# Surgical treatment of resistant chronic painful heel using endoscopic versus open approaches: a comparative study

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**Background**
Plantar fasciitis has been reported to be the commonest cause of inferior heel pain. Most cases of plantar fasciitis respond to conservative nonsurgical measures. In 5–10% of the cases of plantar fasciitis resistant to conservative treatment, surgery may be required. Plantar fascia release performed by sectioning a part of the fascia via an open or endoscopic procedure has been the mainstay of treatment. This study was conducted to compare the outcome of open versus endoscopic plantar fascia release in cases of chronic resistant heel pain.

**Patients and methods**
A total of 50 patients with comparable demographics having chronic persistent heel pain that was diagnosed clinically to be due to plantar fasciitis were randomized to either open or endoscopic plantar fascia release. The patients were randomly divided in two groups; each consisted of 25 patients. The open procedures was done through a 3-cm medial incision, whereas the endoscopic procedure was done by the two-portal technique. The patients were assessed preoperatively and postoperatively using the modified American Orthopedic Foot and Ankle Society Ankle-Hindfoot Score. In addition, the patient's overall satisfaction with the procedure, pain level, time taken to return to full activity, and the complication rate were determined.

**Results**
The postoperative score was significantly better in group I (the endoscopic group) than group II (the open surgery group). Regarding the pain, restoration of the function without imitation was significantly better in the endoscopic group.

**Conclusion**
Endoscopic plantar fasciotomy is a minimally invasive procedure that entails minimal soft tissue dissection, excellent visualization of the plantar fascia, precision in transecting only the medial one-third of the plantar fascia, and thus minimizing postoperative instability. It also results in minimal postoperative pain, with early return to full weight-bearing status and earlier return to normal activities of daily living.

**Keywords:**
chronic heel, endoscopic, pain

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## Introduction

Chronic plantar heel pain is one of the most common conditions affecting the foot. Plantar heel pain is one of the great nuisance pains of the foot and can be a formidable challenge to orthopedic surgeons and other practitioners who manage it [1,2].

A variety of soft tissue, osseous, and systemic disorders can cause heel pain. By far the most common etiology is plantar fasciitis, which is reported to be the most common cause of pain in the inferior heel. It is estimated to account for 11–15% of all foot symptoms among adults, requiring professional care [3,4].

It is usually observed in the age between 40 and 60 years old. It accounts for approximately 10% of injuries that occur in runners and is common among military personnel. The predominance of the condition according to sex varies from one study to another. The condition is bilateral in up to a third of the cases [5].

Studies have identified risk factors that seem to be associated with plantar fasciitis such as obesity, occupations that require prolonged standing, pes planus (excessive pronation of the foot), limited first metatarsophalangeal joint range of motion, leg-length discrepancy, reduced heel pad thickness, reduced calf muscle strength, and inferior calcaneal exostoses [6–9].

There is a slightly higher incidence of heel spurs (75%) in patients with plantar fasciitis versus asymptomatic patients, having approximately a 63% incidence of heel spurs [10–14].

Nonsurgical measures include, but are not limited to, rest, icing, stretching, NSAIDs, shoe modification, orthoses, physical therapy, weight loss, corticosteroid injection, night splinting, and heel pads. In 5–10% of the cases of plantar fasciitis, surgery may be required. It is reserved for those in whom a thorough 6 months of conservative treatment has failed. Plantar fascia release performed by sectioning a part of the fascia via an open or endoscopic procedure has been the mainstay of treatment. Endoscopic plantar fasciotomy is a minimally invasive and minimally traumatic surgical treatment for the common problem of chronic plantar fasciitis [15–17].

This study was conducted to compare the outcome after open versus endoscopic plantar fascia (EPF) release in cases of chronic resistant heel pain.

## Patients and methods

Between June 2013 and January 2016, 50 patients with chronic persistent heel pain that was diagnosed clinically to be owing to plantar fasciitis were randomized to either open or EPF release. Each group consisted of 25 patients. Both the surgeons as well as the patients were blinded to the surgical procedure, whereas the randomization procedure was done by one of the assistants. However, a fully informed consent was taken from all patients according to the ethical standards of our institution, explaining to each patient the pros and cons of each procedure.

Regarding the inclusion criteria, the patients fulfilling the following criteria before being eligible for surgical intervention by plantar fascia release were included:

(1) Heel pain with the first steps out of bed or after periods of rest. The pain tends to get better with increased activity.
(2) Upon physical examination, the most tender point is that elicited upon palpation of the plantar-medial calcaneal tubercle at the site of plantar fascial insertion to the heel bone. This tenderness is intensified by passive dorsiflexion of the ankle and toes that places tension on the plantar fascia exacerbating the discomfort.
(3) Normal radiography of the foot with or without calcaneal spur.
(4) Symptoms for at least a year.
(5) At least 1 year of conservative therapy without improvement.

Exclusion criteria were patients with rheumatoid arthritis, peripheral neuropathy, pes planus, or gout.

Preoperative as well as postoperative assessments were done according to the modified American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot score. A total score of 90 points or higher was considered excellent, 80–89 points good, 70–79 points fair, and a score lower than 70 points was considered poor.

All of the patients were subjected in addition to general and regional clinical examination to laboratory examination (erythrocyte sedimentation rate, C-reactive protein, serum uric acid, and rheumatoid factor) as well as plain radiography of both feet in anteroposterior, oblique, and lateral standing positions to evaluate the presence of calcaneal spur, or otherwise any associated foot abnormality such as pes planus. In this prospective randomized double-blind study, the patients were divided into two groups:

(1) Group I: EPF consisting of 25 patients.
(2) Group II: open plantar fascia release consisting of 25 patients.

The characteristic demographic features of both groups are shown in Table 1, whereas Table 2 shows the duration of symptoms before surgical intervention in both groups. Both groups were of comparable

**Table 1 Characteristic feature of the studied groups**

| | Group I [*n* (%)] | Group II [*n* (%)] | *P* |
|---|---|---|---|
| Age | | | |
| Range | 27–55 | 29–53 | 0.241 |
| Mean | 39.52 | 40.96 | |
| SD | 8.05 | 6.21 | |
| Sex | | | |
| Male | 12 (48.0) | 10 (40.0) | 0.394 |
| Female | 13 (52.0) | 15 (60.0) | |
| Side | | | |
| Right | 14 (56.0) | 15 (60.0) | 0.774 |
| Left | 11 (44.0) | 10 (40.0) | |
| Occupation | | | |
| Manual worker | 7 (28.0) | 10 (40.0) | |
| Office worker | 5 (20.0) | 3 (12.0) | 0.726 |
| Housewife | 13 (52.0) | 12 (48.0) | |
| Spur | | | |
| Yes | 13 (52.0) | 14 (56.0) | 0.77 |
| No | 12 (48.0) | 11 (44.0) | |

demographic data, with no statistically significant difference in between.

### Surgical procedure

*Two-portal technique of EPF release: group 1*

Under general or spinal anesthesia with a tourniquet over the thigh, the medial portal was located over a reference point that was immediately anterior and inferior to the inferior aspect of the medial calcaneal tubercles viewed on lateral projection. (Fig. 1). A 5-mm stab incision was performed, incising the skin only, and then bluntly dissecting superior to the level of the plantar fascia.

Care was taken to ensure that the dissection was superior to the fascia to avoid neurovascular injury.

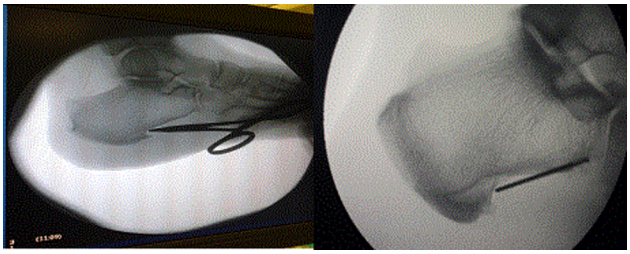
**Table 2 Duration of complaints in the studied groups**

| | Group I | Group II | *P* |
|---|---|---|---|
| Duration of complains | | | |
| Range | 7–24 | 7–19 | 0.105 |
| Mean | 13.48 | 12.08 | |
| SD | 4.33 | 3.40 | |

Arthroscopic trocar sheath was then introduced into this channel and advanced across the superior surface of the plantar fascia to the lateral aspect of the foot. A 5-mm incision was made over the trocar's tip, allowing the sheath to be passed through the skin, and then the trocar was removed, leaving the sheath in place. The endoscope was then introduced medially and the fascial probe laterally.

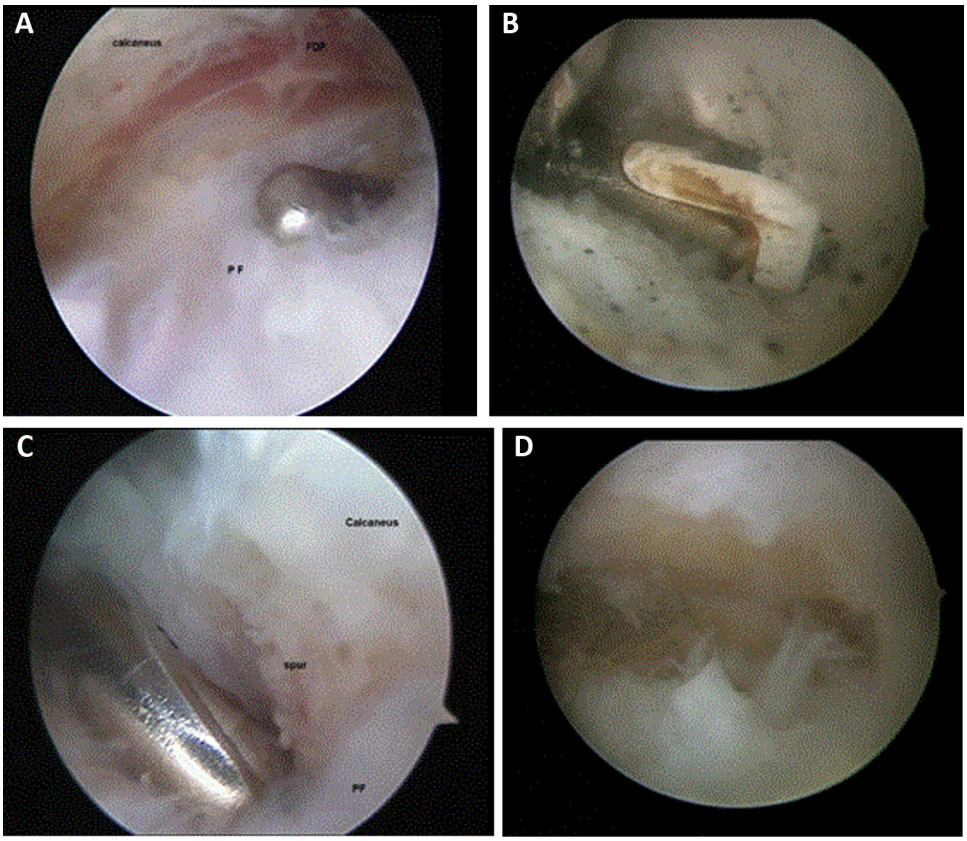
Using the endoscope, the entire superior surface of the plantar fascia was viewed on the monitor (Fig. 2a). The endoscope was then introduced laterally and the

**Figure 1**



The medial portal on lateral projection.

**Figure 2**




(a) Endoscopic view of calcaneus and plantar fascia. (b) The medial half of the plantar fascia was resected with the arthroscopic ablation device. (c) A heel spur was resected with an arthroscopic burr. (d) The fat pad was visualized beneath the fascia to ensure complete removal. FDB, flexor digitorum brevis; PF, plantar fascia.

arthroscopic ablation device was introduced medially to sever the medial one-third of the fascia (Fig. 2b). Care was taken to perform only a medial one-third release to minimize the amount of destabilization of the longitudinal arch.

As the fascia was severed, the muscle of the flexor digitorum brevis was visualized. The calcaneal spur was resected in all cases using an arthroscopic burr until the original fascial origin was clearly seen (Fig. 2c). The ankle and toes were maximally dorsiflexed and separation of the edges of the plantar fascia was seen, and the fat pad was visualized beneath the fascia to ensure complete removal (Fig. 2d).

*Open plantar fascia release: group II*

Surgical procedure: the patients were given spinal anesthesia and a mid-thigh pneumatic tourniquet was applied. The foot and ankle were draped in the usual manner.

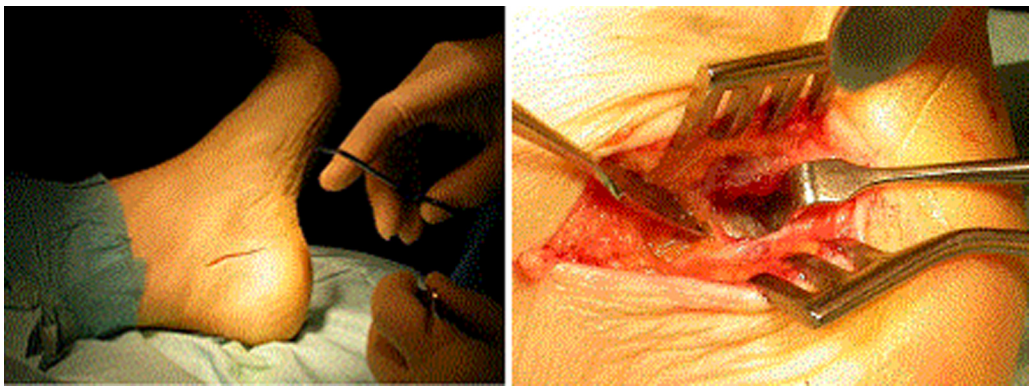
(1) An oblique 3-cm to 4-cm incision was made along the medial aspect of the heel overlying the course of the first branch of the lateral plantar nerve and the proximal edge of the belly of the abductor hallucis muscle (Fig. 3). The incision was directed obliquely in a distal and plantar direction, ending at the junction of the plantar and medial skin.
(2) Sharp dissection was carried through the subcutaneous fat, paying careful attention to the superficial branch of calcaneal nerves.
(3) The superficial fascia of the abductor was identified. A self-retaining retractor was inserted into the wound. The plantar fascia was identified by passing an elevator from the medial distal edge of the abductor in a plantar and lateral direction. A small lamina spreader was inserted at this junction of the abductor fascia and plantar fascia. Once exposure was complete, the superficial fascia of the abductor was sharply released.
(4) Next, the deep fascia of the abductor was identified with the use of an elevator. This fascia is concave and must be identified clearly before the release is performed. With a retractor, the abductor muscle was pulled superiorly and the deep fascia was released of the abductor with a scalpel. Careful release of the fascia could be warranted when a sharp edge of the medial caudal border of the quadratus plantae was palpated.
(5) If there is a large spur preoperatively, it could be resected by gently reflecting the flexor digitorum brevis off the exostosis. A Freer elevator was placed superior and inferior to the spur, which was transected with a one-fourth-inch osteotome. Care was taken not to damage the first branch of the lateral plantar nerve that lies just superior to the spur. After the spur was cut, it was removed with a rongeur, and the bone edges were smoothed.
(6) The release was checked by placing a small, curved hemostat deep to the deep fascia of the abductor and gently spreading it, palpating for any tight bands.
(7) The wound was irrigated copiously. The tourniquet was deflated and good hemostasis was achieved. The skin was then closed using simple interrupted sutures, and a dressing was applied.

**After treatment**

Prophylactic antibiotics in the form of broad-spectrum cephalosporins at a dose of 1 g before inflation of the tourniquet and one gram every 12 h for 2 days were administrated.

Patients were allowed protected weight-bearing wearing heel cushion immediately after surgery as tolerated but without excessive ambulation. The

**Figure 3**



Open plantar fascia release.

patient could return to regular shoes fitted with an orthotic appliance as soon as tolerated.

Stitches were removed on the 14th day postoperative. Patients were encouraged to resume full weight bearing after the third week as tolerated. Follow-up period was for 6 months. All patients were asked to visit El-Hadra Outpatient Clinic. In the postoperative follow-up visits, the patients were assessed according to modified AOFAS.

## Results

The final postoperative modified AOFAS Ankle-Hindfoot Score was significantly better in group II. The pain and restoration of the function without imitation were significantly better in the endoscopic group (Table 3).

Earlier time to return to work was detected in the first group which averaged 5.2 weeks, in comparison with the second group, which was 10.44 weeks on an average. The difference in between was highly statistically significant (Table 4).

### Complications

Overall, the incidence of complications and unsatisfactory findings was significantly higher in the second group who had open plantar fasciotomy. *I*n group I, the mild lateral pain was accepted by all the patients and was too mild to affect their daily activities. No postoperative foot deformities or change in the arches were noted clinically or radiologically (Table 4).

On the contrary, in group II, persistent pain mostly owing to heal neuropathy was detected in five cases. Three of them improved after 18 weeks postoperatively after casting for 6 weeks, partial weight bearing, heel cups, and a course of neurotonics and anti-inflammatory drugs, whereas the other two cases showed major limitation of daily activity and major limits of foot wear that required orthoses. They partially improved on the sixth-month follow-up. Superficial wound infection was detected in two cases; superficial debridement was done with a course of local and systemic antibiotic and dressing. The wound healed in the two cases, and healing occurred after 4 weeks.

**Table 3 Preoperative and final scores of complications in the studied groups**

| | Group I | Group II | *P* |
|---|---|---|---|
| Preoperative Score | | | |
| Range | 20–55 | 26–52 | 0.014* |
| Mean | 35.04 | 40.44 | |
| SD | 9.01 | 7.86 | |
| Final postoperative Score | | | |
| Range | 82–98 | 65–90 | 0.0001* |
| Mean | 91.08 | 81.96 | |
| SD | 4.80 | 6.33 | |
| Preoperative Pain | | | |
| Range | 0–20 | 0–20 | 0.190 |
| Mean | 8.0 | 5.6 | |
| SD | 10.00 | 9.17 | |
| Postoperative Pain | | | |
| Range | 30–40 | 0–40 | 0.007* |
| Mean | 37.6 | 31.2 | |
| SD | 4.36 | 11.66 | |
| Preoperative functional score | | | |
| Range | 0–4 | 0–4 | 0.023* |
| Mean | 2.24 | 1.12 | |
| SD | 2.03 | 1.83 | |
| Postoperative functional score | | | |
| Range | 7–10 | 4–10 | 0.001* |
| Mean | 9.64 | 7.96 | |
| SD | 0.99 | 2.41 | |

## Discussion

The most important finding of this double-blind prospective randomized clinical trial is that EPF release results in less pain, better functional outcome, and earlier return to work than open plantar fasciotomy.

Plantar fascia release is one of the most popular methods of surgical management of resistant plantar fasciitis [18–20]. Partial release of less than 40% of the fascia is recommended to minimize the effect on arch instability and maintain normal foot biomechanics. Total plantar fasciotomy may lead to loss of stability of the medial longitudinal arch and abnormalities in gait, in particular an excessively pronated foot.

Du Vries advocated a medial calcaneal incision, which is a linear incision over the medial side of the calcaneus, about two cm above the plantar border [3,20].

Michetti and Jacobs advocated a plantar approach, which is a linear incision placed from distal to

**Table 4 Comparison between the two studied groups regarding the outcome**

| | Group I | Group II | *P* |
|---|---|---|---|
| Return to work in weeks | | | |
| Range | 4–6 | 8–12 | 0.0001* |
| Mean | 5.2 | 10.44 | |
| SD | 0.82 | 1.26 | |
| Complications [*n* (%)] | | | |
| Yes | 0 | 5 (20.0) | 0.018* |
| No | 25 (100.0) | 20 (80.0) | |

proximal with the center over the calcaneal tuberosity. It is supposed that the line of incision is parallel to Langer's line of the foot with less liability to dehiscence and gaping with the tension of weight bearing [21].

Ward and Clippinger advocated a curved oblique plantar incision, which is made over the posterior aspect of the medial longitudinal arch, beginning just anterior to the mid portion of the medial longitudinal arch. The authors supposed that this incision which is obliquely oriented is more aligned with the longitudinal skin stress lines and therefore is less likely to dehiscence [22].

In this study, an oblique medial incision was used to allow partial release of the plantar fascia, in the same time excision of the calcaneal spur. We believed that it results in less tender postoperative scar, and being away from the weight-bearing area does not interfere with early weight bearing and functional rehabilitation.

Kinley and colleagues, compared the endoscopic procedure (26 cases) with traditional open surgery (26 cases), demonstrating an 80% resolution of symptoms with endoscopic plantar fasciotomy 4 weeks sooner than with traditional treatment, as well as less postoperative pain and fewer complications. This was similar to the findings of our study, which showed statistically significant earlier return to work and better functional recovery in the endoscopic group [23].

Bader and colleagues evaluated the functional outcome of EPF release in 48 patients (56 feet), and of them, 41 patients (49 feet) were available for follow-up. They concluded that EPF was an effective operation with reproducible results, low complication rate, and little risk of iatrogenic nerve injury with proper technique. An AOFAS Hindfoot Scale was used for analysis. Pain resolved completely in 37 feet, decreased in 11 feet, and increased in one foot. The mean postoperative AOFAS Hindfoot score improved to 39 points (54–93, $P<0.001$) [24].

After cadaveric investigation, researchers performed the first series of endoscopic plantar fasciotomies, as described and recommended by Barrett and Day in 1991. The two-portal procedure allowed for better visualization of the anatomical structures. It also had a smaller diameter incision and dissection, so it was less traumatic than the one-portal system. Most importantly, far more surgeons have been able to achieve successful results in using the two-portal approach. In our study, we used the two-portal endoscopic technique with a lateral viewing portal and ablator device in the medial portal to allow precise partial release under direct visualization [25].

Baxter and Thipgen [26] recommended release of the medial third of the plantar fascia with or without limited debridement of the calcaneal spur to avoid the consequences of complete plantar fascia release.

Barrett suggests that the key of success of the plantar fasciotomy and preventing the postoperative instability complication is to precisely confine the procedure to the medial one-third of the plantar fascia. When the lateral fibers of the plantar fascia are left intact, it is felt that the locking mechanism for the calcaneocuboid joint will not be disrupted, thus reducing the possibility of lateral column destabilization [27].

Endoscopic plantar fasciotomy offered several important advantages; minimal soft tissue dissection, excellent visualization of the plantar fascia, precision in transecting only the medial one-third of the plantar fascia, minimal postoperative pain, earlier return to full weight-bearing status, and earlier return to activities and work [28].

In Brekke and Green's comparison of surgical procedures for releasing the plantar fascia (54 patients), the 17 endoscopic plantar fasciotomy patients had the least postoperative pain and returned to normal activities 5 weeks earlier than those who underwent minimal incision or open approach procedures [29].

O'Malley and colleagues reported 23 feet on 20 patients treated with EPF release. The mean AOFAS Ankle-Hindfoot score improved from 62 to 80 points [30].

Hake performed 40 endoscopic plantar fasciotomy procedures, where 36 cases showed resolution of heel pain, two cases were unchanged from the previous pain level, and two remaining patients related less pain than preoperatively but were not pain free [17].

Urovitz and colleagues studied the use of endoscopic plantar fasciotomy in the treatment of chronic heel pain that was irresponsive to conservative treatment in 55 patients. The mean follow-up was 18 months. The mean preoperative AOFAS Ankle-Hindfoot score was 66.5 points, and improved to 88.2 points postoperatively [31].

Komatsu and colleagues reported 100% success rate of endoscopic plantar fasciotomy that was performed in

10 feet in eight patients who were treated conservatively for more than 6 months with failure to relieve their symptoms. The mean AOFAS Ankle-Hindfoot Score was 64.2+6.3 points before surgery and 92.6+7.1 points at 2 years after surgery [32].

Endoscopic plantar fasciotomy can be successful even when shock-wave therapy has failed. El-Shazly performed EPF release after failed shock-wave therapy in 18 patients. Nine patients (50%) had excellent results, six (35%) had good results, two patients (10%) had fair results, and one patient (5%) had failure of improvement of pain [33–36].

Regarding the functional level in our study, the modified AOFAS Ankle-Hindfoot score for activity of daily living improved from a mean of 2.24 points preoperatively to 9.64 points postoperatively. This was more significant among group 1 who had EPF release. This finding matched with the results of other research studies in the literature.

## Conclusion

Plantar fascia release is a considerable method for treatment of resistant plantar fasciitis. EPF release is a minimally invasive precise procedure that allows controlled partial release of less than 40% of the fascia, with preservation of the medial longitudinal arch stability and maintenance of normal foot biomechanics. The endoscopic technique results in less pain, better functional outcome, and earlier return to work than open plantar fasciotomy.

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### Conflicts of interest

There are no conflicts of interest.

## References

1 Kinley S, Frascone S, Calderone D, Wertheimer S, Squire M, Wiseman F. Endoscopic plantar fasciotomy versus traditional open heel spur surgery: a prospective study. J Foot Ankle Surg 1993; 32:595–603.

2 Tomczak R, Haverstock B. A retrospective comparison of endoscopic plantar fasciotomy to open plantar fasciotomy with heel spur resection for chronic plantar fasciitis/heel spur syndrome. J Foot Ankle Surg 1995; 34:305–311.

3 Toomey EP. Plantar heel pain. Foot Ankle Clin 2009; 14:229–245.

4 Gill L, K GM. Outcome of nonsurgical treatment for plantar fasciitis. Foot Ankle Int 1996; 17:527–532.

5 Prichasuk S, Subhadrabandhu T. The relationship of pes planus and calcaneal spur to plantar heel pain. Clin Orthop 1994; 306:192–196.

6 Rano J, Fallat L, Savoy-Moore R. Correlation of heel pain with body mass index and other characteristics of heel pain. J Foot Ankle Surg 2001; 40:351–356.

7 Wolgin M, Cook C, Graham C, Mauldin D. Conservative treatment of plantar heel pain: long term follow-up. Foot Ankle Int 1994; 15:97–102.

8 Furey J. Plantar fasciitis. The painful heel syndrome. J Bone Jt Surg Am 1975; 57:672–673.

9 Davis P, Severud E, Baxter DE. Painful heel syndrome: results of nonoperative treatment. Foot Ankle Int 1994; 15:531–535.

10 Mario R, Roxas M. Plantar fasciitis: diagnosis and therapeutic considerations. Altern Med Rev 2005; 10:83–93.

11 Jarde O, Diebold P, Havet E, Boulu G, Vernois J. Degenerative lesions of the plantar fascia: surgical treatment by fasciectomy and excision of the heel spur: a report on 38 cases. Acta Orthop Belg 2003; 69:267–274.

12 Lemont H, Ammirati K, Usen N. Plantar fasciitis: a degenerative process (fasciosis) without inflammation. J Am Pod Med Assoc 2003; 93:234–237.

13 Leach R, Seavey M, Salter D. Results of surgery in athletes with plantar fasciitis. Foot Ankle Int 1986; 7:156–161.

14 Buchbinder R. Plantar fasciitis. N Engl J Med 2004; 350:2159–2166.

15 Barrett S, Day S, Pignetti T. Endoscopic plantar fasciotomy: a multi-surgeon prospective analysis of 652 cases. J Foot Ankle Surg 1995; 34:400–406.

16 Blanco CE, Leon HO, Guthrie TB. Endoscopic treatment of calcaneal spur syndrome: a comprehensive technique. Arthroscopy 2001; 17:517–522.

17 Hake DH. Endoscopic plantar fasciotomy: a minimally traumatic procedure for chronic plantar fasciitis. Ochsner J 2000; 2:175–178.

18 Schepsis A, Leach RE, Gorzyea J. Plantar fasciitis: etiology, treatment, surgical results, and review of the literature. Clin Orthop 2006; 266:185–196.

19 Tanz SS. Heel pain. Clin Orthop 2001; 28:169–178.

20 Du Vries HL. Heel spur. Arch Surg 1987; 74:536–542.

21 Michetti ML, Jacobs SA. Calcaneal heel spur: etiology, treatment and new surgical approach. J Foot Surg 1983; 22:234–239.

22 Ward WG, Clippinger FW. Proximal medial longitudinal arch incision for plantar fascia release. Foot Ankle 1997; 8:152–155.

23 Chan LK, Lui TH, Chan KB. Anatomy of the portal tract for endoscopic decompression of the first branch of the lateral plantar nerve. Arthroscopy 2008; 24:1284–1288.

24 Bader L, Park K, Gu Y, O'Malley MJ. Functional outcome of endoscopic plantar fasciotomy. Foot Ankle Int 2012; 33:37–43.

25 Barrett SL, Day SV. Endoscopic plantar fasciotomy/heel spur syndrome: surgical technique, early clinical results. J Foot Surg 1991; 30:568–570.

26 Baxter DE, Thipgen CM. Heel pain: operative results. Foot Ankle 1984; 5:16–21.

27 Nery C, Raduan F, Mansur N, Baunfeld D, Del Buono A, Maffulli N. Endoscopic approach for plantar fasciopathy: a long-term retrospective study. Int Orthop 2013; 37:1151–1156.

28 Cottom JM, Maker JM, Richardson P, Baker JS. Endoscopic debridement for treatment of chronic plantar fasciitis: an innovative technique and prospective study of 46 consecutive patients. J Foot Ankle Surg 2016; 55:748–752.

29 Brekke M, Green D. Retrospective analysis of minimal incision, endoscopic, and open procedures for heel spur syndrome. J Am Pod Med Assoc 1998; 88:64–72.

30 Cottom JM, Maker JM. Endoscopic debridement for treatment of chronic plantar fasciitis: an innovative surgical technique. J Foot Ankle Surg 2016; 55:655–658.

31 Urovitz E, Urovitz A. Endoscopic planter fasciotomy in the treatment of chronic heel pain. Can J Surg 2008; 51:281–283.

32 Komatsu F, Takao M, Innami K. Endoscopic surgery for plantar fasciitis: application of a deep-fascial approach. J Arthrosc Relat Surg 2011; 27:1105–1109.

33 El Shazly O, El Hilaly RA, Abou El Soud MM, El Sayed MNMA. Endoscopic plantar fascia release by hooked soft-tissue electrode after failed shock wave therapy. J Arthrosc Relat Surg 2010; 26:1241–1245.

34 Lui TH. Endoscopic decompression of the first branch of the lateral plantar nerve and release of the plantar aponeurosis for chronic heel pain. Arthrosc Tech 2016; 5:589–594.

35 Jerosch J, Schunck J, Liebsch D, Filler T. Indication, surgical technique and results of endoscopic fascial release in plantar fasciitis (EFRPF). Knee Surg Sports Traumatol Arthrosc 2004; 12:471–477.

36 Saxena A. Uniportal endoscopic plantar fasciotomy: a prospective study on athletic patients. Foot Ankle Int 2004; 25:882–889.