Are conventional treatments effective for patients with chronic plantar fasciopathy? – A review of the literature

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Background

Plantar fasciopathy (PF) is a common pathology with an incidence of 10% in adults [1,2]. With a 7.9% incidence in runners, PF is the third most common overuse running injury with an estimated financial burden of $376 million per year in the United States of America [3,4]. Despite a wealth of research PF is still considered a difficult condition to treat.

Currently, it is not clear which intervention, physiotherapy, podiatry, pharmacological treatment, or surgery best stimulate a healing response. While there is no consensus among orthopaedic clinicians regarding the best treatment for PF, many authors recommend exhausting conventional treatment options typical of Physiotherapy and Podiatry (exercise, orthotics, manual therapy, tape, acupuncture, night splints) before proceeding to extracorporeal shockwave therapy (ESWT), injection therapy or surgery [5]. The advantages of a conventional approach include lower associated costs and less risk of complications such as infection, rupture, fat pad atrophy, osteomyelitis or nerve damage when compared to injection or surgery [6,7].

Symptoms of PF are plantar heel pain on first steps after waking, pain on sustained loading and pain on palpation of the medial calcaneal tubercle [8]. Historically, this condition has been referred to as plantar fascitis which would suggest an inflammatory pathology. This may be inappropriate as the underlying pathophysiology of this condition is not fully understood. Structural changes consistent with degeneration [9], associated plantar intrinsic muscle atrophy [10,11], softening of the plantar fascia [12], hypertonic muscle patterns [13] and a failed healing response have been reported rather than inflammation. The term plantar fasciopathy is therefore more reflective of this condition.

A number of narrative and systematic reviews have been conducted regarding conventional treatments for PF. A search of MEDLINE, AMED, EMBASE, Cochrane and PEDro databases between 2007 and September 2017 identified six systematic reviews of conservative treatments for plantar fasciopathy. These included tape [14, 15], stretching [16], acupuncture [17] and orthotics [18]. One review considered a limited range of modalities [19]. To the authors’ knowledge no review has exclusively looked at high quality evidence (randomised controlled trials) of conservative treatments alone. As PF is considered difficult to treat, interventions that are considered in the normal scope of Physiotherapy and Podiatry are usually recommended as the first line of management, the aim of this systematic review was to evaluate the efficacy of these treatments.

Materials and method

Data source

The electronic databases of MEDLINE, EMBASE, Cochrane and PEDro were searched. The keywords used for the search are presented in table 1. The inclusion and exclusion criteria for the review are listed in table 2. The period for the review was from the beginning of the databases until March 2018.

Study identification

Two reviewers (AL and AMH) independently reviewed all titles and abstracts that were identified against the eligibility criteria. Full-text manuscripts were requested when eligibility could not be assessed from the abstract and title.

Data extraction

The reviewer (AL) performed data extraction for each eligible paper. Data extraction included population characteristics (sample size, mean age, gender, and duration of symptoms), clinical diagnostic criteria, risk of bias, adverse events, and outcome measures.

Table 1. Keywords used in the search, “S” indicating a truncated search term

|   |   |
|---|---|
| 1 | plantar fasciitis OR plantar fasciosis OR plantar fasciopathy OR heel pain |
| 2 | Tap$ OR electro$ OR laser OR LLLT OR cryo$ OR heat OR stretch$ OR physiotherapy$ OR exercise$ OR physical therapy$ OR podiatr$ OR ultrasound OR orthotic$ OR insole$ OR night splint$ OR acupuncture |
| 3 | Exploded terms: plantar fasciitis, physical therapy modalities, exercise therapy, orthotic devices, acupuncture |
|   |   |
| 1 AND (2 OR 3) |   |

Table 2. Eligibility criteria

| Inclusion | Exclusion |
|-----------|-----------|
| Randomised Controlled Trials | Aged under 18 years old |
| English Language | Use of injection therapies |
| Treatments considered by author consensus to be within the normal scope of practice for Physiotherapists or Podiatrists | Use of ESWT |
| Chronic PF (duration of symptoms over 3 months) (if this was not explicitly stated studies were included) | Use of invasive techniques |
| Human subjects | Pilot studies |

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### Table 3. Data extraction included population characteristics (sample size, mean age, gender, and duration of symptoms), clinical diagnostic criteria, investigations, treatment interventions, outcomes, results, follow-up period, country of study and athletic population (involvement in sport)

| Author year | Modality | Country of study | Mean age, SD, range | No. subjects, No. fascias | Gender male / female | Population sporting / sedentary | Minimum symptom duration / mean (months) | Diagnosis Radiological or clinical | Outcome Measures | Treatments | Main between groups result | Follow-up (months) | PEDro score /10  (* If calculated by authors) |
|-------------|----------|------------------|---------------------|--------------------------|---------------------|-------------------------------|----------------------------------------|-----------------------------------|-----------------|----------------|-------------------------------|-----------------|-----------------------------------------------|
| Alotaibi 2015 | Exercise | USA | 49.3, NR, NR | 44 / NR | 22 / 22 | NR | NR / 12 | clinically | VAS | 4 weeks | monophasic pulsed current (MPC) vs MPC and plantar fascia stretch | Nil difference | 1 5 |
| DiGiovanni 2003 | Exercise | USA | 46, 7.5, 23-60 | 82 / 82 | 24 / 58 | NR | 10 / NR | Clinically | Modified FFI | Calf stretch vs plantar fascia stretch | Plantar stretch better than calf stretch | 2 4 |
| DiGiovanni 2006 | Exercise | USA | NR | 66 / 66 | NR | NR | 10 / NR | Clinically | Modified FFI | Calf stretch vs plantar fascia stretch | Nil difference | 24 3 |
| Engkananuwat 2017 | Exercise | Thailand | 49.8, 6.5, NR | 50 / 50 | 18 / 32 | NR | 1 / 7.25 | clinically | VAS-FA | Achilles stretch | Improved PPT in plantar stretch at 1 month only | 8 * |
| Kamonseki 2016 | Exercise | Brazil | 45.8, NR, NR | 83 / 83 | 18 / 65 | NR | 1 / 18.3 | clinically | VAS | Stretching | Nil difference | 2 6 * |
| Radford 2007 | Exercise | Australia | 50, 11, NR | 92 / 92 | 36 / 56 | NR | 1 / 13 (median) | clinically | FHSQ | Sham U/S & stretch vs Sham U/S | Nil difference | 2 weeks 8 * |
| Rathleff 2014 | Exercise | Denmark | 46.8, NR | 48 / 48 | 16 / 32 | NR | 03-Jul | Clinically & ultrasound | FFI | Insoles and stretches vs insoles and strength training | Strength training better at 3 months only | 6 * |
| Abigail 2017 | Manual therapy | India | NR, NR, NR | 30 / 30 | NR | NR | NR / NR | clinically | NPRS | U/S | Manual better | 10 days 7 * |
| Ajimsha 2014 | Manual therapy | Qatar | 41.5, NR, NR | 65 / 65 | 17 / 48 | sedentary | NR / 4 | clinically | FFI | Myofascial release vs sham U/S | Myofascial better | 3 6 |
| Cleland 2009 | Manual therapy | USA and New Zealand | 48.4, 8.7, NR | 54 / 54 | Oct-44 | NR | NR / 8.7 | clinically | LEFS | U/S, ice and iontophoresis vs soft tissue and rear foot mobs with mobs to hip, knee, ankle, foot as required | Manual better than electrotherapy | 1 6 * 7 |
| Dimou 2004 | Manual therapy | United Kingdom | NR, NR, 23-59 | 20 / 20 | 13-Jul | NR | NR / 23.2 | clinically | PSW | foot and ankle joint mobilisations with stretches | Mobs better at 1 month | 1 |
| Ghafoor 2016 | Manual therapy | Pakistan | 47.4, 9.1, NR | 60 / 60 | Dec-48 | NR | NR | clinically | FAAM | standard vs standard & LEFS | Manual better | 3 weeks |

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| Author(s)          | Year | Country | Region | Study Design | Comparator | Treatment | Start | End | Sample Size | Duration | Follow-up | Result | Notes |
|-------------------|------|---------|--------|--------------|------------|-----------|-------|-----|-------------|----------|-----------|--------|-------|
| Am 2010           |      | India   |        | Manual therapy |            |           | 35.5, | 60 / | 35 / 25 | 10 days  | 4          |        |       |
| Kuhar 2007        |      | India   |        | Manual Therapy |            |           | 43,   | 30 / | 15 / 15 | 10 days  | 7 *        |        |       |
| Renas-Ordine 2011 |      | Brazil  |        | Manual therapy |            |           | 44,   | 60 / | 15 / 45 | 10 days  | 7 *        |        |       |
| Shashua 2015      |      | Israel  |        | Manual therapy |            |           | 51.3, | 56 / | 14 / 32 | 10 days  | 8          |        |       |
| Wynne 2006        |      | USA     |        | Manual therapy |            |           | NR,   | 20 / | Apr-16 | 4         |            |        |       |
| Basford 1998      |      | USA     |        | electrotherapy |            |           | NR,   | 28 / | Jul-24 | Immediate | 7          |        |       |
| Brook 2012        |      | USA     |        | electrotherapy |            |           | 52,   | 70 / | 18 / 52 | 1 week   | 9*         |        |       |
| Cinar 2017        |      | Turkey  |        | electrotherapy |            |           | 45.5, | 49 / | Sep-40 | 3 weeks  | 7 *        |        |       |
| Crawford 1996     |      | UK      |        | electrotherapy |            |           | NR,   | 19 / | 15-Nov | 1 week   | 8 *        |        |       |
| Gudeman 1997      |      | USA     |        | electrotherapy |            |           | 42.1, | 36 / | Jul-32 | 1.5       | 3.5        |        |       |
| Kiritsi 2010      |      | Greece  |        | electrotherapy |            |           | 40,   | 25 / | 15-Oct | 1.5       | 7          |        |       |
| Marcias 2015      |      | USA     |        | electrotherapy |            |           | 56.7, | 69 / | 17 / 42 | 1.5       | 7          |        |       |
| Osborne 2006      |      | Australia |     | electrotherapy |            |           | 51.1, | 31 / | 31 / 42 | 1 week   | 9*         |        |       |
| Straton 2009      |      | USA     |        | electrotherapy |            |           | 41,   | 26 / | 26 / 26 | 1.5       | 7          |        |       |

*FFI: Fascia Facilitated Injection, PPT: Proprioceptive Neuromuscular Facilitation, U/S: Ultrasound, VAS: Visual Analog Scale, Myofascial release, Immediate: No difference, 1 week: No difference, 2 weeks: No difference, 3 weeks: No difference, 6 weeks: No difference, 12-minute walk: Standard vs. Myofascial release better, 3 months only: Myofascial release better.
| Study         | Treatment | Location | Age/Cohort | Duration | Follow-up | Outcomes | Treatment Comparison | Results |
|--------------|-----------|----------|------------|----------|-----------|----------|----------------------|---------|
| Hyland 2006  | Tape      | USA      | 39.5, NR, NR | 41 / 41  | 21 / 20   | NR       | clinically            | Tape better for VAS 1st step |
| Khataorkar 2015 | Tape   | India    | 31.5, NR, NR | 30 / 30  | Sep-21    | NR / NR  | Clinically            | Tape better all measures |
| Radford 2006  | Tape      | Australia| 50, 14, NR   | 92 / 92  | 37 / 55   | NR       | clinically            | Tape better for 1st step VAS only |
| Tsai 2010    | Tape      | Taiwan   | NR, NR, NR   | 52 / 57  | 19 / 33   | NR       | Clinically            | Tape better |
| Vishal 2010  | Tape      | India    | 38.4, NR, NR | 60 / 60  | 35 / 25   | NR       | clinically            | Plantar fascia tape better than calcaneal |
| El Salam 2010 | Tape and orthotics | Saudi Arabia | 53, NR, NR | 30 / 30  | 23-Jul    | NR       | clinically            | Standard and pre-fab orthotic |
| Baldassin 2009 | Orthotics | Brazil   | 47.4, NR, NR | 105 / 105 | 25 / 80   | sedentary | clinically            | Pre-fabricated vs custom insole |
| Fong 2012    | Orthotics | China    | 50.6, 5.3, NR | 15 / 15  | 03-Dec    | NR       | clinically            | Rocker better than normal |
| Landorf 2006  | Orthotics | Australia | 48.3, NR, NR | 135 / NR | 46 / 89   | NR       | clinically            | Orthotics: 3 months |
| Oliviera 2015 | Orthotics | Brazil   | 50.5, NR, NR | 74 / NR  | Aug-66    | NR       | clinically            | No difference 6 min walk test |

*Note: VAS = Visual Analog Scale, PSFS = Plantar Sole Fatigue Score, FFI = Foot Function Index, SF-36 = Short Form 36, Likert = Likert Scale, US = Ultrasonography, PFPS = Patellar Femoral Pain Syndrome, TENS = Transcutaneous Electrical Nerve Stimulation, FHSQ = Foot Health Status Questionnaire, Sham = Sham Treatment, Pre-fab = Pre-fabricated, Custom = Customized, F (median) = Foot Function (median), VAS first step = VAS at first step, Pre-fab 12 months = Pre-fab 12 months, VAS 1st step = VAS at 1st step, PPFS = Patellar Patellar Pain Syndrome, VAS = Visual Analog Scale, Intrinsic foot exercises & cryotherapy = Intrinsic foot exercises and cryotherapy, Taping = Taping, U/S = Ultrasonography, PSFS, Stretching vs tape vs sham vs control = PSFS, Stretching vs tape vs sham vs control, Sham U/S and tape = Sham U/S and tape, Tape for VAS = Tape for VAS, tape vs sham tape vs control = tape vs sham tape vs control, Tape better for VAS = Tape better for VAS, Tape better only = Tape better only, Tape better = Tape better, NR = Not Reported.
| Year   | Treatment Type | Location | Participants | Follow-up | Outcomes | Study Design | Results |
|--------|----------------|----------|--------------|-----------|----------|--------------|---------|
| Pfeffer 1999 | Orthotics | USA | NR, NR, 23-81 / 200 | 200 / 200 | clinically FFI | Stretch vs Stretch silicone heel pad vs Stretch felt insert vs Stretch heel cup vs Stretch custom | FFIs better than custom or stretching alone |
| Ryan 2009 | Orthotics | Canada | 40.3, NR, NR / 20 / 21 | NR NR Jun-21 | Clinically and x-ray VAS | Ultra-flexible shoe Vs Conventional running shoe | No difference |
| Winemiller 2003 | Orthotics | USA | 41.3, NR, NR / 101 / 101 | 21 / 80 | Clinically Likert VAS | Magnetised insoles vs placebo insoles | No difference |
| Wrobel 2015 | Orthotics | USA | 49.6, 12.7, 23.75 / 69 / 69 | 26 / 43 | Less than 12 / 5.2 X-ray and U/S | FFI Orthotics: Custom orthotic increased activity. | FFIs better than standard |
| Batt 1996 | Night Splint | USA | 45.7, NR, 20-74 / 32 / 33 | Nov-21 NR NR / 12.7 | Clinically and X-ray VAS | Standard vs standard with night splint | Number self reported as healed |
| Lee 2012 | Night Splint | Hong Kong | 44, NR, 31-34 / 28 / 28 | Feb-26 NR NR / 7.3 | Clinically FFI VAS | Orthosis Vs orthosis and night splint | No difference |
| Martin 2001 | Night Splint | USA | 47, NR, 21-70 / 193 / 193 | 68 / 125 NR NR / 5 | clinically VAS | Custom orthotic vs pre-fab orthotic Vs night splint | No difference |
| Powell 1998 | Night Splint | USA | 48, NR, 22-72 / 37 / 49 | Aug-29 NR 6 / NR | Clinically and X-Ray MCSS AHIRS | Night splint for 4 weeks (crossover) | Better with night splint |
| Probe 1999 | Night Splint | USA | 46, 11, NR / 116 / 146 | 35 / 81 NR NR / 5 | Clinically & X-Ray Pain 4-point scale stetches, piroxicam vs stretches, piroxicam and night splint | No difference |
| Roos 2006 | Night Splint | Sweden | 46, NR, 22-63 / 34 / 34 | Jul-27 40% "active in sports" >1 / 4.2 | clinically FAOS | Custom Orthosis vs night splint vs both | No difference |
| Wheeler 2017 | Night splints | United Kingdom | 52.1, NR, NR / 40 / 40 | Nov-29 NR 4 / 25.2 | Clinically & either U/S or MRI FFI | Exercises Vs MOXEQ FQ Exercisess and night splint | Nil difference |
| Cotchett 2014 | Acupuncture | Australia | 56, 122, NR / 84 / 84 | 44 / 40 NR Jan-14 | clinically VAS FHSQ | Dry needling vs sham dry needling | Dry needling better |
investigations, treatment interventions, outcomes, results, follow-up period, country of study and athletic population (involvement in sport) (Table 3).

Critical appraisal

The methodological quality of each article was assessed using the Physiotherapy Evidence Database (PEDro) score. This scoring system was selected as it was developed to assess the internal validity of randomised controlled trials (RCTs) investigating Physiotherapy modalities [20]. The PEDro score is an 11-point scale rating the internal validity of a study's method. It was developed using a Delphi approach with one measure of external validity not contributing to the total score [20]. Reliability and validity of this approach have been established [21,22] where a PEDro score of 0 represents a study with poor internal validity and a score of 10 a high internal validity. When a study had yet to be reviewed by PEDro this was performed by the authors, indicated by * on table 3. Using the PEDro score, studies were considered excellent quality (≥8/10), good quality (5-7/10) or poor quality (≤4/10) [21,23]. The quality and number of studies were combined for each modality to establish the strength of supporting evidence against criteria proposed by van Tulder, et al. [24] (Table 4).

Results

Search strategy

A total of 1941 articles were identified by the initial search, following removal of duplicates 1102 remained for review of which 1034 studies were excluded from their title and abstracts against the inclusion and exclusion criteria leaving 68 articles requiring review of the fulltexts. Five articles were unobtainable, in these cases the lead authors were contacted via e-mail. One author replied and was included; the remaining four did not reply and therefore were not included in the review. Seven studies were excluded based on the eligibility criteria (two were not RCTs, three reported mean symptom duration of less than 3 months, one used non-steroidal anti-inflammatory medication, one used cortisone injections). In seven studies only the abstracts had been published leaving 50 eligible articles (Figure 1). A meta-analysis could not be performed due to the extensive heterogeneity in methodology, follow-up and outcome measures used. As a result, an in-depth narrative review was conducted.

Population characteristics

The gender distribution of 45 studies (not reported by 5 studies) was 67% females and 33% males with a mean age (reported in 41 studies) of 46.9 years, a range of 20 – 81 and mean symptom duration of 16.0 months (reported in 26). This is similar to a recent meta-analysis of ESWT for PF with a 65% : 35% female to male ratio, mean age of 50.7 years and mean duration of 16.2 months based on 9 studies and 935 patients [25].

The 50 studies were conducted in 19 countries (USA n=17, Australia n=5, India n=5, Brazil n=4, United Kingdom n=3, Hong Kong n=2, Thailand n=2 and n=1 for China, Canada, Denmark, Greece, Israel, Pakistan, Qatar, Saudi Arabia, Sweden, Taiwan and Turkey with a multi-national study in New Zealand and USA). Racial differences in foot morphology have been demonstrated [26] potentially affecting the ability to generalise these results to a specific population group.

Clinical diagnosis and investigations

To the authors' knowledge, no clinical tests have been investigated for accuracy in diagnosing PF so the reliability and validity of the tests used within the studies are not known. Only 8 studies employed imaging to support the diagnosis, 7 used ultrasound [27-33] and one study used either ultrasound or MRI [34].

Critical appraisal

Findings of the critical appraisal are presented in table 3. Whilst only the highest level of evidence, namely RCTs, were chosen for this review widespread methodological limitations were seen. Only studies considered high quality (PEDro ≥8/10) or medium-quality (PEDro 5-7/10) were included in the final analysis however all studies were included in table 3 for completeness. Sample sizes of studies were frequently small with a range of 15 to 200 patients and a mean sample size of 59 patients. The internal validity as assessed by the PEDro score showed substantial variability ranging from 2/10 to 10/10 with a mean of 6/10. Only 15 of the 50 studies achieved a high PEDro score (≥8/10) and a further 24 achieved a medium PEDro score (5-7/10).

Treatments

The review identified 50 RCTs that tested the efficacy of conservative treatments for PF. Seven categories of treatments were identified; exercise (n=7), manual treatment, (n=10), electrotherapy (n=9), tape (n=6), orthotics (n=8), night splints (n=7), and acupuncture (n=3).

| Kummerde et al. 2012 | acupuncture | Thailand | 53, NR, NR | 24 / 24 | NR | NR | 6 / NR | clinically | VAS | FFI | Conventional vs. conventional and electro acupuncture | Electro acupuncture better | 1 ½ | 6 |
|--------------------|-------------|----------|------------|----------|-----|-----|--------|-----------|-----|-----|---------------------------------|-------------------------------|-----|-----|
| Zhang 2011         | acupuncture | Hong Kong| 48, NR, NR | 53 / 53 | 14 / 39 | NR | Mar-34 | clinically | Pressure pain | Acupuncture vs. control acupuncture | Acupuncture better at 1 & 6 month | 1 | 3 | 8 |

Outcome Measures: AHR – Ankle Hind foot Rating Scale, DF ROM – dorsiflexion range of movement, FAAM – Foot and Ankle Ability Measure, FAOS – Foot and Ankle Outcome Score, FFI – Foot Function Index, FHS – Foot Health Status Questionnaire, FSP – First Step Pain, HPL – Heel pain Leisure, LEFS – Lower Extremity Functional Scale, McGill – McGill Medintack pain questionnaire, MCSS – Mayo Clinical Scoring System, MFOPS – Manchester foot pain & disability Schedule, MFS – Maryland Foot Score, NRS – Numerical Rating Scale, P&DFQ – Pain and Dysfunction Questionnaire, PPFS – Plantar fasciopathy pain / Disability Scale score, PPT – Pressure Pain Threshold, PSFS – Patient Specific Functional Scale, PSI – Pain Scale Least, PWS – Pain Scale Worst, SF-36 – Medical Outcomes Study Short Form-36, VAS – Visual Analogue Scale

F/u – follow-up, LLLT – low light laser therapy, Mobs – mobilisations, MRI – Magnetic resonance imaging, NR – not reported, NSAIDs – Non-Steroidal Anti-Inflammatory Drugs, Rx – Treatment, U/S – ultrasound

Table 4. Criteria for strength of evidence (RCTs – randomised controlled trials, CCTs – case-control trials)

| Level of evidence | Criteria |
|--------------------|----------|
| Strong             | Consistent findings among multiple high-quality RCTs |
| Moderate           | Consistent findings among multiple low-quality RCTs and/or CCTs and/or one high-quality RCT |
| Limited            | One low-quality RCT and/or CCT |
| Conflicting        | Inconsistent findings among multiple trials (RCTs and/or CCTs) |
| No evidence        | No RCTs or CCTs |
Records identified through database searching (n = 1941)

Records after duplicates removed (n = 1102)

Records screened against title and abstract (n = 1102)

Full-text articles assessed for eligibility (n = 68)

Studies included in final review (n = 50)

Records excluded (n = 1034)

Figure 1. Flow chart showing the search results

Exercise (n = 7)

Seven studies investigated exercise therapy; five were medium or high quality. Five reviewed the efficacy of stretching [35–39] and two reviewed strengthening [30, 40]. Two studies found short term benefits of exercise, DiGiovanni, et al. [35] found a plantar fascia specific stretch to be more effective than a calf stretch after eight weeks treatment and Rathleff, et al. [30] found strengthening (weighted heel raises with maximum metatarsal phalangeal joint dorsiflexion) superior to stretching at 12 weeks. Kamonseki, et al. [40] found no benefit of adding either foot or foot and hip strengthening to stretching. Whilst a within-group benefit was demonstrated with exercise, no one exercise found to be superior to another beyond 3 months.

When evidence was combined based on the criteria proposed by van Tulder, et al. (table 4) stretching was not useful in either the short term defined as ≤6 months (strong evidence) or the mid-term defined as >6 months (moderate evidence). Strengthening was not useful in the short or long term defined as ≥6 months (moderate and limited evidence respectively) with conflicting evidence in the mid-term.

Manual therapy (n = 10)

Ten studies investigated the efficacy of manual therapy techniques including joint mobilisations, soft tissue mobilisation or a combination of both [41–50]. Different manual therapy techniques were investigated in each study and inconsistencies in results were demonstrated. Joint mobilisations were investigated in two studies [41, 48] with neither finding benefit at 2 months. Soft tissue therapy was investigated in six studies finding no benefit of positional release or counterstrain techniques [42, 45] however benefit was shown with local frictions at 10 days [50], myofascial release at 10 days and 3 months [43, 47] and trigger point therapy at 1 month [46]. A combination of soft tissue and joint techniques were supported by both investigating studies. Joint mobilisations to the foot with soft tissue mobilisations to the foot and calf were beneficial at 3 and 6 weeks [49]. Soft tissue and rear-foot joint mobilisations combined, as required, with mobilisations to the hip, knee and ankle joints were beneficial at 4 weeks and 6 months [44].

When evidence was combined joint mobilisations have limited support in the short term with moderate evidence of no effect in the mid-term. Soft tissue mobilisations were useful in the short term (moderate evidence) and mid-term (limited evidence). A combination of joint and soft tissue techniques were beneficial during the short, mid and long-term (moderate evidence).

Electrotherapy (n = 9)

Nine articles investigated five different forms of electrotherapy including Low Light Laser Therapy (LLLT), Pulsed Radiofrequency Electromagnetic Field Therapy (PRFE), Low Frequency Electrical Stimulation (LFES), ultrasound and iontophoresis. LLLT was investigated in four studies with conflicting results [51, 28, 32, 52]. A PRFE device worn for 7 days was significantly better than a placebo at day 7 [53]. LFES was superior at 4 weeks however at 3 months there was no benefit over a placebo [54]. Ultrasound was of no benefit at 1 month [55]. Comparing iontophoresis with three different chemicals (acetic acid, dexamethasone or placebo) found acetic acid significantly more effective for pain relief and stiffness at 2 weeks [27]. Iontophoresis was significantly better than placebo iontophoresis at 2 weeks but not at 6 weeks [56].

When evidence was combined LLLT was not effective in the short term (strong evidence) however was effective in the mid-term (strong evidence). PRFE was effective in the short term only (moderate evidence), there was conflicting evidence for iontophoresis in the short-term and not effective in mid-term (limited evidence).

Tape (n = 5)

Five studies investigated the efficacy of tape [57–59, 29, 31]. All studies found a significant improvement at a one week follow up, however the tape was applied differently in each study. Non-stretch tape applied to either the longitudinal arch or calcaneus was better than sham [57, 58]. Non-stretch tape was more effective when applied to the longitudinal arch than the calcaneus [59]. Kinesio-tape on the calf and plantar surface was more effective than electrotherapy [29] and when applied to the plantar surface was more effective than intrinsic foot exercises [31].

Tape vs orthotics (n = 1)

Non-stretch tape was compared to a pre-fabricated (pre-fab) orthotics for 3 weeks with the orthotic more effective [60]. The location of taping was not described.

When evidence was combined tape was effective in the short term (strong evidence) regardless of how applied. There was also limited evidence that an orthotic was more effective than tape in the short-term.
Orthotics (n=8)

Comparing shoe type, one study found both rocker shoes and normal shoes better than barefoot with a rocker better than normal shoes with immediate re-testing only [61], a second study found no difference between a normal running shoe and an ultra-flexible shoe [62].

Studies comparing pre-fabricated (pre-fab) and custom insoles found conflicting results. No difference in any outcomes were found at 2, 3 and 12 months [63,64]. In contrast a pre-fab was better than a custom insole at 2 months [65]; Oliveira, et al. and Wrobel, et al. found a custom insole increased activity only at 3 and 6 months respectively with no effect on pain [66,63]. On immediate re-testing only a custom insole was better than a flat insole [61].

Studies investigating a “true” insole (either a custom or pre-fab) against a sham insole, found a true insole better at 3 months with no difference at 12 months [63] and a magnetised insole was no better than a placebo insole [67].

When evidence was combined shoe type was effective in the short-term only (limited evidence). Comparing a custom and pre-fab insole there was conflicting evidence in the short term, no difference in the mid-term (strong evidence) or long term (moderate evidence). A “true” orthotic was more effective in the mid-term (moderate evidence) with no difference in the long term (moderate evidence).

Night splints (n=7)

Night splints were investigated in seven studies with conflicting results. No difference was found at 12 weeks between custom orthoses, night splints and a combination of both [68]. Similarly, no difference was detected between custom orthoses, prefabricated orthoses and night splints at 12 weeks [69]. No benefit was found by adding a night splint to calf stretches and NSAIDs at 4, 8 and 12 weeks [70]. No benefit was found by adding a night splint either to an exercise programme [34] or to an orthotic [71]. In contrast, 1 month of night splint use led to a significant improvement that was maintained at 6 months [72]. Also, night splinting gave a significant improvement when added to ibuprofen, calf stretches and a heel cushion at 12 weeks [73]. The quality of studies in this group was the lowest with a mean PEDro of 4/10 and only 3 studies of medium or high quality.

When evidence was combined night splints were ineffective in both the short term (limited evidence) and mid-term (moderate evidence)

Acupuncture (n=3)

Three studies investigated acupuncture [74], electro-acupuncture [75] or dry needling [76]. All demonstrated positive results although all had a relatively short follow-up period, 6 weeks of dry needling to myofascial trigger points was significantly more effective than sham dry needling at 6 and 12 weeks [76]. A specific acupuncture point (PC 7) was more effective than a control point (LI 4) at both 1- and 6-month follow-up [74]. A 5-week multimodal approach (analgesics, shoe modification, stretches to calf and plantar fascia) was compared to the same approach and twice weekly electro-acupuncture. After 6 weeks the electro-acupuncture group were significantly better [75]. The acupuncture group had the highest methodological quality with a mean PEDro of 7/10.

When evidence was combined acupuncture was effective in the short term (moderate evidence), mid-term (strong evidence) and long term (moderate evidence).

Discussion

The aim of this review was to determine the efficacy of conservative modalities considered by author consensus to be within the normal scope of practice for Physiotherapists and Podiatrists treating plantar fasciopathy, termed conventional treatment. This review included only RCTs with their internal validity assessed against the PEDro tool. A range of treatments are currently used reflecting either the difficulty in treating this condition, the poor efficacy of current treatments, or a lack of understanding of this pathology.

ESWT has become more common as an intervention for plantar fasciopathy and tendinopathies. Despite the increase in use, ESWT is still not widely available due to the high equipment cost and additional training required to deliver this modality. A literature search of ESWT for PF identified four recent meta-analyses of RCTs [77-80]. Due to these recent high-level reviews and its use as a second line modality (after initial conservative treatment has failed) ESWT was not included in this review by author consensus.

The studies included in this review highlight a lack of high-quality research in conventional modalities for this pathology. Only 15 of the 50 included studies were deemed of high quality (PEDro ≥8/10). A common limitation of the studies was a short follow-up period with only 3 studies following their patients for one year or longer and two studies only investigating an immediate effect of treatment. No data were provided in any study on symptom recurrence.

This review demonstrated inconsistencies in the ability of conventional treatments to reduce pain and function with no single treatment being found to be superior at all time points. No adverse outcomes were reported for stretching or strengthening programs. In contrast, long-term use of orthotics was found to reduce intrinsic plantar muscle strength [81] which has been linked to PF [10,11].

Only one study reported their patient group included a sporting population [68]. No study exclusively examined the athletic population, so this group is under-represented both in this review and the current literature. Differences in the rate, repetition and duration of plantar fascia loading are expected between, for example, high-mileage runners and sedentary groups. As such the findings of this review should be applied to this group with caution.

No study has investigated the accuracy (reliability and validity) of clinical diagnostic tests for PF. It was therefore surprising to find that only 8 of the 50 studies employed radiological imaging to support their clinical diagnosis (US n=7, US or MRI n=1). Findings by McMillan, et al. [82] demonstrated a fascial thickening greater than 4mm and hypoechoic areas detected on US were 100 and 200 times respectively more likely to confirm the presence of PF. A number of differential diagnoses for PF exist including Baxter’s nerve compression, tarsal tunnel syndrome, calcaneal stress fracture and plantar fascia rupture [83,84] with 15% of plantar heel pain suggested to be neural in origin [85]. It is therefore possible that in the trials that did not use radiological investigations patients may have been included who did not have PF. The validity of these studies is therefore questionable, and this should be considered in any interpretation.

A meta-analysis of included studies was not possible as 22 different outcome measures were used. The most common outcome measures were versions of the Visual Analogue Scale / Numerical Rating Scale (n=7). The substantial variation in outcome measures as well as the lack of validated instruments for assessing the efficiency of treatments for PF makes this an area of priority for future research.
Efficacy of individual treatments is difficult to conclude as only 14 studies assessed interventions against a placebo and 16 against a control intervention. The remaining 20 studies compared two or more interventions. When interventions are compared without a control, between-group and within-group differences are difficult to interpret. For example, Rathleff, et al. [30] compared stretching to strengthening with no between group difference at 1-year follow-up however both groups showed a within group difference. Either this may represent the natural course of PF or that both treatments were equally effective.

Moderate or strong evidence from medium and high quality RCTs (PEDro ≥5) were collated. Supported modalities in the short-term (up to 1 month) were manual therapy, PRFE, tape and acupuncture. In the mid-term (less than 6 months) the most evidence was for LLLT, an orthotic and tape. In the long-term (≥6 months) there was no strong evidence for any modality in the short-term (<6 months) and there was no strong evidence for any modality in the long-term (≥6 months). Based on strong evidence only, a very limited number of modalities were supported. In the short term only tape was supported, in mid-term LLLT and acupuncture were supported, no modalities were supported in the long term based on strong evidence alone.

Interestingly, a survey of 457 UK Physiotherapists’ and Podiatrists’ perception of the most effective treatment for PF does not correlate with the findings of this review [86]. Both professions advocated calf stretches, Podiatrists advocated custom orthotics, arch support orthotics and night splints, while Physiotherapists advocated electrotherapy (specifically ultrasound), manual therapy and acupuncture.

Limitations

This systematic review was limited by the inability to perform a meta-analysis as 22 different outcome measures were used. Only RCTs were included in the review to enhance the validity of conclusion however robust cohort studies may have added to the evidence base available to review.

Conclusion

This review has highlighted no major safety concerns of the conventional treatments for plantar fasciopathy. The research is generally of low to medium quality with poor sample sizes and short follow-up making definitive conclusions difficult to formulate. Based on strong evidence alone tape was supported in the short term (≤1 month), low light laser therapy (LLLT) and acupuncture were supported in the mid-term (<6 months) and there was no strong evidence for any modality in the long term (≥6 months). Further well-designed multi-centre RCTs that include accurate clinical diagnostic criteria as well as valid and reliable outcome measures are required to help guide therapists to the optimal conservative treatments for this condition.

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