The Journal of Foot & Ankle Surgery 61 (2022) 396–400

Contents lists available at ScienceDirect

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org

Gastrocnemius Recession in Recalcitrant Plantar Fasciitis: A Systematic Review

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ARTICLE INFO

Level of Clinical Evidence: 3

Keywords:
chronic
heel pain
medial gastrocnemius release
plantar fasciopathy
surgical management

ABSTRACT

Plantar fasciitis is a common cause of heel pain. Recalcitrant plantar fasciitis can be difficult to manage. Medial gastrocnemius recession is increasingly being used to treat recalcitrant plantar fasciitis, with advocates describing fewer complications and quicker recovery time than other surgical options. This systematic review aimed to determine the effectiveness of gastrocnemius recession for the treatment of patients with recalcitrant plantar fasciitis. Multiple databases were searched using Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines. The level of evidence of each study was assessed according to the American Academy of Orthopaedic Surgeons Levels of Evidence. The level of bias for each study was assessed using the National Institutes of Health (NIH) Study Quality Assessment Tools. Seven studies were retrieved: 3 retrospective case series, 1 retrospective study that compared gastrocnemius recession to open plantar fasciotomy, 1 prospective cohort study (pre-post study with no control group), and 2 randomized controlled trials. All 6 studies that assessed pre- and postoperative pain using the Visual Analogue Scale showed a large reduction in pain postoperatively. Four studies that assessed pain at 12 months postoperatively showed a weighted mean of 76.06 ± 10.65% reduction in pain. No major complications were reported. Minor complications included sural neuritis. This review found a consistent reduction in pain following gastrocnemius release in patients with recalcitrant plantar fasciitis, suggesting it is a very promising treatment. However, the included studies are limited by low quality study designs and inherent biases, limiting the strength of recommendation. Further definitive, well-designed trials are required.

Plantar fasciitis is the most common foot condition causing plantar heel pain, affecting up to 1 in 10 people in their lifetime (1). Management is often initiated in primary care and the large majority consists of conservative, non-operative management. This includes stretching exercises, orthotics, NSAIDs and steroid injections (2). However, some cases of plantar fasciitis do not respond to non-operative measures. These cases of recalcitrant plantar fasciitis have a significant impact on patient quality of life, leaving many in pain for years before surgical options are explored.

Recalcitrant plantar fasciitis management can be difficult. One of the first surgical options in widespread use is plantar fasciotomy. This can be open or endoscopic, and the recession can be complete or partial (3). Some have reported positive results with these techniques, though overall results have been variable (1-3). Importantly, this technique has been associated with complications, relating to changes in biomechanics of the foot, particularly the loss of the medial arch (4). Therefore, other surgical options were sought.

Gastrocnemius recession has been increasingly used for the treatment of many foot pathologies including Achilles tendinopathy and recalcitrant plantar fasciitis (5,6). In 2002, Patel and Diovanni reported that isolated tightness of the gastrocnemius muscle was associated with recalcitrant plantar fasciitis (7). This tightness, or contracture, can be assessed using the Silfverskiöld test (1). Therefore, the rationale behind this operation is to release the gastrocnemius muscle, reducing tightness and strain on the plantar fascia, so reducing pain. Barouk et al reported that surgical proximal recession, or release, of the medial gastrocnemius muscle led to a significant reduction in symptoms (8). Studies have described promising results, with advocates describing fewer complications and quicker recovery time than plantar fasciotomy. Concerns have been raised about the effect on calf strength, but a review found no significant effect on strength postoperatively (9).

Financial Disclosure: None reported.
Conflict of Interest: None reported.
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1067-2516/$ - see front matter
https://doi.org/10.1053/j.jfas.2021.10.029

Table 1
Full search strategy for PubMed database

Database	Keywords	MeSH Terms	Limits Used
PubMed	((("Fasciitis, Plantar"[Mesh]) OR (plantar fasciopathy) OR (plantar heel pain) OR (heel pain)) AND ((recalcitrant) OR (chronic) OR (resistant))) AND ((medial gastrocnemius release) OR (gastrocnemius release) OR (medial gastrocnemius recession) OR (gastrocnemius recession) OR (proximal gastrocnemius release) OR (proximal gastrocnemius recession))	"Fasciitis, Plantar"	English language Human species Publication date: no limit Article type: no limit

To the best of the authors' knowledge, no systematic review with a published search strategy has examined the efficacy of gastrocnemius recession in recalcitrant plantar fasciitis. The aim of this systematic review is to assess whether gastrocnemius recession reduces pain in patients with recalcitrant plantar fasciitis. The primary outcome is the reduction of pain pre- and postgastrocnemius recession. Secondary outcomes are patient satisfaction, calf strength, and complications.

Materials and Methods

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (10). Broad search terms were developed to ensure inclusion of all relevant studies: ((("Fasciitis, Plantar"[Mesh]) OR (plantar fasciopathy) OR (plantar heel pain) OR (heel pain)) AND ((recalcitrant) OR (chronic) OR (resistant))) AND ((medial gastrocnemius release) OR (gastrocnemius release) OR (medial gastrocnemius recession) OR (gastrocnemius recession) OR (proximal gastrocnemius release) OR (proximal gastrocnemius recession)). MeSH terms were used where available.

The databases searched were: PubMed, Medline, Embase, Web of Sciences, Cochrane database, and CINHAL (Table 1). All reported studies from the inception of data until May 25, 2021 were considered. Duplicates were removed and then the manuscripts were screened by title, abstract and full text by 2 authors independently according to inclusion criteria (Table 2). Any disagreements were resolved via a consensus meeting.

The final included studies were read in full and data were collected on patient selection criteria, intervention, patient characteristics, outcomes and complications (Table 3). These data were extracted on to predefined fields on an Excel spreadsheet. The level of evidence of each study was assessed according the American Academy of Orthopaedic Surgeons (AAOS) Levels of Evidence (11). The level of bias for each study was assessed using the National Institutes of Health (NIH) Study Quality Assessment Tools (12). Each study was assessed as Poor, Fair or Good quality.

The primary outcome was the reduction of pain pre- and postgastrocnemius recession. Secondary outcomes were patient satisfaction, calf strength and complications. Data were analyzed on an Excel spreadsheet. Mean, standard deviation and weighted mean of reduction in pain pre- and postoperatively were calculated. The clinical and statistical heterogeneity in patients and study design precluded a formal meta-analysis.

Table 2
Inclusion and exclusion criteria

Inclusion	Exclusion
Studies of patients with chronic symptoms of plantar fasciitis of at least 6 months duration	Studies not published in the English language
Studies of patients who have exhausted conservative treatment options	Studies conducted on animals
Published in the English language	Studies that assess gastrocnemius recession for other foot disorders
Involving humans	
Patients >18 years old	

Table 3
Data extraction variables

	Data Extracted
Patient selection criteria	Diagnostic criteria of plantar fasciitis (whether clinical only or supported by imaging). Symptom duration. Previous conservative management (type and duration). Exclusion criteria. Whether a Silfverskiöld test was part of the selection criteria.
Intervention	Conservative treatment regime preceding operative management (if present). Operative intervention. Postoperative protocol.
Patient characteristics	Symptom duration. Previous treatment.
Outcomes	Reduction of pain pre- and postgastrocnemius recession defined by change in visual analogue scale (VAS). Patient satisfaction. Calf strength. Complications (type and frequency).

Results

The search strategy produced 7 final included studies (Fig.). These included 3 retrospective case series (6,13,14), one retrospective study that compared gastrocnemius recession to open plantar fasciotomy (15), one prospective cohort study (pre-post study with no control group) (16), and 2 randomized controlled trials (17,18) (Table 4). One of the randomized controlled trials compared gastrocnemius recession to stretching (17), and the other to open plantar fasciotomy (18). The authors in this review only assessed the effectiveness of gastrocnemius release—in the studies that compared gastrocnemius recession to another intervention, the gastrocnemius arm was isolated in analysis.

Patient Selection Criteria

Patient selection in all studies included a clinical diagnosis of plantar fasciitis based on typical history and symptoms (Table 4). A minimum period of conservative treatment (6,13,14,18), a minimum number of conservative treatments (16), or a classification as "unresponsive" or a "failure" of conservative treatment (15,17), was required as part of the inclusion criteria. Gastrocnemius tightness was part of the selection criteria in 4 of the included studies (6,13,14,17) (Table 4).

Intervention

The intervention was a medial gastrocnemius release in all 7 studies (Table 4). In 5 studies this was proximal. In 2 studies this was more distal: one using the modified strayer technique (14), and one releasing "15-20 cm above the medial malleolus" (16). The postoperative protocol in all 7 studies allowed immediate weightbearing as tolerated.

Patient Characteristics

The duration of symptoms for included patients varied from a mean of 14 months (15), to 51 months (16) (Table 5). All but one of the studies that reported sex distribution for the gastrocnemius recession group showed more than 70% female patients. All patients did immediate weightbearing postoperatively (except for one patient in the Abbassian et al study who had a concomitant open reduction internal fixation). The follow-up period was at least 12 months in all studies except

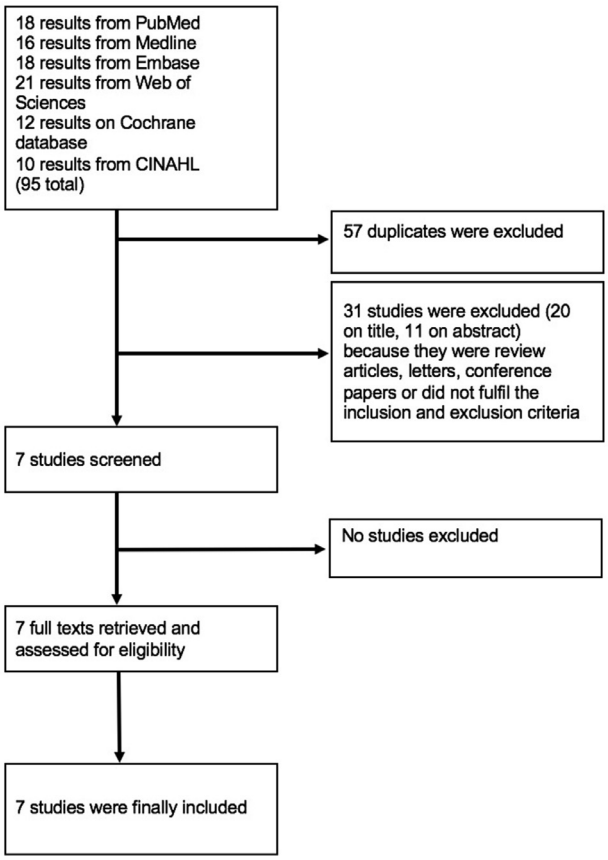

Fig. Search strategy flowchart.

Maskill et al who reported a mean clinical in person follow-up period of 28.1 weeks, though the mail follow-up period (questionnaires sent via post rather than in person follow-up) was a mean of 19.5 months.

Outcomes

Six out of the 7 studies assessed pre and postoperative pain using the visual analogue scale (VAS). All 6 studies showed a large reduction in pain postoperatively (Table 6). This ranged from a 48/100 to 73/100 decrease in VAS score, which corresponds to a greater than 63% reduction in pain in all studies, up to a maximum of 89.02% (15).

Insufficient data were available from the studies to perform a formal meta-analysis. The mean reduction in VAS score in the 4 studies that assessed pain at 12 months was 76.09 ± 10.65%. This mean does not take into account the sample size of the studies, or intrastudy variation, but all studies gave a result within the range of 63.16 to 89.02%. A mean weighted by sample size gave a similar result (76.06 ± 10.65%).

The 2 remaining studies did not report assessments of pain at 12 months. One assessed pain at 19 months postoperatively and found a 76.54% reduction in pain. The other study assessed pain at 24 months and found a 71.08% reduction in pain. The findings from these 2 studies with longer follow-up could suggest that pain relief following gastrocnemius recession may persist in the longer term.

Five studies assessed patient satisfaction or whether the patient would recommend the procedure to a friend: all showed a high satisfaction. Five studies assessed objective calf strength postoperatively, though the definition of adequate strength differed between the studies: Abbassian et al assessed this as 20 single heel raises at final follow-up, Ficke et al only assessed one single heel rise, Gamba et al assessed 10 single heel rises, Hoefnagels et al assessed 20

Table 4
Details of included studies

	Study Design	Time Period	Patient Selection Criteria	Intervention	Postoperative Protocol
Abbassian et al (2012)	Retrospective case series	3 years pre-2012	Clinical diagnosis. Positive Silfverskiöld test. Min. 1 year conservative treatment	Proximal medial gastrocnemius recession	Weightbearing as tolerated. Stretching exercises
Ficke et al (2018)	Retrospective case series	June 2011 to August 2014	Clinical diagnosis. Positive Silfverskiöld test. Min. 6 months non-operative treatment	Medial gastrocnemius recession. Modified Strayer technique	Weightbearing as tolerated. Stretching exercises
Gamba et al, 2019	Randomized controlled trial. Control: Open Plantar Fasciotomy	2012 to 2016	Clinical diagnosis. Unresponsive to min. 9 months conservative treatment	Proximal medial gastrocnemius release	Weightbearing as tolerated. Rigid postoperative shoe for 2 weeks. Stretching exercises
Hoefnagels et al (2020)	Prospective cohort study. No control group	October 2013 to May 2014	Clinical diagnosis. Min. 12 months symptom duration and at least 3 different conservative treatment measures	Gastrocnemius recession (15-20 cm above the medial malleolus, 2 fingers under the tibia crest)	Weightbearing as tolerated. Walking cast for 2 weeks. Night splint for 4 weeks. Physical therapy 6 weeks postoperatively
Maskill et al (2010)	Retrospective case series	June 2002 to June 2005	Diagnosis not described. Positive Silfverskiöld test. Min. 6 months conservative treatment	Gastrocnemius recession at the musculotendinous junction	Weightbearing as tolerated. Pneumatic walking boot for 2 weeks, followed by a postoperative shoe. Stretching exercises
Molund et al (2018)	Randomized controlled trial. Control: Stretching	June 2014 to December 2016	Clinical diagnosis. Positive Silfverskiöld test. Unresponsive to min. 12 months conservative treatment	Proximal medial gastrocnemius recession	Weightbearing as tolerated. Stretching exercises
Monteagudo et al (2013)	Retrospective comparative study	4 years pre-2012	Clinical diagnosis. Failure of min. 12 months non-operative treatment	Isolated proximal medial gastrocnemius release	Weightbearing as tolerated. Postoperative open shoe for 2 weeks. Stretching exercises

Abbreviation: Min., minimum.

Table 5
Patient characteristics of the included studies

	n (Patients)	n (Heels)	Sex (Male/Female)	BMI	Age (Years)	Symptom Duration (Years)	Follow-Up Period (Months)
Abbassian et al (2012)	17	21	3/14	NR	52 (31-70)	3.8 (1-6)	24 (8-36)
Ficke et al (2018)	17	18	5/12	34.7 (26.6-57.8)	46 (26-59)	NR	20 (6-50)
Gamba et al (2019*)	15	NR	90.5% female	31.7 ± 3.7	46.2 ± 11.1	2.68	12
Hoefnagels et al (2020)	32	NR	9/23	28.5 ± 3.8	50 ± 10	4.25 ± 4.50	12
Maskill et al (2010)	NR	25	NR	NR	NR	NR	Clinical follow-up period: 7.03 (1.5-24), Mail follow-up period: 19.5 (7-44)
Molund et al (2018)	20	28	5/15	27.8 (20.1-49.8)	46 (29-68)	2.58 (1-21)	12
Monteagudo et al (2013)	30	NR	16/14	29.3 (26-32)	44 (21-63)	1.17 (0.83-5.33)	12 (12-36)

Abbreviation: NR, not reported.
BMI, age, symptom duration and follow-up period values presented as: mean ± standard deviation or mean (range), where reported.
* Gamba et al did not specify sex ratio for gastrocnemius recession arm.

Table 6
Pre- and postoperative visual analogue scale (VAS) scores

	Preoperative VAS Score	Postoperative VAS Score	Postoperative VAS Score Timing (Months)	Difference in VAS (Out of 100)	% Reduction in VAS Score
Ficke et al (2018)	83 (50-100)	24 (0-70)	24 (8-36)	59	71.08%
Gamba et al (2019)	68.1 ± 18.8	15.1 ± 18.3	12	53	77.82%
Hoefnagels et al (2020)	78 ± 19	20 ± 24	12	58	74.36%
Maskill et al (2010)	81	19	19.5 (7-44)	62	76.54%
Molund et al (2018)	76 (39-100)	28 (0-81)	12	48	63.16%
Monteagudo et al (2013)	82	9	12	73	89.02%

Pre- and postoperative VAS score and postoperative VAS score timing values presented as: mean ± standard deviation or mean (range), where reported.

bilateral and 5 unilateral heel raises, and Monteagudo et al a one minute single heel raise. Only one study (13) showed calf weakness (according to the authors' criteria) that had not resolved by the final follow-up visit: 3/21 patients could not do 20 heel rises when followed at an average of 24 (range, 8-36) months. However, 2 studies reported subjective calf weakness (11/17 patients in Ficke et al, and one in Abbassian et al) but all these were in patients who were successfully able to perform the heel raise assessment of calf strength.

Complications

No study reported any major complications. Wound-related issues such as prolonged discharge or infection have been reported in 3 studies (13,16,18). Three studies reported complications relating to the sural nerve: one sural neuritis, which resolved within 14 weeks (14), one sural nerve lesion, which resolved within 6 months (18), and one neuropraxia of the sural nerve, which resolved within 1 year (16). All reported complications resolved except for 2 patients in the Molund et al study who reported popliteal fossa pain or increased cramping in the calf at one year postoperatively (17).

Study Quality

Three studies were level IV evidence according to the AAOS criteria (6,13,14). One study was level III (15), one was level II (16), and 2 were level I (17,18). All studies had a bias assessment of "Fair" for their study design according to the NIH tools specific to their study design (12). The main issue was clinical heterogeneity with differences in the demographics of the included patients: most studies showing a large majority of female patients.

Discussion

This systematic review found that gastrocnemius recession for recalcitrant plantar fasciitis offers consistent pain reduction with a low reported complication rate.

Recession of the gastrocnemius-soleus complex has been used in gastrocnemius contracture associated with various conditions (19). For plantar fasciitis, isolated gastrocnemius recession has been described as a promising treatment to reduce pain, with early postoperative mobilization and fewer potential complications than the alternative, plantar fasciotomy (1). In a survey of foot and ankle surgeons, 27% chose gastrocnemius recession as their preferred treatment at 12 months symptom duration, compared to 7% for plantar fasciotomy (20).

This review found a consistent reduction in pain postoperatively. The studies that assessed pain at one year using VAS scores showed a 76.06 ± 10.65% reduction in pain postoperatively. Whilst these findings are clinically important, pain reduction in these cohorts may also have been due to confounding factors, including postoperative analgesia and physiotherapy, or the natural history of plantar fasciitis, though similar findings were also found in the 2 randomized controlled trials included in this review (17,18).

While the included studies reported positive findings for patient satisfaction and calf strength, there was too much variation in the way they assessed these for strong conclusions to be drawn.

The included studies reported few complications. This is in contrast to plantar fasciotomy, where concerns have been raised about long-term complications from changes in biomechanics of the foot following the recession of the plantar fascia, specifically the loss of integrity of the medial arch (2,4). One review found that whilst there were changes in the arches with plantar fasciotomy, there were no clinical negative outcomes associated with this (4). Cheney et al argue that gastrocnemius

recession, which does not affect the biomechanics of the foot, is preferable (2). This review did not compare gastrocnemius recession to plantar fasciotomy and therefore no conclusions can be made about whether one is better than the other. Further studies are required comparing plantar fasciotomy and gastrocnemius recession, to assess whether theoretical differences in foot biomechanics translate into differences in patient reported outcomes in the long term.

The implications of this review for practice are that gastrocnemius recession has been shown to be a safe and effective option for clinicians to offer patients with recalcitrant plantar fasciitis to reduce pain in the short to medium term. It can produce a clinically important reduction of 63 to 89% in pain as assessed by VAS score.

Before gastrocnemius recession can become the operation of choice for recalcitrant plantar fasciitis, and used earlier in the disease course, more studies comparing gastrocnemius recession to plantar fasciotomy, assessing long-term outcomes, are needed. Future research should focus on prospective randomized controlled trials comparing gastrocnemius recession to a control group of plantar fasciotomy. The subset of patients in which gastrocnemius recession is most appropriate also needs to be explored, particularly with regards to whether this is only effective, or more effective, in those with a gastrocnemius contracture.

Despite systematically reviewing the available evidence in this niche area, the strength of recommendations are limited by the quality of the included studies, and biases inherent in their study designs. Only 2 studies were level I evidence, with 3 studies at the lowest level IV evidence. The studies had relatively small sample sizes and lacked consistent, validated outcome measures. Therefore, though this review found positive outcomes following gastrocnemius recession, further trials are required for definitive recommendations on policy and practice.

In conclusion, this review found a consistent improvement in pain following gastrocnemius recession in patients with recalcitrant plantar fasciitis, with a low postoperative complication rate. Whilst the included studies are limited by low quality study design, and further well designed trials are required, the review supports the use of gastrocnemius recession for safely reducing pain in patients with recalcitrant plantar fasciitis.

Institutional Review Board Approval

We did not seek IRB approval for this review as it involves no use of human or animal subjects. It is a systematic review of previously published studies, with all data available online.

Acknowledgment

The authors gratefully acknowledge Helen Farquharson, Librarian at the Royal Orthopaedic Hospital, for her help in conducting literature searches for this review.

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