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Manual therapy for plantar heel pain

Review

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Highlights

- Soft tissue restrictions may be a part of etiology oms of plantar heel pain.
- Soft tissue mobilizations is an effective modality for treating plantar heel pain.
- Outcomes relating to joint mobilizations are controversial.
- Further studies are needed to evaluate the effect of soft tissue mobilizations

ABSTRACT

Background: Manual therapy employed in the treatment of plantar heel pain includes joint or soft tissue mobilizations. Efficacy of these methods is still under debate.

Aims: To determine whether manual therapy, consisting of deep massage, myofascial release or joint mobilization is effective in treating plantar heel pain.

Methods: A critical review of all available studies with an emphasis on randomized controlled trials (RCTs) was performed. PubMed, PEDro, and Google Scholar databases were searched for keywords relating to plantar heel pain, joint, and soft tissue mobilizations. There were no search limitations or language restrictions. The reference lists of all retrieved articles were searched. The PEDro score was used to assess the quality of the reviewed papers.

Results: A total of six relevant RCTs were found: two examined the effectiveness of joint mobilization on plantar heel pain and four the effectiveness of soft tissue techniques. Five studies showed a positive short-term effect after manual therapy treatment, mostly soft tissue mobilizations, with or without stretching exercises for patients with plantar heel pain, compared to other treatments. One study observed that adding joint mobilization to the treatment of plantar heel pain was not effective. The quality of all studies was moderate to high.

Conclusions: According to reviewed moderate and high-quality RCTs, soft tissue mobilization is an effective modality for treating plantar heel pain. Outcomes of joint mobilizations are controversial. Further studies are needed to evaluate the short and long-term effect of different soft tissue mobilization techniques.

*Keywords***:** Joint mobilizations; manual therapy; plantar heel pain; soft tissue mobilizations; treatment.

1. Background

Plantar fasciitis or plantar heel pain affects approximately 10% of the general population over a lifetime [1]. It has been reported that plantar heel pain encompasses 8%-15% of foot complaints [1, 2], without gender-specific tendency [3] and has a negative impact on foot-specific and general health-related quality of life presenting distinct patterns of disability on different functional domains [2]. To date, there is evidence that this condition may not be characterized by inflammation but rather by non-inflammatory degenerative changes in the plantar fascia [2], therefore, it is acceptable to refer to this disorder as plantar fasciosis [3, 4]. Plantar heel pain is associated with a disorder of the insertion site of the plantar fascia distinguished by microscopic tears, collagen tissue breaking, and scarring. Patients with plantar heel pain usually report an insidious sharp pain at the bottom of the heel and along the medial border of the plantar fascia to its insertion at the medial tuberosity of the

calcaneus [2, 5]. The pain is worse in the morning when taking the first steps after getting out of bed; following prolonged periods of inactivity (e.g., sitting, lying) or at the beginning of a workout [2]. The pain typically lessens with increasing activity (e.g., walking, running) but tends to worsen again towards the end of the day [2]. The condition usually develops gradually, with approximately one-third of patients affected in both legs [5, 6].

Most cases of plantar heel pain resolve with time and conservative methods of treatment [5]. As a rule, for the first few weeks, people are advised to rest, tone down their activities, use analgesics and perform stretching exercises. Interventions such as iontophoresis, ultrasound, mobilization/manipulation [7], taping [8] and therapeutic exercises are utilized by physical therapists. In addition, extracorporeal shockwave therapy, orthotics, splinting, or steroid injections may be considered. If no improvement is achieved, surgery may be considered as well [4, 5]. ; However, the available evidence indicates only short-term effects, with almost no differences between these types of interventions following three months [7, 9]. Only weak evidence supports the use of manual therapy interventions and therapeutic exercises in patients with plantar heel pain [7, 9].

Simons et al [10] suggested that myofascial restrictions or trigger points (TrPs) in the gastrocnemii muscles may be involved in the development of plantar heel pain. TrPs are defined as hyperirritable areas within a restricted myofascial tissue that are painful when compressed, contracted or stretched and eliciting referred pain distant to the TrP. Chen et al [11] found that muscle stiffness at the site of a TrP was 50% greater than that of the surrounding muscle tissues. It is likely that the increased stiffness generated by the TrPs, may interfere with the extensibility of the muscles or fascia.

Manual therapy employed in the treatment of plantar heel pain includes joint mobilization or soft tissue mobilization (deep tissue massage or myofascial release (MFR)). Joint mobilization is used for increasing the range of motion, pain modulation and the reduction of soft tissue swelling, inflammation, and restriction [12]. MFR is a soft tissue mobilization technique where a low load and long duration stretch force is applied to the myofascial complex intended to restore optimal length, decrease pain and improve function [1].

The aim of this critical review [13] was to assess all availible evidence on the effectiveness of manual therapy (myofascial release, deep massage, and joint mobilization) on pain, function, and quality of life in patients with plantar heel pain.

2. Methods

PubMed, Google Scholar, Scopus, and PEDro databases were searched from inception until November 2016, using a predefined strategy and keywords such as "plantar fasciitis", "plantar heel pain", "massage", "stretching exercise", "stretching gastrocnemius", "myofascial release therapy", "soft tissue manipulation", "soft tissue mobilization", "myofascial pain", "deep friction massage", "myofascial trigger point", "joint mobilization". The search was run by two reviewers independently. Disagreements were resolved by discussion between the two authors. The search results were pooled and duplicates removed. The titles and abstracts of all articles were reviewed. Full texts of potentially relevant papers were read and their reference lists searched for additional relevant articles. There were no search limitations or language restrictions. Clinical trials of any design or methodological quality dealing with the treatment of plantar heel pain by any type of manual therapy (joints or soft tissue mobilizations) were included.

The methodological quality of interventional studies is evaluated inter alia by the PEDro score (http://www.pedro.org.au/). We used the scores found in PEDro website. The PEDro scale considers two aspects of trial quality, namely the “internal validity” of the trial and whether the trial contains sufficient statistical information, thus making it interpretable. It does not rate the “external validity” of the trial or the size of treatment effect.

3. Results

Six randomized controlled trials (RCTs) examined the effect of manual therapy including soft tissue and joint mobilization on plantar heel pain. Two studies used three outcome measures while all others used only two, mostly related to functional status and pain level. Other outcomes were quality of life questionnaires and Pressure Pain Threshold (PPT). All outcomes are valid and appropriate for assessment of heel pain. The results are shown in Tables 1 and 2, respectively.

Saban et al [14] assessed the effect of a deep massage to posterior calf muscles in combination with neural mobilization exercises. Deep massage consisted of 10 minutes of forceful soft tissue mobilizations directed at the incompliant and painful areas of the posterior calf muscle group. The technique was applied across the muscle fibers, both medially and laterally, with a sufficient sweep and depth pressure, until a pain response was obtained. To increase the mobility of neural structures, patients were instructed to perform a passive straight leg raise combined with dorsiflexion identical to calf stretches, using a long belt [15]. The control group received ultrasound therapy. The outcome measures used were the Foot &

Ankle Computerized Adaptive Test to evaluate the functional status and a 10cm Visual Analog Scale (VAS) to assess pain felt on taking the first steps in the morning. Changes in the functional status score in both groups over time were statistically significant, however, the deep massage group improved significantly greater than the ultrasound group. Decrease in pain level was significant for all participants ($p<0.001$ for both groups), with no differences between groups ($p=0.921$). The study's level of evidence was 2b, with a PEDro quality score of 7/10. Limitations were a short follow-up, and variability of intervention in each group, that not allow assessing the contribution of the deep massage technique.

Renan-Ordine et al's RCT [2] investigated the effects of TrP manual therapy on plantar heel pain. The control group received a self-stretching exercise protocol while the intervention group received the same exercise protocol and a TrP pressure release technique for both gastrocnemii muscles. Pressure was applied over TrPs until the clinician felt an increase in muscle resistance (tissue barrier) and was successively maintained until the release of the taut band was achieved. At this stage, the pressure was increased in order to return to the previous level of muscle TrP tension. The procedure was then repeated for 90 seconds (usually three repetitions). In addition, deep longitudinal strokes over the gastrocnemius muscle were performed. All participants attended a physical therapy clinic, four days a week, for four weeks. The primary outcomes were physical function and bodily pain domains scored by the SF-36 questionnaire. The secondary outcome measure, Pressure Pain Threshold (PPT) was assessed at three predetermined locations on the affected leg: gastrocnemius and soleus muscles and over the posterior aspect of the calcaneus. Patients receiving a combination of self-stretching and TrP manual therapy, experienced a greater improvement in physical function ($p<0.01$) and PPT ($p<0.03$) and a greater reduction in pain ($p<0.01$) compared to those who had only received the self-stretching protocol. The quality of the study was moderate (PEDro quality score of 5/10). Limitations of the study included short follow-up period and lack of specific functional outcome measure.

Ajimsha et al [1] used MFR for gastrocnemius, soleus, and plantar myofascial structures to treat plantar heel pain and compared it to the sham ultrasound. The interventions were performed on the affected side for 30 min. three times a week for four weeks, with a minimum of a 1-day gap between sessions. Outcome measures were: The Foot Function Index and PPT evaluated pre-intervention at week 1, post-intervention at week 4 and follow-up at week 12. Patients in the MFR group demonstrated a significantly greater reduction in pain and functional disability as shown in the Foot Function Index score in weeks 4 and 12 compared to controls. The proportion of patients responding to treatment (defined as ≥50%

reduction in pain and functional disability between weeks 1 and 4) was 100% in the MFR group and 0% in the control group. Patients in the MFR group demonstrated a greater improvement in PPT compared to the control group ($p<0.01$). The quality of the study was moderate (PEDro quality score of 6/10). The long follow-up period (12 weeks) is a strong point of this study.

A high quality (PEDro quality score of 8/10) multicenter RCT conducted by Cleland et al [9], compared manual therapy and exercise (MTEX) to electrophysical agents and exercise (EPAX) [9]. Manual therapy included five minutes of aggressive soft tissue mobilization directed at the triceps surae and insertion of the plantar fascia at the medial calcaneal tubercle and rear foot eversion mobilization. In addition, the MTEX intervention included an impairment-based manual therapy directed at the hip, knee, ankle, and foot, based on the clinical decision of the treating therapists. Patients in the EPAX group received therapeutic ultrasound (3 MHz, 1.5 W/cm2, 100-Hz frequency, 20% duty cycle) for five minutes followed by iontophoresis with dexamethasone (40 min). All patients were also instructed to perform stretching exercises directed at the soleus and gastrocnemius muscles and the plantar fascia three times a day, in addition to strengthening exercises for the intrinsic muscles of the foot. At the completion of each treatment session, ice was applied to the plantar fascia for 15 minutes. Patients in both groups received six treatments over a period of four weeks. Outcome measures were collected at baseline, 4-weeks and a 6-month follow-up. The primary outcome measure was the perceived level of disability measured by the Lower Extremity Functional Scale (LEFS) at the 6-month follow-up. Additional outcomes were the Foot and Ankle Ability Measures (FAAM) and the Numeric Pain Rating Scale (NPRS). At the end of the 4-week and 6-month time period, the patients were asked to fill out a 15-point global rating of change questionnaire in order to rate their own perception of improved function. The overall group-by-time interaction in the mixed-model ANOVA showed significantly better results in the MTEX group in the LEFS ($p=0.002$), FAAM ($p=0.005$), and NPRS ($p=0.043$). The MTEX group improved significantly more than the EPAX group in both the 4-week and 6-month follow-up periods in the LEFS and. The NPRS improved significantly greater in the MTEX compared to the EPAX group at the 4-week follow-up, however, these differences were no longer significant at the 6-month follow-up. Furthermore, patients in the MTEX group demonstrated significantly ($p<0.05$) higher scores on the global rating of change questionnaire at both the 4-week and 6-month follow-up periods (mean difference between groups was 1.7 [95% CI: 0.4, 3.0] and 1.4 [95% CI: 0.3, 2.5],

respectively). The strengths of this study were the use of three outcome measures and the long follow-up period.

Celic et al [16] evaluated the effectiveness of joint mobilization when combined with stretching exercises compared to a steroid injection in the treatment of plantar heel pain. The intervention group received subtalar traction, a talocrural dorsal (posterior) glide, a subtalar lateral glide and a first tarsometatarsal joint dorsal glide. For the control group, a medial injection approach was used, usually applied at the point of maximal tenderness upon palpation. The outcome measures, FAAM and VAS, were both evaluated at baseline, at 3, 6, and 12 weeks and at a 1-year follow-up. The pairwise repeated measurement comparisons demonstrated significant improvement in pain and functional outcomes in both groups ($p<0.05$) at the 3, 6 and 12-week follow-up compared to baseline. However, improvement at 12-week and 1-year follow-up period were only significant in the joint mobilization and stretching group ($p=0.002$). The overall group-by-time interaction was statistically significant based on both the FAAM and VAS scores. The between-group differences favored the steroid injection group for pain and functional outcomes at the 3, 6 and 12week follow-up; however, no significant differences were found in these outcomes at the 1-year follow-up. The PEDro quality score was 7/10. The long follow-up period (1 year) is a strong point of the study, but the combination of joint mobilization with stretching exercises not allow to assess the effect of joint mobilizations, as a standalone treatment. Shashua et al's RCT [17] examined the efficacy of ankle and midfoot mobilization on pain and function of patients with plantar heel pain (PEDro quality score was 8/10). Fifty patients with plantar heel pain, aged 23 to 73, were randomly assigned to either the intervention or control group. Both groups received eight treatments, twice a week, consisting of stretching exercises and ultrasound. In addition, the intervention group received ankle and midfoot joint mobilization. The dorsiflexion range of motion was measured at the beginning and at the end of treatment. The results were evaluated by three outcomes: NPRS, LEFS, and algometry. No significant difference was found between groups in any of the outcomes. Within a group comparison, both groups showed a significant difference in the NPRS and LEFS, as well as in the dorsiflexion range of motion. The strength of this study was the use of three outcome measures, and a limitation was the short follow-up period.

4. Discussion

Herein, we present a review of clinical trials critically analyzing the effects of manual therapy on plantar heel pain. The 6 included RCTs were of moderate to high methodological

quality and grouped according to soft tissue or joint mobilizations. All studies used at least two outcome measures, mostly related to functional status and reported pain level. Authors reporting on soft tissue mobilization, with or without stretching exercises [1, 2, 9, 14] or joint mobilization with stretching exercises [16] concluded that manual therapy might be more effective than other treatments or sham treatments for plantar heel pain. One high-quality study [17] did not find any advantage of adding joint mobilization when treating heel pain.

The variability of treatment methods in the reviewed studies makes it difficult to compare the efficacy of each method. For example, Saban et al [14] found that deep massage to posterior calf muscles in combination with neural mobilization exercises is more effective than therapeutic ultrasound. Cleland et al [7] concluded that aggressive soft tissue mobilization, rear foot joint mobilization and exercise were superior to electrophysical agents and exercise in the management of heel pain. Due to the many techniques and joints involved, it could not be determined which technique was superior and which joint was the most relevant.

Ajimsha et al in a systematic review on MFR therapy in treating soft tissue injury [18] found great heterogeneity in research quality, outcome measures, and results. Most recent studies indicate an advantage of MFR over other treatments in treating soft tissue limitation. In many RCTs, MFR was adjunctive to other treatments, and effect of MFR as a single treatment, cannot be determined.

According to our findings, there is consistent evidence as to the efficacy of soft tissue techniques whereas an inconsistency exists as to the efficacy of joint mobilizations in the treatment of plantar heel pain. It seems that shortening of the muscles and fascia are involved in the pathology rather than the limited ankle joint range of motion.

The limitation of our review is the small number of published studies and the heterogeneity of treatment techniques in each of them, thus making it difficult to draw a definitive conclusion as to the effectiveness of manual therapy in patients with plantar heel pain.

5. Conclusion

According to moderate and high-quality RCTs, soft tissue mobilizations appeares to be an effective modality in the treatment of plantar heel pain. Further studies are needed to evaluate the short and long-term effect of different techniques of soft tissue mobilization, as well as a combination of soft tissue mobilizations and other treatment modalities. Outcomes on joint mobilizations are controversial and additional studies are required to evaluate the

efficacy of this technique. Since plantar heel pain is attributed to soft tissue limitations, we feel that treatment should focus on soft tissue rather than joint mobilizations.

Author's contribution

Yosefa Pollack: acquisition of data, drafting the article

Anat Shashua: analysis and interpretation of data, revising the article critically for important intellectual content

Leonid Kalichman: conception and design of the study, analysis and interpretation of data, revising the article critically for important intellectual content

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Brief summary

What is already known:

- Plantar heel pain affects about 10% of the general population over a lifespan.
- Soft tissue restrictions and myofascial trigger points may be a part of etiology or contribute to symptoms of plantar heel pain.
- Manual therapy is widely used in plantar heel pain management, but its effectiveness is still under debate.

What this study adds:

- Six RCTs examined the effectiveness of manual therapy for plantar heel pain treatment, four studied soft tissue mobilizations and two joint mobilizations.
- According to moderate and high-quality evidence, soft tissue mobilizations appears to be an effective modality for treating plantar heel pain.
- Outcomes relating to joint mobilizations are controversial. Additional studies are required to evaluate the efficacy of this technique.

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Table 1. Characteristics of the reviewed RCTs

Study	N (int./cont.)	Age (years)	Sex (females)	Pain duration (months)	Type of treatment		# of procedures (duration)
					Controls	Intervention	
Saban et al [13]	36/33	13±53	57%	5±5 int. 6±5 cont.	US, stretching exercise	Deep massage therapy to posterior calf muscle group, neural mobilization	8 (10 min.)
Renan-Ordine et al [2]	30/30	11±44 int. 10±45 cont.	73% int. 76% cont.	0.9±4.8 int. 1.0±4.6 cont.	Self-stretching	Soft tissue trigger point therapy + stretching	16 (3 x 90 sec.)
Ajimsha et al [1]	34/32	4.6±42.4 int. 7.1±40.8 cont.	76%	0.6±4.0 int. 0.5±4.1 cont.	Sham US on gastrocnemius-soleus, plantar fascia	Myofascial release for gastrocnemius, soleus, plantar fascia	12 (30 min.)
Cleland et al [9]	30/30	8±49.5 int. 9±47.4cont.	67% int. 73% cont.	8.5±6.3 int. 8.9±7.9 cont.	US iontophoresis, stretching exercise, ice	Aggressive soft tissue mobilization directed at the triceps surae and the insertion of the plantar fascia, eversion mobilization	4 (5 min.)
Celik et al [16]	22/21	9.3±45.4 int.7.9±45.6 cont.	64% int. 67% cont.	3.2±11.2 int. 2.6±13.1 cont.	One steroid injection	Joint mobilizations: subtalar traction, talocrural posterior glide, subtalar lateral glide, 1st tarso metatarsal joint dorsal glide. Gastrocnemius stretching, Plantar fascia-specific stretching.	9

Shashua et al [17]	25/25	54.2±13.0 int. 48.5±11.7 cont.	68% int. 72% cont.	5.28±4.54 int. 6.54±5.69 cont.	Stretching exercise and US over the most tender area	Stretching exercise, US over the most tender area and mobilization of the ankle and midfoot joints	8 (5 min.)

Int. - intervention; Cont. - controls, US - therapeutic ultrasound,

Table 2 Studied variables and findings

Study	Outcomes	Findings		Between-group comparison (p-value)	PEDro score
		Intervention	Control		
Saban et al [14]	Functional Status	Mean change of 15 point (CI 95% 9-21, p<0.001)	Mean change of 6 point (CI 95% 1-11, p=0.025)	P=0.034	7/10
	First morning pain (VAS)	Mean change of -2.4 (CI 95% 1.4-3.4, p<0.001)	Mean change of -2.5 (CI 95% 1.4-3.8, p<0.001)	NS	
Renan-Ordine et al [2]	SF-36 questionnaire:	Within group changes	Within group changes		5/10
	-Physical Function	20.9	11.6	P<0.01	
	-bodily pain	20.8	13.0	P<0.01	
	-general health	6.2	0.8	P<0.05	
	-emotional role	31.0	11.1	P<0.05	
	-physical role	33.2	21.3	NS	
	-vitality	11.0	7.6	NS	
	-social function	15.6	10.8	NS	
	-mental health	6.7	9.0	NS	
	PPT:	Within group changes	Within group changes		
	-gastrocnemius	1.4	0.5	P<0.001	
	-soleus	1.1	0.3	P<0.001	
	-calcaneus	1.5	0.3	P<0.001	
Ajimsha et al [1]	Foot Function Index	Within group changes 72.4% -4week.	Within group changes 7.4%- 4 week	P<0.001	6/10

		60.6%-12 week	2.0%-12 week	P<0.001	
	PPT:	Within group changes	Within group changes		
	-gastrocnemius	0.8	0.1	P<0.001	
	-soleus	0.7	-0.1	P<0.001	
	-calcaneus	1.0	0.1	P<0.001	
Cleland et al [9]	LEFS	Between-group differences			8/10
		13.5 at 4 weeks		P<0.05	
		9.9 at 6 mounts			
	FAAM	13.3 at 4 weeks		P<0.05	
		13.6 at 6 mounts			
	NPRS	-1.5 at 4 weeks		P=0.008	
		-0.6 at 6 mounts		NS	
Celik et al [16]	FAAM	Baseline 55.2	45.5	P<0.05	7/10
		3 weeks 60.6	80.7	P=0.001	
		6 weeks 70.2	85.7	P=0.002	
		12 weeks 69.4	83.5	P=0.008	
		12 months 86.7	83.4	NS	
	VAS	Baseline 7.8	7.7	P<0.05	
		3 weeks 5.4	1.8	P=0.001	
		6 weeks 5.0	1.2	P=0.001	
		12 weeks 4.9	1.5	P=0.001	
		12 months 2.7	3.3	NS	

Shashua et al [17]		Mean difference between groups		8/10
	NPRS	0.09 (95% CI –1.14, 1.32)	NS	
	LEFS	5.89 (95% CI–3.69, 15.47)	NS	
	Algometry (Pa)	61.74 (95% CI –42.71, 166.18)	NS	
	Dorsiflexion	0.2 (95% CI –4.03, 4.43)	NS	

NS-non-significant, VAS-visual analog scale, PPT-pressure pain threshold, NPRS-numerical pain rating scale, FAAM- Foot and Ankle Ability Measures, LEFS- Lower Extremity Functional Scale, CI-confidence interval