

Efficacy of pharmacological and non-pharmacological therapies on pain intensity and disability for plantar fasciitis: a systematic review and meta-analysis

Bianca Martins Lourenço, Mariana Gabrich Moraes Campos , Laísa Maia, Brenda Castro, Renato Guilherme Trede, Vinícius Cunha Oliveira 

► Additional supplemental material is published online only. To view, please visit the journal online (<http://dx.doi.org/10.1136/bjsports-2022-106403>).

Postgraduate Program in Rehabilitation and Functional Performance, Universidade Federal dos Vales do Jequitinhonha e Mucuri, Diamantina, Brazil

Correspondence to

Dr Vinícius Cunha Oliveira, Postgraduate Program in Rehabilitation and Functional Performance, Universidade Federal dos Vales do Jequitinhonha e Mucuri, Diamantina, 39100-000, Brazil; vcunhaoliveira@gmail.com

Accepted 14 August 2023
Published Online First
24 August 2023

ABSTRACT

Objective To investigate the effects of pharmacological and non-pharmacological therapies on pain intensity and disability for plantar fasciitis.

Design Systematic review of randomised controlled trials (RCTs).

Data sources AMED, MEDLINE, PEDro, Cochrane, SPORTDiscus, CINAHL, EMBASE and PsycINFO without language or date restrictions up to 3 February 2023.

Eligibility criteria RCTs that evaluated the efficacy of any pharmacological and non-pharmacological therapies compared with control (placebo, sham, waiting list or no intervention) on pain intensity and disability in people with plantar fasciitis. Two reviewers independently screened eligible trials, extracted data, assessed the methodological quality of included trials and assessed the certainty of the evidence using the Grading of Recommendations, Assessment, Development and Evaluations framework. Mean differences (MDs) with 95% CIs were reported.

Results Seventeen different therapies investigated in 28 trials were included in the quantitative analysis. For non-pharmacological therapies, moderate certainty evidence showed short-term effects of customised orthoses on pain intensity when compared with control (MD of -12.0 points (95% CI -17.1 to -7.0) on a 0–100 scale). Low certainty evidence showed short-term effects of taping on pain intensity (-21.3 (95% CI -38.6 to -4.0)). Long-term effects and effects on disability are still uncertain. For pharmacological therapies, low to very low quality evidence from few trials with small samples was inconclusive and supports that high-quality trials are needed.

Conclusions Moderate-quality and low-quality evidence demonstrates customised orthoses and taping, respectively, reduce pain intensity in the short term in patients with plantar fasciitis.

PROSPERO registration number CRD42021224416.

INTRODUCTION

Plantar fasciitis (PF) is one of the most common musculoskeletal disorders of the foot, classified as acute (duration of symptoms up to 3 months), subacute (duration >3 and up to 6 months) and chronic (duration >6 months).^{1 2} Clinical findings include plantar and medial heel pain, mainly with initial steps after a period of inactivity and following prolonged weight bearing.¹ Lifetime prevalence estimates are up to 34.7% in the general population.^{3–6} Most of the time, PF is self-limiting, but the time for complete resolution of symptoms can

WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ Plantar fasciitis (PF) is a common musculoskeletal disorder of the foot.
- ⇒ Non-invasive therapies are the first-line interventions in the management of PF.
- ⇒ The effects of non-invasive interventions are still unclear.

WHAT THIS STUDY ADDS

- ⇒ Seventeen different therapies were investigated in PF.
- ⇒ Evidence supports customised orthoses and taping on pain in the short term.

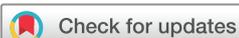
HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ There is uncertain evidence for disability or for the long-term effects in PF.
- ⇒ Evidence is inconclusive for pharmacological therapies.

take up to 1 year, disabling patients' quality of life.⁷ Known risk factors are excessive load and chronic overload of the plantar aponeurosis, either from lifestyle or exercise.⁸ People who are overweight, women in middle age, athletes and male runners are more likely to have plantar heel pain.⁹

Non-pharmacological therapies are acknowledged as the first-choice management option for PF, such as biomechanical support, stretching and extracorporeal shockwave therapy (ESWT).^{10–13} Pharmacological options are also commonly prescribed (eg, non-steroidal anti-inflammatory drugs (NSAIDs),^{14 15} botulinum toxin,^{16–18} platelet-rich plasma injections,^{19–21} corticosteroid injections.^{22–24}

In this context, previous systematic reviews investigated the efficacy of some therapies on pain intensity and disability through their different potential mechanisms of action; for example, anti-inflammatory action of pharmacological therapies, joint stability and neovascularisation action of non-pharmacological therapies.^{10–13 25–29} However, reviews were limited in scope and methods^{12 13} and evidence is still unclear to support the decision-making processes. Limited methods include inappropriate comparisons, for example, evaluating the effectiveness of one conservative intervention versus another conservative intervention.^{12 13 22 25 30 31}



© Author(s) (or their employer(s)) 2023. No commercial re-use. See rights and permissions. Published by BMJ.

To cite: Lourenço BM, Campos MGM, Maia L, et al. *Br J Sports Med* 2023;**57**:1516–1521.

Current evidence needs to be updated to provide reliable information on PF management, taking into account that new types of pharmacological and non-pharmacological therapies have been investigated (eg, orthoses, shoes).^{32,33} Therefore, this systematic review aims to investigate and update the short-term and long-term effects of pharmacological and non-pharmacological therapies on pain intensity and disability in people with PF.

METHODS

This systematic review of randomised controlled trials followed Cochrane³⁴ and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) recommendations.³⁵ The protocol was prospectively registered at PROSPERO (CRD42021224416) and at the Open Science Framework (<https://osf.io/e5kph/>).

Declaration of equity, diversity and inclusion

The author group consists of four women and two men; in addition, it consists of junior (two), mid-career (two) and senior researchers from different disciplines (two); all members of the author group are from a developing country (Brazil). Our study population included men and women from different countries, therefore, the findings may be generalisable to environments with fewer resources.

Search strategy and inclusion criteria

Searches were conducted up to 3 February 2023 on AMED, MEDLINE, PEDro, Cochrane, SPORTDiscus, CINAHL, EMBASE and PsycINFO without language or date restrictions. Descriptors were related to “randomised controlled trial” and “plantar fasciitis” (ie, including “plantar fasci”, “fasci*”, “heel spur*”, “heel spur syndrome” and “heel pain”). To maximise the sensitivity of our search strategy and consequently avoid exclusions of potential therapies of which we were not aware, descriptors related to pharmacological and non-pharmacological therapies were not used. The detailed search strategy is provided in online supplemental material 1. In addition, reference lists of previous systematic reviews and the clinical trials registers (www.clinicaltrials.gov, www.anzctr.org.au) were manually searched to maximise the identification of all eligible trials.

Parallel group, cross-over or cluster randomised controlled trials investigating the efficacy of any pharmacological or non-pharmacological therapies in people over 18 years old with PF were considered. PF was defined as a degenerative or inflammatory pathology in and around the plantar fascia of any duration (ie, acute, subacute and chronic) diagnosed through clinical or radiological examination.^{36,37} Pharmacological and non-pharmacological therapies were defined as any non-invasive active intervention, including drugs.^{10,14} To be included, trials had to compare any stand-alone pharmacological or non-pharmacological therapy with control (ie, no intervention, placebo, sham or waiting list). Cross-over randomised controlled trials were included if data from the first phase were reported separately. The outcomes of interest were pain intensity and disability assessed with any valid instruments (eg, Numerical Pain Rating Scale³⁸ or Visual Analogue Scale for pain intensity; Foot Function Index,³⁹ Foot Health Status Questionnaire⁴⁰ and the Foot and Ankle Ability Measure for disability).⁴¹

Study selection

After searches, the identified references were exported to an EndNote file and duplicates were removed. Then, two independent reviewers (MGMC and BC) screened titles and abstracts,

and assessed potential full texts using the eligibility criteria outlined above. Between-reviewer discrepancies were resolved by a third reviewer (VCO).

Assessment of risk of bias of included trials

The methodological quality of included trials was assessed by two independent reviewers (BML and LM) using the 0–10 Physiotherapy Evidence Database (PEDro) scale.⁴² Discrepancies were resolved by a third reviewer (VCO). When available, we extracted scores directly from the PEDro database (<http://www.pedro.org.au/>). The PEDro scale is a valid and reliable tool to evaluate the risk of bias of trials investigating non-invasive therapies.⁴²

Data extraction

Two reviewers (BML and MGMC) independently extracted data from included trials: countries in which investigations are being conducted; participants’ inclusion criteria; age; sex; type and dosage for pharmacological, non-pharmacological and controls; outcomes; and time points. The extracted outcome data included means, SDs and sample sizes of all groups to investigate short-term and long-term effects. The short-term effect was considered a follow-up up to 12 weeks after randomisation, and the long-term effect was considered a follow-up over 12 weeks after randomisation. When more than one time point was available in the same follow-up period, the one closer to the end of the intervention was considered. When trials evaluated more than one similar pharmacological and non-pharmacological or control, we combined outcome data.³⁴ When data were not reported, authors were emailed three times with 1-week in-between attempts for clarification of the information. In trials in which SD was not reported, missing data were imputed from 95% CIs, SEs, p values, baseline changes, graphical representations, medians and IQRs or SDs from the baseline.³⁴ When imputations were not possible, trials were excluded from the quantitative analysis. Between-reviewer discrepancies during data extraction were resolved by a third reviewer (VCO).

Data synthesis

Meta-analysis was conducted using a random-effect model (DerSimonian and Laird method), when possible. Mean differences (MDs) and 95% CIs were reported for each specific pharmacological and non-pharmacological therapy in forest plots. The clinical importance of therapies was interpreted by comparing the estimated effect sizes and 95% CIs in association with the minimal clinically important difference (MCID) of the outcome of interest.^{43,44} The MCIDs considered were estimates >20% of the scale.⁴⁵

Data were converted to a common scale before the meta-analysis. For this, we used a simple rule of three, with all scales converted to a 101-point scale. Therefore, the common scale for pain intensity and disability ranged from 0 to 100 points.³⁴

Two independent reviewers (BML and LM) assessed the certainty of the current evidence using the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) approach.⁴⁶ According to the four-level GRADE system, evidence can vary from high to very low certainty, with low levels of certainty indicating that future high-quality trials are likely to change the estimated effects. In the current review, the evidence started with high certainty and was downgraded by one point for each of the following issues: publication bias when it was present in the analysis of at least ten trials⁴⁷; imprecision when <400 participants were analysed⁴⁷; risk of bias when >25%

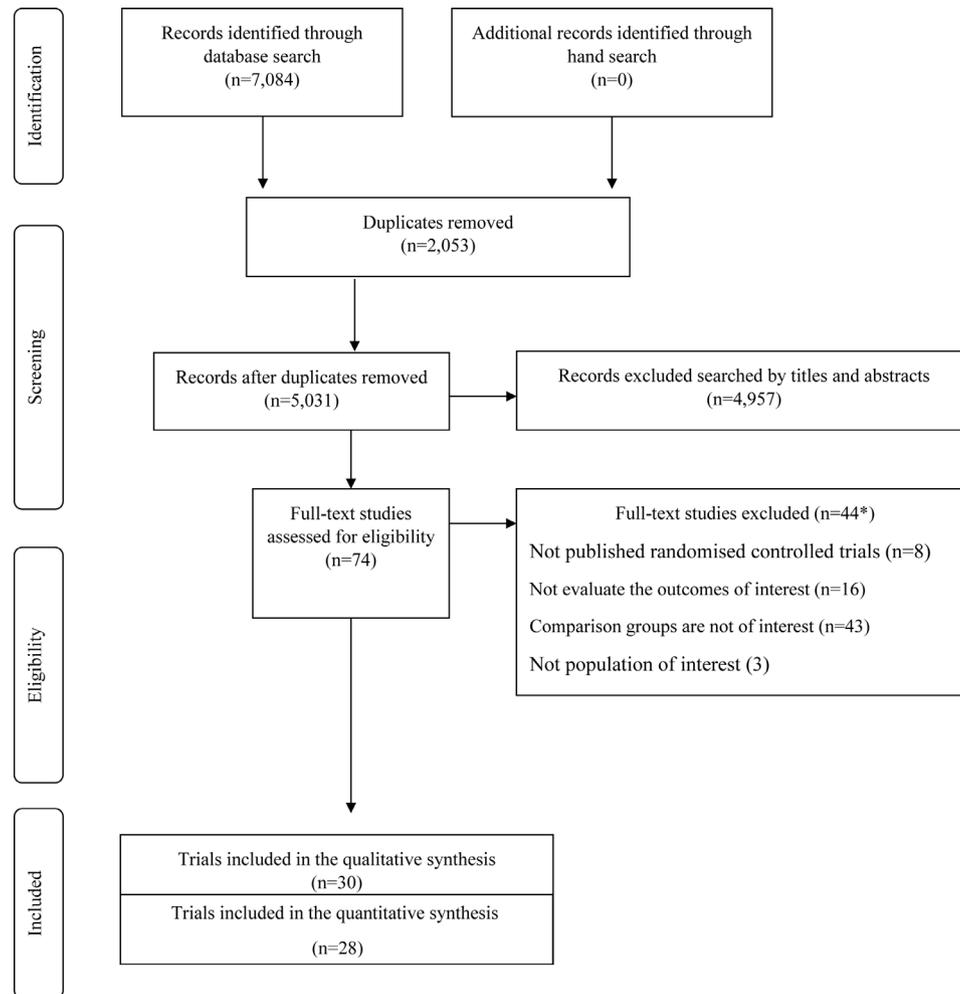


Figure 1 Flow of studies through the review (n=30 original trials included in qualitative synthesis and n=28 original trials included in quantitative synthesis). *Studies may have been excluded for more than one reason.

of the participants were from trials with a high risk of bias (ie, PEDro score <6 out of 10)⁴⁸ and inconsistency of results when I^2 statistic >50%, visual inspection of forest plot or when pooling was not possible. The third reviewer (VCO) resolved discrepancies between reviewers.

We planned sensitivity and subgroup analyses to assess the potential impact of sources of heterogeneity. Meta-regression was not possible because of the small number of trials pooled and qualitative analyses were conducted.³⁴ To investigate the potential impact of the methodological quality on the estimates, we removed trials with poor methodological quality (ie, PEDro scores <6 out of 10).⁴² All analyses were conducted using Comprehensive Meta-analysis software, V.2.2.04 (Biostat, Englewood, New Jersey, USA).

RESULTS

Searches identified 7084 references, 5031 titles and abstracts were screened, 74 potential full texts were assessed using the eligibility criteria and 30 original trials were included in the review. From the 30 included trials, 28 trials were included in the quantitative analysis. Two trials were excluded from the quantitative analysis because outcome data were not reported, and imputations were not possible.^{49–50} The flow of studies through the review is in figure 1.

Study characteristics

Thirty randomised controlled trials published between 1998 and 2022 were included in the qualitative analysis. Trials were conducted in Europe (n=9, 30%), Asia (n=7, 23.3%), Oceania (n=6, 20.0%), North America (n=5, 16.6%) and South America (n=3, 10.0%). Sample sizes of included trials ranged from 20 to 251 participants.

Four trials with 228 participants in total compared pharmacological treatments (ie, botulinum toxin injection, steroid injection, polydeoxyribonucleotide (PDRN) injection, homeopathic medicine) with control^{51–54} and 26 trials including 2418 participants in total compared non-pharmacological therapies (ie, ESWT, orthoses, taping, cream, dry needling, laser therapy, radiofrequency, shoes, stretching, stretching+sham ultrasound therapy, myofascial release, electroacupuncture plus warm needling (EAWN)) with control.^{9 32 55–76} Twenty-eight trials reported short-term effects (ie, up to 12 weeks after randomisation) and four trials reported long-term effects (ie, >12 weeks after randomisation). Pain intensity and disability were investigated in 29 (96.5%) and 10 (3.1%) trials, respectively. Online supplemental material 2 shows detailed characteristics of the included trials (n=30).

PAIN- Pharmacological and non-pharmacological therapies (i.e., any non-surgical therapy) versus control (i.e., placebo, sham, waiting list, no intervention)

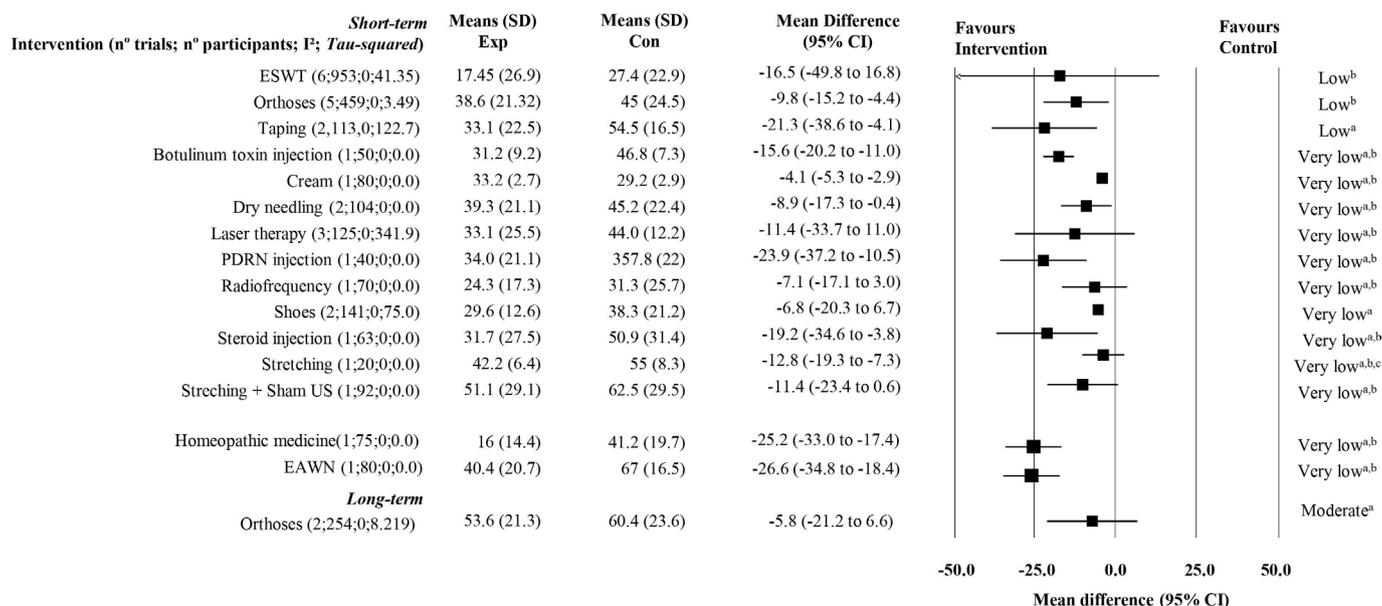


Figure 2 Summary of moderate, low and very low certainty evidence meta-analysis on pain intensity in plantar fasciitis. ^aDowngraded owing to imprecision: less than 400 participants included in the meta-analysis. ^bDowngraded owing to inconsistency: I² statistic was higher than 50%, absence of overlap between CI or pooling was not possible. ^cDowngraded owing to risk of bias: more than 25% of the participants in the meta-analysis were from trials with a high risk of bias (ie, PEDro score <6 of 10). Con, control group; EAWN, electroacupuncture plus warm needling; ESWT, extracorporeal shockwave therapy; Exp, experimental group; PDRN, polydeoxyribonucleotide; US, ultrasound.

Risk of bias of included trials

The mean methodological quality of the 30 included trials was 7.3 points on the 0 to 10 PEDro scale, with scores ranging from 4 to 10 points. Of the 30 trials included in the review, 28 trials (93.3%) were considered to have a low risk of bias (ie, PEDro score ≥6 out of 10). The main methodological issues of included trials were absence of therapist blinding (n=26, 86.6%), absence of intention-to-treat analysis (n=13, 43.3%) and absence of concealed allocation (n=12, 40.0%). Online supplemental material 3 shows detailed assessment of risk bias of included trials.

Effects of pharmacological and non-pharmacological therapies on pain intensity and disability in PFs

Figures 2 and 3 show the results and GRADE assessment for pain intensity and disability in the short term and long term. Effect estimates were reported as MDs on a 0–100 points scale. Quality of the evidence ranged from moderate to very low quality for the estimates of pharmacological and non-pharmacological therapies on pain intensity and disability. The main reasons for downgrading the certainty of the evidence were imprecision (27 of 29 comparisons,

DISABILITY- Pharmacological and non-pharmacological therapies (i.e., any non-surgical therapy) versus control (i.e., placebo, sham, waiting list, no intervention)

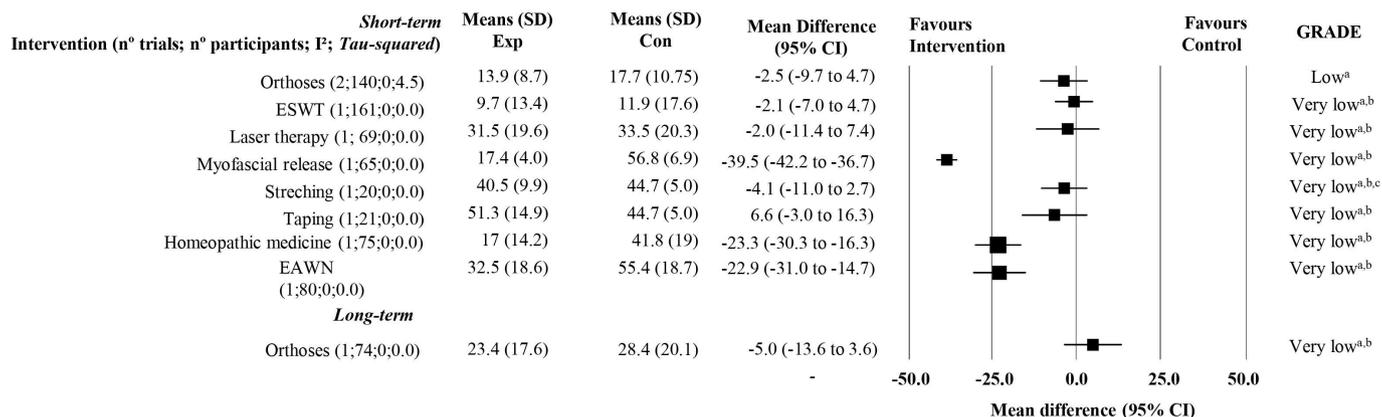


Figure 3 Summary of moderate, low and very low certainty evidence meta-analysis on disability in plantar fasciitis. ^aDowngraded owing to imprecision: less than 400 participants included in the meta-analysis. ^bDowngraded owing to inconsistency: I² statistic was higher than 50%, absence of overlap between CI or pooling was not possible. ^cDowngraded owing to risk of bias: more than 25% of the participants in the meta-analysis were from trials with a high risk of bias (ie, PEDro score <6 of 10). ESWT, extracorporeal shockwave therapy; GRADE, Grading of Recommendations, Assessment, Development and Evaluations; US, ultrasound therapy.

93.1%), inconsistency (20 of 29 comparisons, 68.9%) and risk of bias (4 of 29 comparisons, 13.7%). Online supplemental material 4 shows detailed forest plots for moderate, low and very low quality evidence.

Effects of non-pharmacological therapies versus control (ie, placebo, sham, waiting list or no intervention)

For pain intensity in the short term, moderate certainty evidence showed the effect of customised orthoses when compared with control (MD of -12.0 points (95% CI -17.1 to -7.0), 4 trials,^{32 51 65 68} $n=272$ participants), whereas low certainty evidence showed no effect of prefabricated orthoses (MD of -5.5 (95% CI -12.2 to 1.2), 2 trials,^{64 72} $n=272$ participants). In the long term, moderate to low certainty evidence showed no effect of orthoses; in general (ie, customised and prefabricated orthoses pooled), customised or prefabricated (figure 2). In addition, low certainty evidence showed no effects of ESWT (MD of -16.5 (95% CI -49.8 to 16.8), 6 trials,^{58 61-63 67 71} $n=953$ participants), and suggested an effect of taping (MD -21.3 (95% CI -38.6 to 4.0), 2 trials,^{62 68} $n=113$ participants) on pain intensity in the short term, when compared with control.

For disability, low to very low quality evidence from few trials with small samples showed uncertain evidence in the short term and long term (figure 3).

Effects of pharmacological therapies versus control (ie, placebo, sham, waiting list or no intervention)

For pharmacological therapies, low to very low quality evidence from few trials with small samples showed uncertain evidence for pain intensity and disability in the short term (figures 2 and 3). For instance, low to very low certainty evidence suggested that steroid injections (MD -19.2 (95% CI -34.6 to -3.7), 1 trial,⁵¹ $n=63$ participants) and botulinum toxin-A (MD -15.6 (95% CI -20.2 to -11.0), 1 trial,⁵² $n=50$ participants) have promising effects in the short term, respectively.

DISCUSSION

This systematic review provides moderate to very low quality evidence of 17 non-invasive therapies to manage PF. Moderate-quality to low-quality evidence shows that customised orthoses and taping improve pain intensity in the short term. Very low quality evidence also suggested that other therapies (eg, dry needling, stretching and steroid injection) may improve pain and disability in the short term and long term; however, further high-quality trials should provide more precise estimates, mainly in the long term.

The results of this systematic review disagreed with previous reviews for ESWT,⁷⁷ and agreed for taping, dry-needling and other investigated pharmacological therapies.^{77 78} Our review found a moderate effect in favour of customised orthoses for pain intensity in the short term. Morrissey *et al*³⁷ reported that the efficacy of orthoses was uncertain and that there were no effects of prefabricated orthoses. Moreover, they suggested further investigation of different prescription processes, comprising casting technique, shell material, top-covers and modifications. We partially clarified evidence for customised orthoses but few trials limited further investigation of different prescriptions. A potential explanation for the difference between customised and prefabricated insoles is that customised insoles are built based on specific needs of the individual.⁷⁹

Low certainty evidence showed that taping has potentially relevant effects for patients in the short term.^{9 69 80} Schuitema *et al* aimed to investigate the effectiveness of mechanical support

in the management of PF and also concluded that taping was an effective short-term treatment.⁸¹ Therapeutic taping is a common clinical intervention to improve pain intensity and joint stability. Potential mechanisms of action that explain its effects might be the increased mechanical stability of the joint.¹⁷

A previous systematic review reported short-term effects of ESWT on pain intensity.⁸² Moreover, guidelines for managing people with PF³⁷ acknowledged effects of ESWT in the short term, medium term and long term, with minimal known adverse events for most patient-reported outcomes. ESWT is advocated for treatment of chronic degenerative processes of the bone-tendon junctions because of the potential induction of hyperaemia, neovascularisation and regeneration of the tendon tissue.^{37 83} In contrast with the previous studies, ESWT was not supported by our findings and a potential explanation is that previous studies considered cohort studies to answer whether ESWT was effective. In regard to the safety of the ESWT, Roerdink *et al* investigated adverse events and concluded that the treatment was safe in the short term. Pain during treatment and transient red skin were the most reported side effects. Transient redness of the skin is commonly reported but it was not considered clinically relevant. Long-term adverse events of ESWT are still unknown.⁸³

In the review, low to very low certainty evidence suggests that pharmacological therapies such as PDRN injection, steroid injections and botulinum toxin-A have promising effects for pain intensity in the short term.⁸⁴ Previously, Tsikopoulos *et al* showed that botulinum toxin-A provides significant short-term and long-term effects.⁷⁸ Lee *et al* aimed to investigate the effects and safety of PDRN injection and corticosteroid injection, and Kim and Chung evaluated the efficacy and complications of PDRN injection in PF.^{53 85} They concluded that PDRN injection is an effective and safe treatment option in the short term.^{53 85} Moreover, NSAIDs, which are common clinical practice, have not been investigated and further high-quality trials should clarify their evidence. We acknowledge that low to very low quality evidence from individual trials with small samples provides imprecise estimates with poor reproducibility. We need to be cautious when interpreting their suggested effects.^{51 54}

Few individual trials with small samples suggest relevant effects for some non-pharmacological therapies such as myofascial release and EAWN on disability in the short term.^{54 55 75} In addition, few trials aimed to investigate PF in the long term. PF may evolve into a chronic condition, with persistent pain, disability and poor quality of life.³⁷ In this context, there is an urgent call for high-quality randomised controlled trials investigating effects of therapies in people with PF, mainly in the long term.

Strengths and limitations

The strengths of this systematic review of randomised controlled trials include strict methodology, with a prospectively registered protocol, inclusion of all investigated pharmacological and non-pharmacological therapies (any non-invasive therapy), from any care setting and summary of the quality of the evidence using the GRADE approach. This systematic review was designed to be comprehensive with a robust search strategy. Our review included randomised controlled trials because it is considered the gold-standard design to investigate the efficacy of therapies by comparing them with placebo, sham, no intervention or waiting list. The study design typically incorporates random allocation to groups and blinding to rule out sources of bias, allowing conclusions regarding the effect of the therapy of interest.⁸⁶

However, this study has some limitations. Planned sensitivity and subgroup analyses to explore the potential impact of high risk of bias, dosage and characteristics of the population were limited by the small number of included trials or because data were poorly reported. We suggest future trials improve data reporting on participants and interventions. In addition, a limitation of our study was the difficulty in extracting data. To minimise this limitation, a protocol for sending emails to the authors was initiated, with three attempts. In case of failure, we followed the Cochrane recommendations for imputing outcome data.³⁴

CONCLUSIONS

We found moderate and low quality evidence that customised orthoses and taping, respectively, improve pain intensity in the short term. Low and very low quality evidence showed uncertain evidence for disability or for long-term effects. Our findings should be evaluated by clinicians, stakeholders and researchers, taking into account that most of the 17 investigated therapies have currently low or very low certainty evidence. Our findings expose the need to conduct new larger trials with high methodological quality.

Twitter Vinicius Cunha Oliveira @oliveira_vc1

Contributors BML, MGMC, LM, BC, RGT and VCO contributed to planning, conduct and reporting of the work described in this article. BML is the author responsible for the overall content as the guarantor.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article or uploaded as online supplemental information.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

ORCID iDs

Mariana Gabrich Moraes Campos <http://orcid.org/0000-0001-6012-8995>
Vinicius Cunha Oliveira <http://orcid.org/0000-0002-8658-3774>

REFERENCES

- McPoil TG, Martin RL, Cornwall MW, *et al.* Heel pain--Plantar fasciitis: clinical practice guidelines linked to the International classification of function, disability, and health from the orthopaedic section of the American physical therapy association. *J Orthop Sports Phys Ther* 2008;38:A1-18.
- Young C. In the clinic. Plantar fasciitis. *Ann Intern Med* 2012;156:ITC1-1.
- Thong-On S, Bovonsunthonchai S, Vachalathiti R, *et al.* Effects of strengthening and stretching exercises on the temporospatial gait parameters in patients with plantar fasciitis: a randomised controlled trial. *Ann Rehabil Med* 2019;43:662-76.
- Abidin SZU, Haneef K, Malik NR, *et al.* Prevalence and associated risk factors for Plantar Fasciitis among security forces personnel in Peshawar. *A of Allied Health Sci* 2019;5:20-3.
- Hashmi R, Naeem L, Arif S, *et al.* Frequency of plantar fasciitis among females in teaching profession. *JAFMDC* 2020;2:53-7.
- Riddle DL, Schappert SM. Volume of ambulatory care visits and patterns of care for patients diagnosed with plantar fasciitis: a national study of medical doctors. *Foot Ankle Int* 2004;25:303-10.
- Buchbinder R. Plantar fasciitis. *N Engl J Med* 2004;350:2159-66.
- Rathleff MS, Thorborg K. 'Load me up, Scotty': mechanotherapy for plantar fasciopathy (formerly known as plantar fasciitis): table 1. *Br J Sports Med* 2015;49:638-9.
- Hyland MR, Webber-Gaffney A, Cohen L, *et al.* Randomised controlled trial of calcaneal taping, sham taping, and plantar fascia stretching for the short-term management of plantar heel pain. *J Orthop Sports Phys Ther* 2006;36:364-71.
- Puttaswamaiah R, Chandran P. Degenerative plantar fasciitis: a review of current concepts. *The Foot* 2007;17:3-9.
- Schneider HP, Baca JM, Carpenter BB, *et al.* American college of foot and ankle surgeons clinical consensus statement: diagnosis and treatment of adult acquired Infracalcaneal heel pain. *J Foot Ankle Surg* 2018;57:370-81.
- Diaz López AM, Guzmán Carrasco P. Effectiveness of different physical therapy in conservative treatment of plantar fasciitis: systematic review. *Rev Esp Salud Publica* 2014;88:157-78.
- Huffer D, Hing W, Newton R, *et al.* Strength training for plantar fasciitis and the intrinsic foot musculature: a systematic review. *Phys Ther Sport* 2017;24:44-52.
- Karagounis P, Tsrioni M, Prionas G, *et al.* Treatment of plantar fasciitis in recreational athletes: two different therapeutic protocols. *Foot Ankle Spec* 2011;4:226-34.
- Donley BG, Moore T, Sferra J, *et al.* The efficacy of oral nonsteroidal anti-inflammatory medication (NSAID) in the treatment of plantar fasciitis: a randomised, prospective, placebo-controlled study. *Foot Ankle Int* 2007;28:20-3.
- Acosta-Olivo C, Simental-Mendía LE, Vilchez-Cavazos F, *et al.* Clinical efficacy of botulinum toxin in the treatment of plantar fasciitis: a systematic review and meta-analysis of randomized controlled trials. *Arch Phys Med Rehabil* 2022;103:364-71.
- Abbasian M, Baghban S, Barangi S, *et al.* Outcomes of ultrasound-guided gastrocnemius injection with botulinum toxin for chronic plantar fasciitis. *Foot Ankle Int* 2020;41:63-8.
- Al-Boloushi Z, López-Royo MP, Arian M, *et al.* Minimally invasive non-surgical management of plantar fasciitis: a systematic review. *J Bodyw Mov Ther* 2019;23:122-37.
- Fei X, Lang L, Lingjiao H, *et al.* Platelet-rich plasma has better mid-term clinical results than traditional steroid injection for plantar fasciitis: a systematic review and meta-analysis. *Orthop Traumatol Surg Res* 2021;107:103007.
- Yu T, Xia J, Li B, *et al.* Outcomes of platelet-rich plasma for plantar fasciopathy: a best-evidence synthesis. *J Orthop Surg Res* 2020;15:432.
- Hohmann E, Tetsworth K, Glatt V. Platelet-rich plasma versus corticosteroids for the treatment of plantar fasciitis: a systematic review and meta-analysis. *Am J Sports Med* 2021;49:1381-93.
- Sousa Filho LF, Barbosa Santos MM, Dos Santos GHF, *et al.* Corticosteroid injection or dry needling for musculoskeletal pain and disability? A systematic review and GRADE evidence synthesis. *Chiropr Man Therap* 2021;29:49.
- Hurley ET, Shimozone Y, Hannon CP, *et al.* Platelet-rich plasma versus corticosteroids for plantar fasciitis: a systematic review of randomised controlled trials. *Orthop J Sports Med* 2020;8:2325967120915704.
- Alkhatib N, Salameh M, Ahmed AF, *et al.* Platelet-rich plasma versus corticosteroids in the treatment of chronic plantar fasciitis: a systematic review and meta-analysis of prospective comparative studies. *J Foot Ankle Surg* 2020;59:546-52.
- Al-Siyabi Z, Karam M, Al-Hajri E, *et al.* Extracorporeal shockwave therapy versus ultrasound therapy for plantar fasciitis: a systematic review and meta-analysis. *Cureus* 2022;14:e20871.
- Trinh K, Belski N, Zhou F, *et al.* The efficacy of acupuncture on foot and ankle for pain intensity, functional status, and general quality of life in adults: a systematic review. *Med Acupunct* 2021;33:386-95.
- Rhim HC, Kwon J, Park J, *et al.* A systematic review of systematic reviews on the epidemiology, evaluation, and treatment of plantar fasciitis. *Life (Basel)* 2021;11:1287.
- Guimarães JS, Arcanjo FL, Leporace G, *et al.* Effect of low-level laser therapy on pain and disability in patients with plantar fasciitis: a systematic review and meta-analysis. *Musculoskelet Sci Pract* 2022;57:102478.
- Melese H, Alamer A, Getie K, *et al.* Extracorporeal shock wave therapy on pain and foot functions in subjects with chronic plantar fasciitis: systematic review of randomised controlled trials. *Disabil Rehabil* 2022;44:5007-14.
- Llurda-Almuzara L, Labata-Lezaun N, Meca-Rivera T, *et al.* Is dry needling effective for the management of plantar heel pain or plantar fasciitis? An updated systematic review and meta-analysis. *Pain Med* 2021;22:1630-41.
- Nazim B Tengku Yusof T, Seow D, Vig KS. Extracorporeal shockwave therapy for foot and ankle disorders: a systematic review and meta-analysis. *J Am Podiatr Med Assoc* 2022;112:1-26.
- Bishop C, Thewlis D, Hillier S. Custom foot orthoses improve first-step pain in individuals with unilateral plantar fasciopathy: a pragmatic randomised controlled trial. *BMC Musculoskelet Disord* 2018;19:222.
- Xu R, Wang Z, Ma T, *et al.* Effect of 3D printing individualized ankle-foot orthosis on plantar biomechanics and pain in patients with plantar fasciitis: a randomised controlled trial. *Med Sci Monit* 2019;25:1392-400.
- Higgins JPT, Thomas J, Chandler J, *et al.* *Cochrane Handbook for Systematic Reviews of Interventions version*. 2019.
- Moher D, Liberati A, Tetzlaff J, *et al.* Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med* 2009;6:e1000097.
- Wearing SC, Smeathers JE, Urry SR, *et al.* The biomechanics of plantar fasciitis. *Sports Medicine* 2006;36:585-611.

- 37 Morrissey D, Cotchett M, J'Barí AS, *et al.* Management of plantar heel pain: a best practice guide synthesising systematic review with expert clinical reasoning and patient values. *In Review* [Preprint] 2021.
- 38 Hawker GA, Mian S, Kendzerska T, *et al.* Measures of adult pain: visual analog scale for pain (VAS pain), Numeric rating scale for pain (NRS pain), McGill pain questionnaire (MPQ), short-form McGill pain questionnaire (SF-MPQ), chronic pain grade scale (CPGS), short Form-36 bodily pain scale (SF-36 BPS), and measure of intermittent and constant osteoarthritis pain (ICOAP). *Arthritis Care Res (Hoboken)* 2011;63 Suppl 11:S240–52.
- 39 Budiman-Mak E, Conrad KJ, Roach KE. The foot function index: a measure of foot pain and disability. *J Clin Epidemiol* 1991;44:561–70.
- 40 Bennett PJ, Patterson C, Wearing S, *et al.* Development and validation of a questionnaire designed to measure foot-health status. *J Am Podiatr Med Assoc* 1998;88:419–28.
- 41 Martin RL, Irrgang JJ, Burdett RG, *et al.* Evidence of validity for the foot and ankle ability measure (FAAM). *Foot Ankle Int* 2005;26:968–83.
- 42 Maher CG, Sherrington C, Herbert RD, *et al.* Reliability of the pedro scale for rating quality of randomised controlled trials. *Phys Ther* 2003;83:713–21.
- 43 Landorf KB, Radford JA, Hudson S. Minimal important difference (MID) of two commonly used outcome measures for foot problems. *J Foot Ankle Res* 2010;3:7.
- 44 Landorf K, Radford JA. Minimal important difference: values for the foot health status questionnaire. *Foot Function Index and Visual Analogue Scale* 2008;18:15–9.
- 45 Ostelo RWJG, Deyo RA, Stratford P, *et al.* Interpreting change scores for pain and functional status in low back pain: towards international consensus regarding minimal important change. *Spine (Phila Pa 1976)* 2008;33:90–4.
- 46 Balsem H, Helfand M, Schünemann HJ, *et al.* GRADE guidelines: 3. rating the quality of evidence. *J Clin Epidemiol* 2011;64:401–6.
- 47 Ioannidis JPA, Trikalinos TA. The appropriateness of asymmetry tests for publication bias in meta-analyses: a large survey. *CMAJ* 2007;176:1091–6.
- 48 Foley NC, Teasell RW, Bhogal SK, *et al.* Stroke rehabilitation evidence-based review: methodology. *Top Stroke Rehabil* 2003;10:1–7.
- 49 Gollwitzer H, Diehl P, von Korff A, *et al.* Extracorporeal shock wave therapy for chronic painful heel syndrome: a prospective, double blind, randomised trial assessing the efficacy of a new electromagnetic shock wave device. *J Foot Ankle Surg* 2007;46:348–57.
- 50 Ribeiro AP, João SMA. The effect of short and long-term therapeutic treatment with Insoles and shoes on pain, function, and plantar load parameters of women with plantar fasciitis: a randomised controlled trial. *Medicina (Kaunas)* 2022;58:1546.
- 51 Ball EMA, McKeeman HMA, Patterson C, *et al.* Steroid injection for inferior heel pain: a randomised controlled trial. *Ann Rheum Dis* 2013;72:996–1002.
- 52 Huang YC, Wei SH, Wang HK, *et al.* Ultrasonographic guided botulinum toxin type A treatment for Plantar fasciitis: an outcome-based investigation for treating pain and gait changes. *J Rehabil Med* 2010;42:136–40.
- 53 Kim JK, Chung JY. Effectiveness of polydeoxyribonucleotide injection versus normal saline injection for treatment of chronic plantar fasciitis: a prospective randomised clinical trial. *Int Orthop* 2015;39:1329–34.
- 54 Shahid S, Ghosh S, Chakraborty AS, *et al.* Efficacy of individualized homeopathic medicines in plantar fasciitis: double-blind, randomised, placebo-controlled clinical trial. *Homeopathy* 2022;111:22–30.
- 55 Ajimsha MS, Binsu D, Chithra S. Effectiveness of myofascial release in the management of plantar heel pain: a randomized controlled trial. *Foot (Edinb)* 2014;24:66–71.
- 56 Basford JR, Malanga GA, Krause DA, *et al.* A randomised controlled evaluation of low-intensity laser therapy: plantar fasciitis. *Arch Phys Med Rehabil* 1998;79:249–54.
- 57 Brook J, Dauphinee DM, Korpinen J, *et al.* Pulsed radiofrequency electromagnetic field therapy: a potential novel treatment of plantar fasciitis. *J Foot Ankle Surg* 2012;51:312–6.
- 58 Buchbinder R, Ptasznik R, Gordon J, *et al.* Ultrasound-guided extracorporeal shock wave therapy for plantar fasciitis. A randomised controlled trial. *JAMA* 2002;288:1364–72.
- 59 Costa ARA, de Almeida Silva HJ, Mendes AAMT, *et al.* Effects of Insoles adapted in flip-flop sandals in people with plantar fasciopathy: a randomised, double-blind clinical, controlled study. *Clin Rehabil* 2020;34:334–44.
- 60 Cotchett MP, Munteanu SE, Landorf KB. Effectiveness of trigger point dry needling for plantar heel pain: a randomised controlled trial. *Phys Ther* 2014;94:1083–94.
- 61 Gerdemeyer L, Frey C, Vester J, *et al.* Radial extracorporeal shock wave therapy is safe and effective in the treatment of chronic recalcitrant plantar fasciitis: results of a confirmatory randomised placebo-controlled multicenter study. *Am J Sports Med* 2008;36:2100–9.
- 62 Gollwitzer H, Saxena A, DiDomenico LA, *et al.* Clinically relevant effectiveness of focused extracorporeal shock wave therapy in the treatment of chronic plantar fasciitis: a randomised, controlled multicenter study. *J Bone Joint Surg Am* 2015;97:701–8.
- 63 Ibrahim MI, Donatelli RA, Hellman M, *et al.* Long-term results of radial extracorporeal shock wave treatment for chronic plantar fasciopathy: a prospective, randomised, placebo-controlled trial with two years follow-up. *J Orthop Res* 2017;35:1532–8.
- 64 Kiritsi O, Tsitis K, Malliaropoulos N, *et al.* Ultrasonographic evaluation of plantar fasciitis after low-level laser therapy: results of a double-blind, randomised, placebo-controlled trial. *Lasers Med Sci* 2010;25:275–81.
- 65 Landorf KB, Keenan A-M, Herbert RD. Effectiveness of foot orthoses to treat plantar fasciitis: a randomised trial. *Arch Intern Med* 2006;166:1305–10.
- 66 Macias DM, Coughlin MJ, Zang K, *et al.* Low-level laser therapy at 635 nM for treatment of chronic plantar fasciitis: a placebo-controlled, randomised study. *J Foot Ankle Surg* 2015;54:768–72.
- 67 Malay DS, Pressman MM, Assili A, *et al.* Extracorporeal shockwave therapy versus placebo for the treatment of chronic proximal plantar fasciitis: results of a randomised, placebo-controlled, double-blinded, multicenter intervention trial. *J Foot Ankle Surg* 2006;45:196–210.
- 68 Oliveira HAV, Jones A, Moreira E, *et al.* Effectiveness of total contact Insoles in patients with plantar fasciitis. *J Rheumatol* 2015;42:870–8.
- 69 Radford JA, Landorf KB, Buchbinder R, *et al.* Effectiveness of low-dye taping for the short-term treatment of plantar heel pain: a randomised trial. *BMC Musculoskelet Disord* 2006;7:64.
- 70 Radford JA, Landorf KB, Buchbinder R, *et al.* Effectiveness of calf muscle stretching for the short-term treatment of plantar heel pain: a randomised trial. *BMC Musculoskelet Disord* 2007;8:36.
- 71 Speed CA, Nichols D, Wies J, *et al.* Extracorporeal shock wave therapy for plantar fasciitis. a double blind randomised controlled trial. *J Orthop Res* 2003;21:937–40.
- 72 Vicenzino B, McPoil TG, Stephenson A, *et al.* Orthosis-shaped sandals are as efficacious as in-shoe orthoses and better than flat sandals for plantar heel pain: a randomized control trial. *PLoS One* 2015;10:e0142789.
- 73 Xu R, Wang Z, Ma T, *et al.* Effect of 3d printing individualized ankle-foot orthosis on plantar biomechanics and pain in patients with plantar fasciitis: a randomised controlled trial. *Med Sci Monit* 2019;25:1392–400.
- 74 Young MA, Cook JL, Webster KE. The effect of topical Wheatgrass cream on chronic Plantar Fasciitis: a randomised, double-blind, placebo-controlled trial. *Complement Ther Med* 2006;14:3–9.
- 75 Ho LF, Guo Y, Ching JY-L, *et al.* Efficacy of electroacupuncture plus warm needling therapy for plantar heel pain: a randomised waitlist-controlled trial. *Acupunct Med* 2021;39:283–91.
- 76 Moosaei Saein A, Safavi-Farokhi Z, Aminianfar A, *et al.* The effect of dry Needling on pain, range of motion of ankle joint, and ultrasonographic changes of plantar fascia in patients with plantar fasciitis. *J Sport Rehabil* 2022;31:299–304.
- 77 Aqil A, Siddiqui MRS, Solan M, *et al.* Extracorporeal shock wave therapy is effective in treating chronic plantar fasciitis: a meta-analysis of RCTs. *Clin Orthop Relat Res* 2013;471:3645–52.
- 78 Tsikopoulos K, Vasilidiadis HS, Mavridis D. Injection therapies for plantar fasciopathy ('Plantar Fasciitis'): a systematic review and network meta-analysis of 22 randomised controlled trials. *Br J Sports Med* 2016;50:1367–75.
- 79 Lourenço BM, Magalhães FA, Vieira FM, *et al.* An exploration of the effects of prefabricated and customized Insoles on lower limb kinetics and kinematics during walking, stepping up and down tasks: a time series analysis. *Gait Posture* 2022;98:297–304.
- 80 Whittaker GA, Munteanu SE, Menz HB, *et al.* Foot orthoses for plantar heel pain: a systematic review and meta-analysis. *Br J Sports Med* 2018;52:322–8.
- 81 Schuitema D, Greve C, Postema K, *et al.* Effectiveness of mechanical treatment for plantar fasciitis: a systematic review. *J Sport Rehabil* 2020;29:657–74.
- 82 Li S, Wang K, Sun H, *et al.* Clinical effects of extracorporeal shock-wave therapy and ultrasound-guided local corticosteroid injections for plantar fasciitis in adults: a meta-analysis of randomised controlled trials. *Medicine* 2018;97:e13687.
- 83 Roerdink RL, Dietvorst M, van der Zwaard B, *et al.* Complications of extracorporeal shockwave therapy in plantar fasciitis: systematic review. *Int J Surg* 2017;46:133–45.
- 84 David JA, Sankarapandian V, Christopher PR, *et al.* Injected corticosteroids for treating plantar heel pain in adults. *Cochrane Database Syst Rev* 2017;6:CD009348.
- 85 Lee D-O, Yoo J-H, Cho H-I, *et al.* Comparing effectiveness of polydeoxyribonucleotide injection and corticosteroid injection in plantar fasciitis treatment: a prospective randomized clinical study. *Foot Ankle Surg* 2020;26:657–61.
- 86 Bhide A, Shah PS, Acharya G. A simplified guide to randomized controlled trials. *Acta Obstet Gynecol Scand* 2018;97:380–7.

© 2023 Author(s) (or their employer(s)) 2023. No commercial re-use. See rights and permissions. Published by BMJ.