please circle).
   (a) Infection
   (b) Continued heel pain
   (c) Cuboid syndrome or lateral foot strain
   (d) Pain in the ball or toe region
   (e) Reflex sympathetic dystrophy (chronic nerve pain syndrome)
   (f) Postoperative fatigue and stiffness
   (g) Return of heel pain
   (h) Arch strain
   (I) Numbness in foot
   (j) Other _____

6. Would you recommend this procedure to another patient with chronic heel pain? (Please circle).
   (a) Yes (b) No

7. Would you undergo the procedure again if faced with a similar set of circumstances which existed preoperatively?

8. Other comments which may assist us in preparing this study.

Figure 1. Survey after endoscopic plantar fasciotomy.

Results

The majority of patients (22 out of 40) had three or four conservative treatments prior to surgical intervention. Seventy percent of patients reported that they would recommend the procedure. The mean duration of symptoms preoperatively was 23.18 months, compared with a median of 18 months indicates that there were more patients reporting longer durations of symptoms. Twenty-five percent of patients reported symptom duration of 12 months or fewer. Fifty percent reported a duration of symptoms 18 months or fewer, whereas 75% reported durations of less than or equal to 30 months (Table 1).

Spearman's correlation indicates that as the dura-

Table 1. Results of Survey

Question	Responses (n=40)	Result
Duration of heel pain	33	Mean=23.18 months
Preoperative conservative care	40	
Oral medication	Yes	83%
Taping and padding	Yes	70%
Orthoses	Yes	75%
Cortisone injection	Yes	83%
Physical therapy	Yes	35%
Walking cast	Yes	20%
Time for pain to resolve	36	Mean=66.58 days
Amount of time to return to normal activity	38	Mean=68.82 days
Postoperative complications	40	
Infection		5%
Continued heel pain		45%
Cuboid and lateral pain		33%
Ball and toe pain		28%
Reflex sympathetic dystrophy		8%
Fatigue and stiffness		45%
Return of heel pain		18%
Arch strain		63%
Numbness		23%
Painful scar		0.25%
Heel rim pain		0.25%
Arch cramping		0.25%
Recommend procedure to others	40	
	Yes	70%
	No	30%
Undergo procedure again	40	
	Yes	70%
	No	30%

tion of symptoms increases, the number of complications decreases. That is, there is an inverse correlation ($r = -0.3294$, $p = 0.061$) between duration and success. This correlation was not statistically significant.

There is a moderate but not statistically significant positive correlation between duration of pain and time to return to normal activity level ($r = 0.3057$, $p = 0.156$). There is a modest, but not statistically significant positive correlation between the number of conservative treatments and the number of complications ($r = 0.2235$, $p = 0.166$).

The two-tailed *t*-test was used to compare mean values for continuous variables with patients who would or would not recommend the procedure. Symptom duration averaged 26.36 months among those that would recommend the procedure as compared with 13.25 months for those who would not recommend the endoscopic plantar fasciotomy. There was unequal variance between the two groups, signifying that patients with much longer symptom duration are more pleased with the results of the procedure.

No significant difference is found for time for pain to resolve for those who would recommend the procedure (2.7 months), and for those who would not (3.7 months). There was also no significant difference in the number of conservative treatments between the two groups.

Finally, there is a highly statistically significant difference when comparing the number of complications and the tendency to recommend the procedure or not. There were an average of 2.3 complications per patient in the group that would recommend the procedure, whereas an average of 3.9 complications existed in the group who would not.

Discussion

The endoscopic plantar fasciotomy is not a panacea for chronic plantar fasciitis. This is not a benign procedure that replaces exhaustive conservative therapy or good medical judgment. It is not intended as an alternative conservative treatment prior to resection of inferior calcaneal exostosis.

The procedure is, however, an effective modality to treat recalcitrant insertional plantar fasciitis to its resolution in a majority of patients. Clearly, 70% of all patients would recommend this procedure to others with heel pain or would undergo the procedure again if faced with similar choices for treatment. Thirty percent of patients were not satisfied with the results of the procedure. Most of the dissatisfied patients were early surgical patients who underwent full fascial release and whose feet were not casted. Patients in the later portion of the survey results were more positive with an overwhelming majority willing to recommend the procedure.

A surprising statistical finding was the number of patients reporting postoperative side effects and complications. All patients reported at least one of the postoperative complications in question five. Even the patients who were completely satisfied with the surgical outcome reported some problems after surgery. Most of the problems resolved with therapy, orthoses, and time.

The statistical results of this study call for greater attention to the postoperative side effects and complications. The procedure has been modified in an attempt to reduce several of the more commonly reported side effects. Currently, no more than one half of the fascia is released from a central to medial approach. The endoscope is placed lateralward and the fascia is released from the central portion toward the medial investment. Postoperative casting and either oral or intravenous prophylactic antibiotics are routinely prescribed.

Earlier in the development of the technique, a full fascial release was performed from medial to lateral. This was later modified so that course participants were taught to release no more than two thirds of the fascia. Occasionally, patients with a two-thirds release would rupture the remaining fascia as they began to walk. Patients would report a tearing sensation in the heel or arch.

Full fascial release has been shown to be extremely detrimental to the normal gait function. The plantar fascia is a dynamic structure whose importance cannot be overlooked. It does not function simply as a truss or an aponeurosis to separate the plantar musculature from the skin. Although these functions are important in static stance, the fascia serves other dynamic functions which, when disturbed, can cause devastating results.

One of the most common ramifications of complete fascial release is the cuboid subluxation syndrome. Patients will complain of a deep, unremitting achiness at the calcaneocuboid joint or cubometatarsal articulation. The long and short plantar ligaments are strained, as is the peroneus longus at the peroneal groove. The pain is primarily localized to the lateral wall of the cuboid or at the cubometatarsal and calcaneocuboid joints. Pain is also felt plantar to the cuboid along the lateral plantar fascia.

Cuboid syndrome is usually seen in runners or other athletes or dancers with an inversion and plantar flexion injury. The cuboid becomes subluxed so that the medial aspect becomes rotated plantarly and slightly laterally. Cuboid subluxation syndrome usually responds to manipulation and taping. The painful cuboid seen after some endoscopic fascial releases is more difficult to treat. Often, manipulation and taping alone are inadequate to maintain the cuboid in its normal articulation with the calcaneus and metatarsals. Prolonged casting, corticosteroid injection, nonweightbearing, and physical therapy are often required to reduce the irritation of the cuboid bone. Cuboid subluxation syndrome, secondary to destabilization of the lateral plantar fascia can be extremely recalcitrant. Therapy for 3 to 6 months is often required and, in some instances, the syndrome may not resolve. Bone scans can be ordered to rule out cuboid stress fracture, but are most often negative.

Maintenance of the lateral fascia by one-half fascial release has been shown to dramatically reduce the cuboid subluxation. In the authors' modified procedure, patients are casted for 4 to 6 weeks immediately following surgery. The foot is placed in a neutral weightbearing position to maintain some traction on the plantar fascia but prevent further rupture of the lateral fascia. The cuboid articulation is stabilized, which helps to reduce later subluxation when the cast is removed.

Following fascial release, other areas of the foot have developed postoperative strain and overuse. These areas include the distal plantar fascia, the fourth and fifth metatarsal bones, and the ankle. Patients generally respond to immobilization and physical therapy with these lesser-grade overuse strains. Some individuals have advocated releasing one fourth to one third of the plantar fascia, which reduces the postoperative overuse strain but dramatically increases the chances of continued heel pain and periosteal irritation caused by inadequate release of the fascia. Incomplete plantar fascial release is probably the most common cause for surgical failure according to Barrett and Day[28]. Dull surgical blades, visual impairment from inadequate hemostasis, and faulty video equipment can lead to incomplete release.

Postoperative infection has been noted in two cases in which prophylactic antibiotics were not used. The infections of the avascular fat pad can be extremely difficult to treat, especially if postoperative steroids are instilled. The authors recommend prophylactic antibiotics for this procedure.

Numbness at the endoscopic portals is common and usually resolves within a few weeks. Numbness distally in the arch and toes has been reported because of injury to the medial and lateral plantar nerves and laterally because of injury to the sural nerve. Permanent sensory loss is rare but can occur with this technique.

The most common complication, cuboid syndrome (33%), fatigue and stiffness (45%), arch strain (63%), and pain in the ball and toe region (28%), are considerably more resistant to treatment with a complete fascial release. Patients will complain of a deep, unremitting achiness in the arch, calcaneocuboid and cuboid metatarsal articulations, and at the lesser metatarsophalangeal joints. Full fascial release has been shown to be extremely detrimental to normal gait function. Loss of plantar fascial function causes increased demand on the joint capsules, intertarsal ligaments, bone and joint architecture, and intrinsic muscles to maintain stabilization of the longitudinal arch.

Sellman[31] reported development of persistent symptoms of foot weakness, arch pain, increased foot length, and leg strain in patients after spontaneous rupture of the fascia following steroid injections. Most of these patients had complete resolution of heel pain. These findings are similar to the symptoms reported by patients who underwent full endoscopic fascial release.[9]

The plantar fascia is a dynamic structure whose importance cannot be minimized. It does not simply

function as a truss for the tarsal bones or as an aponeurosis to separate the plantar musculature from the skin. Early anatomical texts described the plantar fascia likening to the string of a bow. Hicks[32] determined that the plantar fascia is attached to the proximal phalanges of all the toes, so that, when the toes were extended the arch would raise. The distance between the metatarsal heads and the heel was shortened. During gait, the arch will rise when the toes are extended by the action of body weight, not by direct muscular action. This effect disappeared when the plantar fascia was severed experimentally.[26]

The windlass action of the plantar aponeurosis described by Hicks is a passive mechanism dependent on the ligamentous and bony architecture. Electromyographic studies of Basmajian and Stecko[33] confirm that the intrinsic musculature of the arch is not responsible for arch raising but for maintenance of the arch during locomotion.

The central thickest band of the plantar fascia narrows proximally to attach to the medial tubercle of the calcaneus. The band widens distally to form five tracts, each with a superficial and deep component. The superficial component attaches to the dermis and subcutaneous structures at the toe ball furrow. The deep components attach to the proximal phalanges of the toes so that extension of the toes at the metatarsophalangeal joints causes the arch to rise. Tension on the plantar fascia by digital hyperextension causes rearfoot inversion and external rotation of the leg.

Severance of the plantar fascia causes strain on the intrinsic musculature attached to the calcaneus and lowering of the arch.[31] This was confirmed experimentally by Daly et al[34] who found that arch height decreased 4.1 ± 2.8 mm while arch length increased and average of 1.7 ± 2.7 mm.[10] An outcome of this study was the results of dynamic piezoelectric force plate analysis that showed a lateral shift of body weight following plantar fasciotomy. A comparison of the medial-to-lateral progression of the center of pressure through the foot at 10%, 25%, and 75% of stance phase revealed significantly less shear from medial to lateral. Patients spent less than 10% of the stance phase on the medial side of the foot with a rapid progression of body weight laterally that was maintained until toe-off. The percentage of body weight on the lateral half of the foot increased by more than 30%. This may help explain the higher incidence of lateral strain postoperatively seen in patients with full fascial releases.

Postoperative complications can create a frustrating experience for both patient and surgeon. Management of postoperative complications following endoscopic plantar fasciotomy follows the same paradigm of principles used to treat any postsurgical problem such as: 1) preoperative counseling and education of the potential risks and complications of the procedure; 2) recognition and acknowledgment of the problem with honest, open communication with the patient; and 3) appropriate management of the problem by accepted treatment protocols; ie, antibiotics, casting, physical therapy, orthoses, nonweightbearing, corticosteroid injections, manipulation, and time.

Conclusion

Endoscopic plantar fasciotomy is a rewarding procedure for both patient and foot surgeon. A vast majority of the patients have complete or near-complete resolution of heel pain 6 months after surgery. The procedure, however, is not without side effects and complications. Most of the postoperative complications experienced by patients early in their recovery have been mitigated by the modifications described. Endoscopic plantar fasciotomy is not a panacea for the treatment of heel pain. Patients with heel pain must be managed conservatively and exhaustively before any decision to perform surgery is made. Patients must be thoroughly prepared for potential risks and side effects described and for an extended recovery of 2 to 6 months.

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