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Review

Endoscopic plantar fasciotomy for plantar fasciitis: A systematic review and network meta-analysis of the English literature

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ABSTRACT

Background: Currently, there is limited evidence on outcomes for endoscopic plantar fasciotomy.
Objectives: An evidence-based literature review for outcomes of endoscopic plantar fasciotomy for the treatment of plantar fasciitis is provided.
Methods: A comprehensive evidence-based literature review of PubMed and Cochrane databases was conducted on 9th March 2019, which identified 12 relevant articles assessing the efficacy of endoscopic plantar fasciotomy. The studies were then assigned to a level of evidence (I–IV). Individual studies were reviewed to provide a grade of recommendation (A–C, I) according to the Wright classification in support of or against endoscopic plantar fascia release.
Results: Based on the results of this evidence-based review, there is poor evidence (grade C) to support endoscopic plantar fascia release. Release of the medial 2/3 of the plantar fascia in endoscopic plantar fasciotomy was associated with higher AOFAS score.
Conclusion: Although the majority of the level of evidence was low (level IV) and grade of recommendation was poor (grade C), there seemed to be good outcomes for endoscopic plantar fasciotomy. There is a need for more high quality level I randomized controlled trials with validated outcome measures to allow for stronger recommendations to be made.

1. Introduction

Plantar fasciitis is one of the commonest foot presentations to an orthopaedic clinic and is prevalent in both athletic and nonathletic populations [1]. The aetiology of plantar fasciitis is believed to be multifactorial. In chronic cases, histological analysis shows no signs of inflammatory cell invasion around the fascia. The tissue instead is infiltrated with macrophages, lymphocytes, plasma cells, immature vascularization and fibrosis [2].

The highest incidence is seen between the ages of 40 and 60 years [3]. Increased body weight and presence of calcaneal spur are main risk factors along with increased age, reduced ankle dorsiflexion, decreased first metatarsophalangeal joint extension and prolonged standing are known associations [4].

The diagnosis is essentially clinical. But X-ray and ultrasound scan can be used to support the diagnosis [5]. Chronic plantar fasciitis is a self-limiting condition that responds to conservative treatment in almost 90% of patients within nine months from onset of symptoms [6]. An array of treatment modalities have been advocated including rest, stretching protocols, nonsteroidal anti-inflammatory medication, manual therapy, heel pads, orthotics, taping, night splints, extracorporeal shock wave therapy, steroid injections and platelet-rich plasma injections [7]. Surgical management is indicated for persistent pain despite all efforts at nonoperative interventions [8].

Endoscopic plantar fasciotomy, first described by Barrett and Day [9], is an alternative to traditional open proximal partial fasciotomy but concerns with endoscopic release are poor visualization and the possibility of unintended complete release [10]. Complete surgical release of the plantar fascia will alter the foot biomechanics as the windlass effect may be lost after surgery [11]. In cadaveric studies, it has shown plantar fascia tension is directly proportional to Achilles tendon tension [12]. Many surgical techniques aimed at dividing the gastrocnemius at different anatomical levels have been proposed for the operative treatment of isolated gastrocnemius tightness [13,14].

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The aim of this review was to evaluate the efficacy of endoscopic plantar fascia release for plantar fasciitis with the current available evidence in the literature. There have been few recent studies reviewing the evidence for endoscopic plantar fasciotomy.

2. Materials and methods

2.1. Sources of information and search strategy

A comprehensive literature review was performed on the PubMed and Cochrane databases by two independent reviewers. Differences were settled by a third independent reviewer. We followed the guidelines proposed by PRISMA declaration (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). Search interval was up to 9th March 2019. The databases were searched for the keywords "endoscopic plantar fasciotomy" or "endoscopic plantar fascia release".

2.2. Inclusion criteria

Endoscopic plantar fasciotomy, at least 2 years follow-up.

2.3. Exclusion criteria

Non-English publications, pathology not related to plantar fasciitis, treatment other than endoscopic plantar fasciotomy, review articles, expert opinion and case studies.

The remaining full text articles were retrieved and assessed for eligibility. Further studies were excluded for having results obtained with less than two years of follow-up. Backward chaining of references from retrieved papers was performed to maximise the search.

Final studies were assigned a level of evidence (I–IV) in accordance with the standard of the Journal of Bone and Joint Surgery (Table 1) [15]. The literature was reviewed by one foot and ankle surgeon and a grade of recommendation (A–C, I) was assigned to each intervention based on the classification of Wright (Table 2) [16].

2.4. Statistical analysis

A random effects model was used to pool the results, given the included studies were under various clinical settings and populations. Pooled mean difference with 95% confidence interval (95% CI) was reported for summarising the difference between pre- and post-treatment outcome (i.e. AOFAS). Statistical heterogeneity was assessed by χ^2 test and I^2 value. A p-value lower than 0.1 from χ^2 test or a I^2 value higher than 50% was considered as heterogeneous. All analyses were conducted in R 5.3.0.

3. Results

After removal of duplicates, 73 studies were identified with database search using keywords "endoscopic plantar fasciotomy" or "endoscopic plantar fascia release" on PubMed and Cochrane databases. Backward chaining of references from final retrieved papers was also undertaken to maximize the search. 5 other additional articles which met our inclusion and exclusion criteria were identified.

29 studies were excluded for non-English publication, pathology not related to plantar fasciitis, treatment other than endoscopic plantar fasciotomy, review articles, case reports and expert opinion. 37 studies were excluded for having results obtained with less than two years of follow-up. A total of 12 studies were included for review (Fig. 1).

Summary of grade of recommendation for or against endoscopic plantar fascia release is seen in Table 3. Summary of study characteristics and outcomes is seen in Table 4.

3.1. Level I studies

Radwan [24] found in a randomized controlled trial comparing endoscopic plantar fasciotomy (EPF) in 31 patients with extracorporeal shockwave therapy (ESWT) in 34 patients with follow-up for 36 months. Both groups showed improvement from baseline at 3 weeks, 3 months and 12 months. The success rate, which was defined as a Roles and Maudsley score of good to excellent, was 70.6% in the ESWT group and 77.4% in the plantar fasciotomy group ($p = 0.19$). EPF median visual analogue score (VAS) improved from 68 (out of 100) to 16 and ESWT median VAS improved from 71 to 15. They concluded that in patients who had experienced failure of conventional treatment of plantar fasciitis, both endoscopic plantar fasciotomy and shock wave therapy can be potentially helpful lines of management.

3.2. Level II studies

Saxena and Fournier [26] in a level II comparative study of 12 EPF, 11 ESWT and 14 placebo-ESWT patients followed up for 24 months found that there was a significant improvement in visual analogue score (VAS) and Roles and Maudsley (RM) scores. In the EPF group VAS improved from 5.8 ± 0.9 to 0.2 ± 0.4 at two years ($p = 0.00001$) and RM scores improved from 3.3 ± 0.5 to 1.1 ± 0.3 ($p = 0.00001$). The ESWT group VAS improved from 8.7 ± 1.4 to 3.4 ± 3.3 ($p = 0.0001$) and RM scores improved from 3.7 ± 0.5 to 2.4 ± 1.2 ($p = 0.003$). The placebo-ESWT group VAS improved from 8.0 ± 1.1 to 5.1 ± 2.7 and RM scores improved from 3.2 ± 1.0 to 2.9 ± 1.1 ($p = 0.16$). Post-EPF VAS and RM scores were significantly better than both ESWT ($p = 0.003$ and 0.005 respectively) and P-ESWT ($p = 0.001$ and 0.004). Patients enrolled in the ESWT group were able though to continue with their exercise regimen, while the EPF group was able to return to their athletic activity at an average of 2.8 months. They concluded that EPF and ESWT were both effective forms of treatment for chronic plantar fasciitis with EPF being superior in outcomes yet ESWT treatment could be preferable since the athlete could remain active during treatment.

3.3. Level IV studies

Ogilvie-Harris [23] performed a level IV study investigating endoscopic complete plantar fascia release for 53 patients (65 feet) followed up for a mean of 25 months, and found that postoperatively 89% of patients had no pain during daily activities and 92% had no morning stiffness or pain at rest. 71% had no pain during sports activities and

Table 1
Levels of evidence for studies.

Level	Therapeutic studies investigating results of treatment
I	High quality randomized trials with statistically significant difference or no statistical difference but narrow confidence intervals; systematic reviews of Level I randomized controlled trials (and study results were homogeneous).
II	Lesser quality randomized controlled trials (e.g. < 80% follow-up, no blinding, or improper randomization); prospective comparative studies; systematic review of Level II studies or Level I studies with inconsistent results.
III	Case-control series; retrospective comparative studies; systematic reviews of Level III studies.
IV	Case series.
V	Expert opinion.

Table 2
Grades of recommendation for summaries or reviews of orthopaedic surgical studies.

Grade	Description
A	Good evidence (level-I studies with consistent findings) for or against recommending intervention.
B	Fair evidence (level-II or III studies with consistent findings) for or against recommending intervention.
C	Conflicting or poor-quality evidence (level-IV or V studies) not allowing a recommendation for or against intervention.
I	There is insufficient or conflicting evidence not allowing a recommendation for or against recommending intervention.

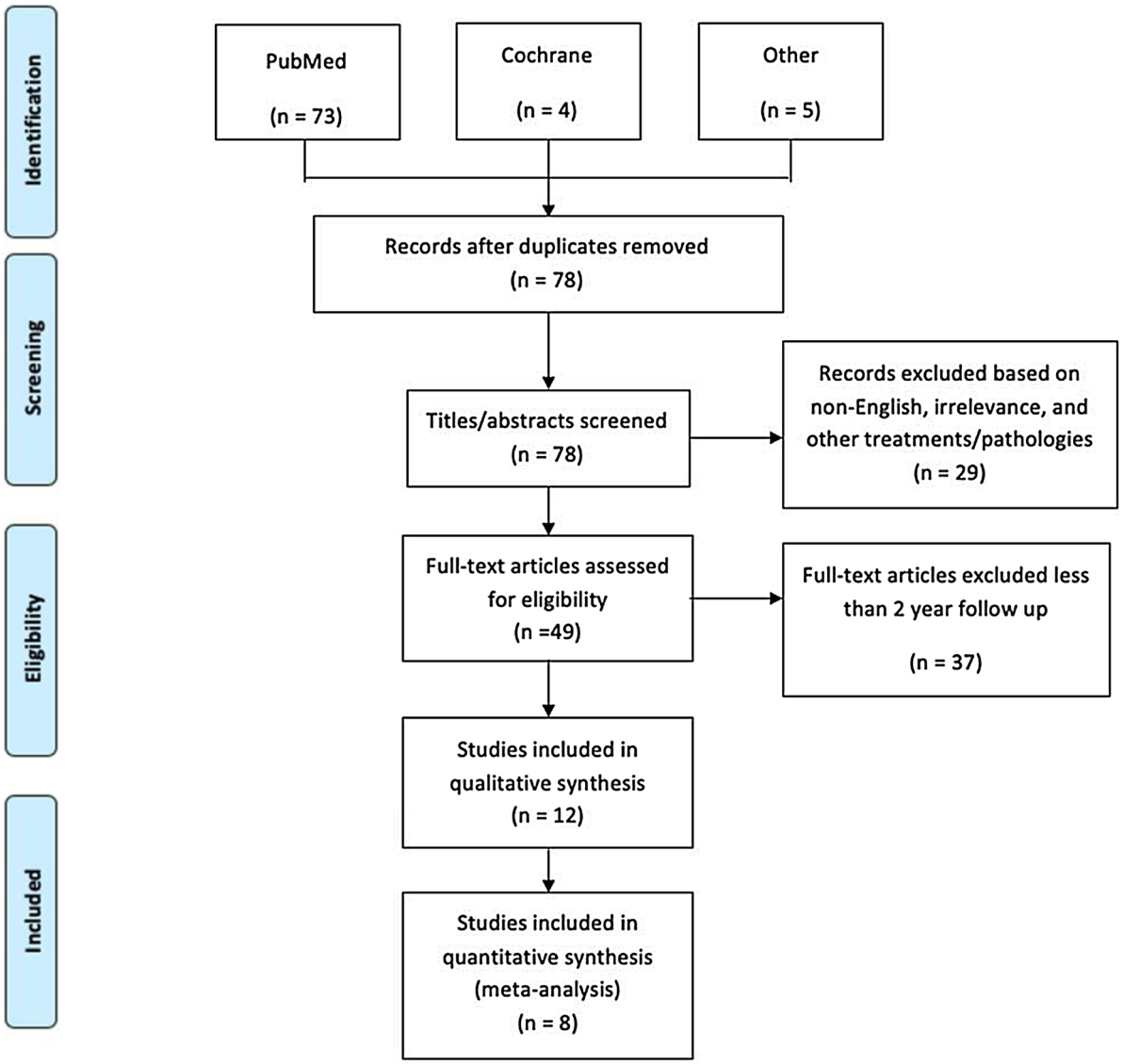

Fig. 1. PRISMA flow diagram.

Table 3
Summary of grade of recommendation for or against endoscopic plantar fascia release.

Intervention	Number of studies	Level I	Level II	Level III	Level IV	Grade	Recommendation
Endoscopic Plantar Fascia Release	12	1	1	–	10	C	Poor quality of evidence recommending intervention.

76% had returned to their previous level of play. They concluded that patients must be properly selected, and must have had the full range of conservative treatment. Symptoms should have been intractable for approximately 1 year. In this group, good results can be expected with minimum short-term morbidity.

One level IV study looking into EPF with Calcaneal Drilling and Spur Removal was performed by El Shazly and El Betagy [18]. 22 patients (24 feet) underwent the procedure, followed up for a mean of 26.9 months, found that there was statistically significant improvement in the mean VAS from 82.81 preoperative to 6.63 and the Mayo score from 7.05 preoperative to 87.5 at 2 years follow-up ($p < 0.05$). The satisfaction rate was 85% with no major complications. They concluded that EPF with calcaneal drilling and calcaneal spur removal has high success rate and patient's satisfaction rate when compared to published

Table 4
Summary of study characteristics and outcomes.

Study	Journal	Level of Evidence	Intervention	Follow-up (months)	Patient (feet)	Gender (M/F)	Mean Age(SD or range)	Duration of Sx (months)	Outcome Measures	Results	Complications
Bader 2012 [10]	Foot & Ankle International	IV	EPF (medial 1/3)	mean 49.5	41 (49 feet)	15 M, 26 F	53.8 (42–68)	25.4 (6–120)	Pain score, AOFAS Hindfoot	Pain resolved in 37 feet, decreased in 11 feet, increased in 1 foot. Mean post op AOFAS improved 39 points ($p < 0.001$). Patients with severe symptoms achieved higher mean improvement than the moderate symptom group ($p < 0.0001$). Patients with symptoms greater than 24 months trended towards lower mean improvement and lower post op AOFAS. Gender and laterality did not significantly influence outcome.	1 superficial portal infection, 5 transient lateral hindfoot pain, 1 3rd & 4th MT stress#
Bazaz 2007 [17]	Foot & Ankle International	IV	EPF (medial 1/3 to 1/2)	mean 47	16 (19 feet)	10 M, 6 F	44.7 (28–70)	23 (7–108)	AOFAS Hindfoot score, Maryland Score	Average AOFAS and Maryland scores improved post op (66–88, $p < 0.05$; 62–83, $p < 0.05$, respectively). Women improved 25 (AOFAS) and 23 points (Maryland) points. Men improved 16 (AOFAS) and 17 points (Maryland) points. Obese patients improved 38 and 28 points, respectively. Normal weight patients improved 16 and 19 points, respectively. Post op scores for patients with high pre op severity improved from 58 to 81 (AOFAS) and from 52 to 73 (Maryland). Patients with moderate pre op severity achieved scores from 72 to 93 and from 70 to 91. Patients who had symptoms longer than 2 years before EPF had lower post op scores. Non-WC patients improved 25 (AOFAS) and 24 (Maryland) points. WC patients improved 18 and 16 points, respectively.	1 Reflex Sympathetic Dystrophy
El Shazly and El Betagy 2010 [18]	The Foot	IV	EPF (medial 2/3) with calcaneal drilling and spur removal	mean 26.9	22 (24 feet)	9 M, 13 F	43 (± 8.6)	> 6	VAS, Modified Mayo Scoring System for Plantar Fasciotomy, patient satisfaction questionnaire	Mean VAS improved from 82.81 pre op to 6.63 and the Mayo score form 7.05 pre op to 87.5 at 2 years follow-up ($p < 0.05$). The satisfaction rate was 85% with no major complications.	3 hyperkeratosis of scar, 2 lateral portal paresthesia
El Shazly and El Hilaly 2010 [19]	Arthroscopy	IV	EPF (medial 2/3)	mean 25.8	18 (21 feet)	7 M, 11 F	41.1 (33–53)	> 18	VAS, AOFAS hindfoot	Mean pre op VAS score (out of 100) significantly improved from 72.52 to 12.94 ($p = 0.019$), mean pre op	2 hyperkeratosis at the portal site, 1 paresthesia at the

(*continued on next page*)

Table 4 (*continued*)

Study	Journal	Level of Evidence	Intervention	Follow-up (months)	Patient (feet)	Gender (M/F)	Mean Age(SD or range)	Duration of Sx (months)	Outcome Measures	Results	Complications
										modified AOFAS score improved from 24.23 to 75.94 ($p = 0.038$). There was statistically significant improvement in morning pain at 2 years' follow-up ($p < 0.05$). 9 (50%) had excellent results, 6 (35%) had good results, 1 (10%) had a fair result, and 1 (5%) had failure of improvement of pain.	lateral border of the foot
Komatsu 2011 [20]	Arthroscopy	IV	EPF (medial < 1/2) with heel spur removal	24	8 (10 feet)	5 M, 3 F	38.2 (14–66)	> 6	AOFAS	Mean AOFAS improved from 64.2 pre op to 92.6 at 2 years after surgery ($p < 0.0001$). Mean duration to full weight bearing after surgery was 13.9 days. All patients returned to full athletic activities by a mean of 10.7 weeks.	3 transient paresthesia on sole
Miyamoto 2017 [21]	Knee Surg Sports Traumatol Athrosc	IV	EPF (medial 1/2)	> 24, median 48	23 (24 feet — 14 Group A athletic, 10 Group S — sedentary)	11 M, 12 F	41 (14–79)	> 6	AOFAS	Mean AOFAS in all patients increased significantly from 65.3 ± 5.0 before surgery to 91.1 ± 8.5 at final follow-up ($p < 0.001$). Mean score in athletic group at final follow-up was significantly higher than that in sedentary group ($p < 0.05$). No significant difference in the mean score at final follow-up between the groups with and without calcaneal spur. In the athletic group, all patients could return to athletic activity after a median 8 weeks.	3 injury to the first branch of the lateral plantar nerve, impairing 5th toe abduction
Nery 2013 [22]	International Orthopaedics	IV	EPF (medial 2/3)	mean 115	22 (26 feet)	10 M, 12 F	52 (27–75)	14.8 (8–21)	AOFAS	The mean preoperative AOFAS score of 51 (range, 41–63) improved to 89 (range, 41–97) at the last follow-up, with no statistically significant difference between patients with or without calcaneal bone spur ($p = 0.43$). At the last appointment, physically active patients reported significantly higher AOFAS scores than sedentary patients ($p = 0.008$).	1 stress fracture of 3rd MT
Ogilvie-Harris 2000 [23]	Arthroscopy	IV	EPF (complete)	mean 25	53 (65 feet)	31 M, 22F	32 (23–56)	23 (12–66)	Pain with rest, ADL, sports, morning stiffness, sports activity	Postoperatively 89% of patients had no pain with ADL and 95% had no morning stiffness or pain at rest. 71% had no pain during sports activities and 76% had returned to their previous level of play.	1 chronic pain syndrome, 2 lateral heel pain, 2 local portal infections, 3 residual portal site tenderness
Radwan 2012 [24]	International Orthopaedics	I	EPF (medial 1/2) versus ESWT	36	31(vs 34)	22 M, 9 F (for EPF), 18 M, 16 F (for ESWT)	39.7 (26–59) for EPF, 37.7 (23–61) for ESWT)	17.45 (7–60) for EPF, 18 (6–60) for ESWT	AOFAS Hindfoot score, Roles and Mausley Score, VAS	Both groups achieved improvement from the base line at 3 weeks, 3 months and 12 months post-intervention. The success rate defined as Roles and Maudsley score of good to excellent was	2 transient postoperative swelling

(*continued on next page*)

Table 4 (*continued*)

Study	Journal	Level of Evidence	Intervention	Follow-up (months)	Patient (feet)	Gender (M/F)	Mean Age(SD or range)	Duration of Sx (months)	Outcome Measures	Results	Complications
										70.6% in the ESWT group, while in the fasciotomy group, the success rate was 77.4 % (p = 0.19). EPF median VAS improved from 68 to 16 and ESWT median VAS improved from 71 to 15.	
Saxena 2004 [25]	Foot & Ankle International	IV	EPF (medial 1/2)	> 24	26 (16 athletic, 10 control)	10 M, 6 F (for athletic); 2 M, 8 F (for control)	39.8 (± 13.1) for athletic, 51.2 (± 5.5) for control	> 12	Modified Plantar Fascia Score (MPFS)	The mean return-to-activity time after surgery was 2.6 ± 0.7 months. The mean MPFS significantly improved from 42.0 ± 2.5 preoperatively to 93.3 ± 2.4 postoperatively (p = 0.00001). All results in athletes were excellent or good. In the control group mean MPFS significantly improved from 23.6 ± 15.7 preoperatively to 63.6 ± 27.1 postoperatively (p = 0.0006) but lower than the athletic group (p = 0.00001). All five poor results in the controls had a BMI of more than 27. Good or excellent results in the control group were obtained only in patients who walked for exercise. The BMI was statistically lower in the athletic group than in the control group (p = 0.00001). The average BMI in women was significantly higher (p = 0.02) than in men, and they required a longer time to return to activity (p = 0.01).	1 transient lateral foot pain, 1 complex regional pain syndrome, 3 pseudohernias at medial incision
Saxena and Fournier 2012 [26]	Muscles Ligaments and Tendons Journal	II	EPF (medial 1/2) versus ESWT versus placebo EWST (P-ESWT)	24	37	6M, 6 F for EPF; 7 M, 4 F for ESWT; 8 M, 6 F for P-ESWT	42.3 ± 11.4 for EPF, 47.9 ± 12.6 for ESWT, for P-ESWT	> 6	VAS, Roles and Maudsley (RM), return to activity	In the EPF group VAS improved from 5.8 ± 0.9 to 0.2 ± 0.4 at two years (p = 0.00001) and RM scores improved from 3.3 ± 0.5 to 1.1 ± 0.3 (p = 0.00001). The ESWT group VAS improved from 8.7 ± 1.4 to 3.4 ± 3.3 (p = 0.0001) and RM scores	Nil

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Table 4 (*continued*)

Study	Journal	Level of Evidence	Intervention	Follow-up (months)	Patient (feet)	Gender (M/F)	Mean Age(SD or range)	Duration of Sx (months)	Outcome Measures	Results	Complications
										improved from 3.7 ± 0.5 to 2.4 ± 1.2 (p = 0.003). The placebo-ESWT group VAS improved from 8.0 ± 1.1 to 5.1 ± 2.7 and RM scores improved from 3.2 ± 1.0 to 2.9 ± 1.1 (p = 0.16). EPF was significantly better than both ESWT and P-ESWT in terms of treatment outcomes. Patients enrolled in the ESWT were able though to continue with their exercise regimen, while the EPF group was able to return to their athletic activity in an average of 2.8 months.4	
Zhou 2015 [27]	The Journal of Foot & Ankle Surgery	IV	EPF (medial 1/3) with spur removal	mean 24	30 (38 feet)	6 M 15 F (type A spur — superior to plantar fascia); 4 M, 5 F (type B spur — within the plantar fascia)	52.7 (41-71) for type A spur; 56.3 (27-69) for type B spur	> 6	VAS, AOFAS	Type B spurs were associated with more severe plantar fasciitis on MRI and had significantly higher preoperative VAS to type A spurs (8.3 ± 2.7 versus 5.7 ± 1.9, p = 0.001). Type A had significantly improved VAS to 1.7 ± 0.3 at one year (p = 0.03). Type B had significantly improved VAS to 2.4 ± 0.4 at one year (p = 0.03). AOFAS score for type A improved from 60.1 ± 3.9 preoperatively to 85.4 ± 5.4 (p = 0.04) and for type B improved from 55.2 ± 3.7 preoperatively to 85.7 ± 7.8 (p = 0.02).	Nil

Abbreviations: EPF, endoscopic plantar fasciotomy; ESWT, extracorporeal shockwave therapy; VAS, visual analogue score; AOFAS, American Orthopaedic Foot & Ankle Society.

reports on isolated endoscopic plantar release.

Two level IV studies looked into EPF with spur removal. Komatsu [20] studied 8 patients (10 feet) who underwent the procedure with 24 month follow-up, found the mean score on the American Orthopedics Foot and Ankle Society Ankle Hindfoot Scale was 64.2 ± 6.3 points before surgery and 92.6 ± 7.1 points at 2 years after surgery ($p < 0.0001$). The mean duration to full weight bearing after surgery was 13.9 ± 8.4 days. All patients returned to full athletic activities by a mean of 10.7 ± 2.6 weeks. They concluded that endoscopic surgery for plantar fasciitis through a deep fascial approach allows a wide field of vision and working space, permitting reliable resection of the plantar fascia and heel spur.

Zhou [27] investigated 30 patients (38 feet) who underwent endoscopic plantar fasciotomy and were followed up for a mean of 24 months. They identified 2 types of calcaneal spurs; type A were located superior to the plantar fascia insertion and type B were located within the plantar fascia. Type B spurs were associated with more severe plantar fasciitis on MRI and had significantly higher preoperative VAS to type A spurs (8.3 ± 2.7 versus 5.7 ± 1.9, $p = 0.001$). Calcaneal spurs were completely removed and did not recur in any of the patients on radiographic assessment during the follow-up period. Type A had significantly improved VAS from 5.7 ± 1.9 preoperatively to 1.7 ± 0.3 at one year ($p = 0.03$) and AOFAS score improved from 60.1 ± 3.9 preoperatively to 85.4 ± 5.4 ($p = 0.04$). Type B had significantly improved VAS from 8.3 ± 2.7 preoperatively to 2.4 ± 0.4 at one year ($p = 0.03$) and AOFAS score improved from 55.2 ± 3.7 preoperatively to 85.7 ± 7.8 ($p = 0.02$). They concluded that type B calcaneal spurs were predisposed to more severe symptoms of plantar fasciitis compared to type A spurs and that endoscopic plantar fasciotomy with spur removal had a high success rate for both types of calcaneal spurs.

There were six other Level IV studies which looked into isolated endoscopic partial fasciotomy. Bader [10] looked at 41 patients (49 feet) who were followed up for a mean of 49.5 months, and found that pain resolved completely in 37 feet, decreased in 11 feet, and increased in 1 foot. Mean postoperative AOFAS Hindfoot score improved 39 points (54 to 93, $p < 0.001$). Patients with severe symptoms achieved higher mean improvement than the moderate symptom group ($p < 0.0001$). Patients with symptoms greater than 24 months trended towards lower mean improvement and lower postoperative AOFAS Hindfoot scores. Both gender and laterality did not significantly influence outcome. They concluded that EPF was an effective operation with reproducible results, low complication rate and little risk of iatrogenic nerve injury with proper technique.

Bazaz [17] studied 16 patients (19 feet) followed up for mean of 47 months and found the average AOFAS and Maryland scores improved postoperatively (66–88, $p < 0.05$; 62–83, $p < 0.05$, respectively). Women improved 25 (AOFAS) and 23 points (Maryland) points. Men improved 16 (AOFAS) and 17 points (Maryland) points. Obese patients improved 38 and 28 points respectively. Normal weight patients improved 16 and 19 points respectively. Postoperative scores for patients with high preoperative severity improved from 58 to 81 (AOFAS) and from 52 to 73 (Maryland). Patients with moderate preoperative severity achieved scores from 72 to 93 and from 70 to 91. Patients who had symptoms longer than 2 years before EPFR had lower postoperative scores. Non-workers compensation patients improved 25 (AOFAS) and 24 (Maryland) points. Workers compensation patients improved 18 and 16 points, respectively. They concluded that EPFR provides significantly improved patient outcomes. Patients with more severe symptoms before EPFR and for longer than 2 years had worse results. Obesity had no negative effect. Workers compensation patients had inferior results to non-workers compensation patients. Women achieved better results than men. This may be biased because most workers compensation patients were men.

El Shazly and El Hilaly [19] in a study of 18 patients (21 feet) followed up for mean of 25.9 months found that the mean preoperative VAS score (out of 100) significantly improved from 72.52 ± 8.5 to 12.94 ± 9 ($p = 0.019$), mean preoperative modified AOFAS score improved from 24.23 ± 8 to 75.94 ± 10 ($p = 0.038$) and mean morning pain score improved from 79.76 ± 6.5 to 5.88 ± 9.7 ($p = 0.027$) at 2 years follow-up. Of the patients, 9 (50%) had excellent results, 6 (35%) had good results, 1 (10%) had a fair result, and 1 (5%) had failure of improvement of pain. They concluded that EPF yields good to excellent outcomes in 85% of 17 patients with plantar fasciitis resistant to treatment by ESWT at 2 years follow-up.

Miyamoto [21] looked at 23 patients (24 feet) who underwent EPF with follow-up of over 2 years and found the mean AOFAS score in all patients increased significantly from 65.3 ± 5.0 before surgery to 91.1 ± 8.5 at final follow-up ($p < 0.001$). The mean score at final follow-up in group A (athletic group) was significantly higher than that in group S (sedentary group) (93.9 ± 6.9 versus 84.3 ± 8.5 respectively, $p < 0.05$). However, there was no significant difference in the mean score at final follow-up between the groups with and without calcaneal spur. In group A, all patients could return to athletic activity after a median 8 weeks. They concluded that endoscopic plantar fascia release using a suprafascial approach was effective for recalcitrant plantar fasciitis. However prognosis for sedentary patients was inferior to that of patients engaged in athletic activity.

Nery [22] followed up 22 patients (26 feet) who underwent EPF for an average of 9.6 years and found the mean preoperative AOFAS score of 51 (range, 41–63) improved to 89 (range, 41–97) at the last follow-up, with no statistically significant difference between patients with or without calcaneal bone spur ($p = 0.43$). At the last appointment, physically active patients reported significantly higher AOFAS scores than sedentary patients ($p = 0.008$). They concluded that endoscopic plantar approach could be a viable alternative to more invasive procedures for management of recalcitrant plantar fasciitis.

Saxena [25] investigated 26 patients who underwent uniportal EPF with over 24 months follow-up and found the mean return-to-activity time after surgery was 2.6 ± 0.7 months. In their athletic group the mean Modified Plantar Fascia Score (MPFS) significantly improved from 42.0 ± 2.5 preoperatively to 93.3 ± 2.4 postoperatively ($p = 0.00001$). Using this scoring system score, all results in athletes were excellent or good. In the control group mean MPFS significantly improved from 23.6 ± 15.7 preoperatively to 63.6 ± 27.1 postoperatively ($p = 0.0006$) but lower than the athletic group ($p = 0.00001$). All five poor results in the controls had a BMI of more than 27. Good or excellent results in the control group were obtained only in patients who walked for exercise. The BMI was statistically lower in the athletic group than in the control group ($p = 0.00001$). The average BMI in women was significantly higher ($p = 0.02$) than in men, and they required a longer time to return to activity ($p = 0.01$). They concluded that athletic patients undergoing uniportal endoscopic plantar fasciotomy can expect good to excellent results based on the MPFS. Fifty percent of the patients with a BMI of more than 27 had poor results.

The most common complications reported were pain (14 cases) and paraesthesia (6 cases). Other complications included portal site infection, transient lateral foot pain likely due to lateral plantar nerve, metatarsal fractures, reflex sympathetic dystrophy, hyperkeratosis scarring and pseudohernias. Only 2 of 12 studies reported no operative complications.

Based on the results of this evidence-based systematic review of one level I study, one level II study and 10 level IV studies, there was poor (grade C) evidence to support endoscopic plantar fascia release (Table 3).

3.4. Meta-analysis

We performed a meta-analysis of the AOFAS outcome scores. In total, only 8 out of the 12 studies assessed AOFAS outcome scores and were eligible for meta-analysis. The pooled mean difference of AOFAS

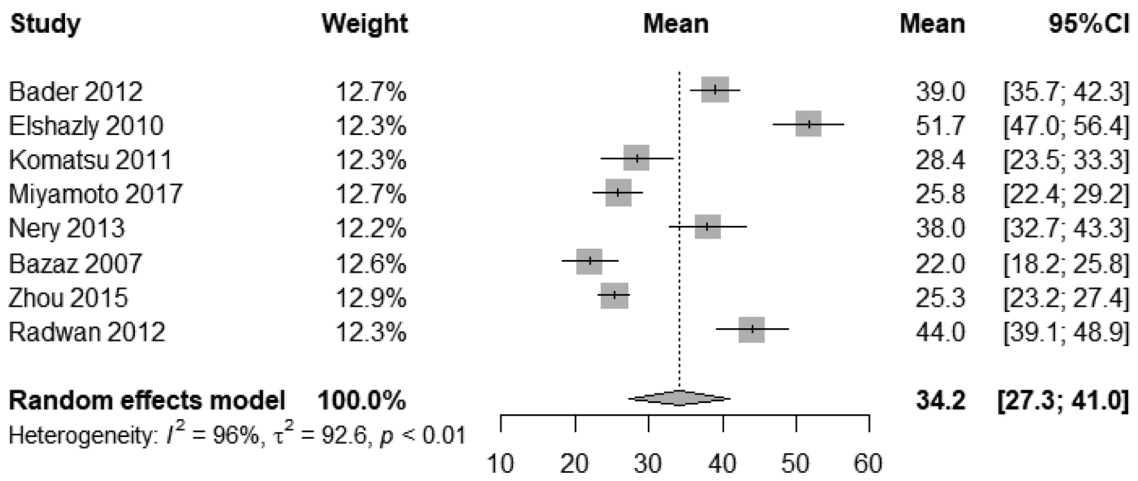

Fig. 2. Forest Plot of Mean Improvement in AOFAS Score with Endoscopic Plantar Fasciotomy.

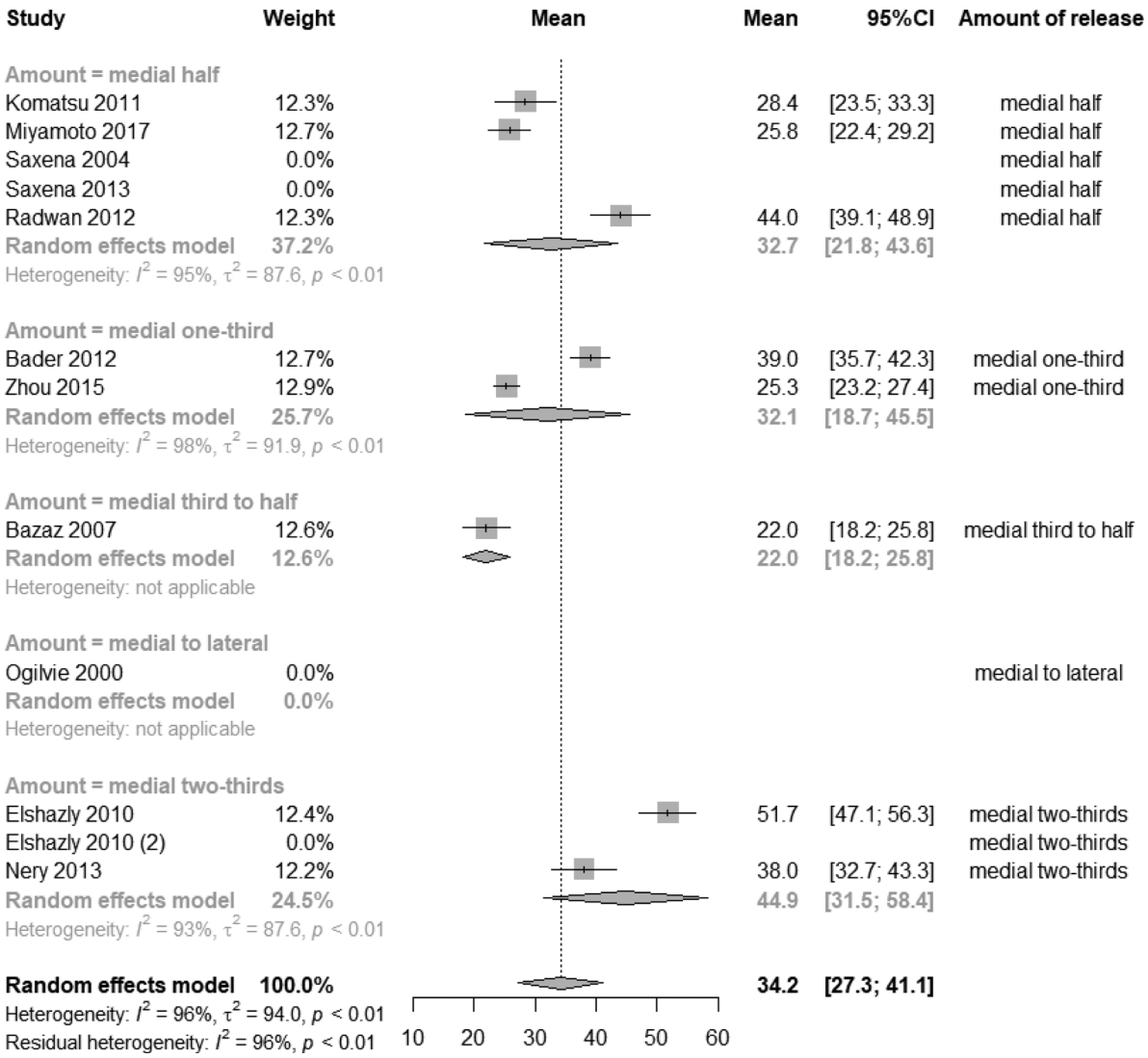

Fig. 3. Forest Plot of Mean Improvement in AOFAS Score in Relation to Amount of Fascia Release.

was 34.2 (95% CI 27.3, 41.0), indicating that endoscopic plantar fascia release was associated an postoperative increase of 34.2 points in AOFAS (Fig. 2). However, high heterogeneity was observed with the p value for χ^2 test less than 0.01 as well as I^2 = 96%. Release of the medial 2/3 of the plantar fascia trended towards improved AOFAS (Fig. 3). This amount of partial fascia release may be advised, however only two studies investigated outcomes with a medial 2/3 partial fascia release. With limited current evidence, more investigation would be required to confirm this.

4. Discussion

Conservative treatment is usually first line for patients with plantar fasciitis but other treatment modalities such as endoscopic plantar fasciotomy have a role to play where conservative treatment has failed [28].

The level of evidence and grade of recommendation was reviewed for endoscopic plantar fascia release for plantar fasciitis based on the most current available literature. Due to the limited studies available, a qualitative summary of the current evidence was reviewed. The majority of evidence available was based on level IV studies. There were no standardized endpoints across all included studies. In our systematic review eight studies reported patient outcomes with AOFAS score, five studies reported visual analogue scale (VAS) and two studies reported Roles and Maudsley Score. These outcome measures do not necessarily translate to patient satisfaction or likelihood to have surgery again. Only the El Shazly and El Betagy study assessed patient satisfaction but did not elaborate on the assessment method. No other studies commented on whether patient would have surgery again or was happy with procedure. 10 of 12 studies reported postoperative complications with endoscopic plantar fasciotomy, with pain and paresthesia reported the most. Based on the results of our evidence-based systematic review, there was poor (grade C) evidence to recommend endoscopic plantar fascia release.

Most of the studies included in our systematic review performed a partial endoscopic plantar fasciotomy. Only Ogilvie-Harris [23] performed a complete plantar fascia release. Complete release biomechanically risks causing a loss of the windlass effect in the foot, subsequent decrease in arch height and increased strains on the plantar ligaments and increased stress and pain in the midfoot [11,29]. However a prospective case series by De Prado found that percutaneous total fascia release did not produce a significant drop in arch height on radiographs [30]. In all 60 of their patients the outcome of the surgery met expectations and all would recommend the procedure to a friend. For open partial plantar fascia release, MacInnes found in an audit of 30 patients (30 feet), the 10-year results were generally poor [31].

Our meta-analysis showed that endoscopic medial two-thirds release of the plantar fascia trended towards a higher improvement in postoperative AOFAS scores. However only 2 studies investigated a medial 2/3 release technique. Further investigations are needed to confirm this.

Al-Boloushi [32] found in a systematic review of minimally invasive non-surgical treatments that shock wave therapy, botulinum toxin type-A injections, platelet-rich plasma injections and intratissue percutaneous electrolysis dry needling showed similar and sometimes better results when compared to only corticosteroid injections which have been the mainstay of treatment for many years despite their associated side effects both locally and systemically. However there was no definitive treatment guideline for plantar fasciitis.

Mahalias [33] performed a systematic review on the outcome of endoscopic plantar fascia release and concluded that there was weak evidence to support that endoscopic plantar fascia release was safe and effective for the treatment of chronic plantar fasciitis. However their review contained studies with follow-up less than two years. Given that plantar fasciitis commonly presents as a chronic condition with episodes of recurrence, our review only included studies with minimum follow-up of two years.

A systematic review on the efficacy of endoscopic plantar fascia release using a clear and reproducible search strategy, utilising evidence based assessment of the individual studies is presented. An area of good clinical interest with potential for further research is highlighted.

A limitation of this review was the lack of high quality studies. The current literature is lacking in large scale randomised controlled trials. More level I and II studies are required to make stronger treatment recommendations. All of the included studies reported benefit with endoscopic plantar fascia release, however our search included only English-language publications. It has been reported that non-English language studies were more likely to be published in international English language journals if results were positive whereas negative findings were more likely to be published in a local non-English journal [34], which may introduce a possibility of publication bias and could be a potential limitation of this paper.

5. Conclusion

Although the majority of the level of evidence for endoscopic plantar fasciotomy was low (level IV) and grade of recommendation was poor (grade C), all of the studies demonstrated good outcomes. There is a need for more high quality level I randomized controlled trials with validated outcome measures to allow for stronger recommendations to be made.

Conflict of interest statement

None of the authors have any conflicts of interest to declare.

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