International Journal of Physical Education, Sports and Health 2024; 11(2): 173-176

P-ISSN: 2394-1685
E-ISSN: 2394-1693
Impact Factor (RJIF): 5.38
IJPESH 2024; 11(2): 173-176

www.kheljournal.com
Received: 23-01-2024
Accepted: 27-02-2024

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Long term effect of different soft tissue manipulation technique on function and range of motion in chronic plantar fasciitis in traffic police

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Abstract
Background: Plantar fasciitis is a common foot disorder in which patients have pain and tenderness at the sole of the foot. Rest, exercises, orthotics, taping, cryotherapy, therapeutic ultrasound, electrical stimulation, whirlpool bath, and iontophoresis have been widely used to relieve plantar pain. Long term use of manual therapy techniques like myofascial release technique, positional release therapy and passive stretching have been used in the past to reduce pain and improve ankle range of motion.
Materials and Methods: A total of 45 participants with chronic plantar fasciitis with an age group of 30-45 years were randomly allocated to Group A (myofascial release group) and Group B (positional release group) and Group C (passive stretching). Iontophoresis with DC mode for 5 min was given for a single session to all the patients and then given the manual techniques. The intervention was given twice a week for 8 weeks and follow-up was done after 4 weeks. At the end 8 weeks and again after one month, the subjects were assessed by Range of motion of the ankle and foot function index scales were outcome measures that were assessed.
Results: The study demonstrated statistically significant improvement in ROM and foot functional ability, in all three groups ($p>0.05$). ROM and foot functional ability showed significant ($p>0.05$) improvement was more in Group A (MFR) as compared to Group B (PRT) and Group C (PS).
Conclusion: Myofascial release technique was effective in improving range of motion and function in unilateral chronic plantar fasciitis there by rejecting Null Hypothesis and accepting Alternate Hypothesis.

Keywords: Unilateral chronic plantar fasciitis, myofascial release, positional release therapy, passive stretching, therapeutic iontophoresis, range of motion and FFI

1. Introduction
The human ankle/foot complex meet the stability demands of providing a stable base of support for the body in a variety of weight bearing postures without undue muscular activities and energy expenditure, and acting as a 'rigid' lever for the mobility demands by dampening of rotations imposed by the more proximal joints of the lower limb, being flexible to absorb the shock of the super-imposed body weight as the foot hits the ground and allowing the foot to conform to the changing and varied terrain on which the foot is placed. Four of Cailliet's criteria for normal foot are absence of pain, normal muscle balance, central heel and straight and mobile-toes [1].

Plantar fascia called as plantar aponeurosis, lies superficial to the muscles of the plantar surface of the foot. It has thick central part which covers the central muscle of the 1st layer, Flexor digitorum-brevis and is immediately deep to the superficial fascia of the plantar surface. It acts as a truss, maintaining the medial longitudinal arch of the foot, and assists during the gait cycle and facilities shock absorption during weight bearing activites [2].

Foot complaints are common in general practice and their incidence increases with age. Three out of four people complains of foot pain during the course of a life time [3], while approximately 20% of people aged 65 years or older complains of non-traumatic foot problems [4]. Plantar fasciitis has been experienced by 10% of the population [5].

Different authors have described heel pain as Achilles spurs, retrocalcaneal bursitis, sub-calcaneal pain, posterior heel pain, plantar fasciitis etc. Heel pain commonly occurs in weight bearing due to inflammation of thick tissue at the sole.

Stress to plantar fascia may also result from injury, or a bruise incurred while walking, running, or jumping on hard surfaces; or being overweight [6].

It is more common in sports that involves running, long distance walking, and is also frequent in dances, tennis players, basket-ball players, long distance runners and non-athletes whose occupation requires prolonged weight bearing, nonathletic individuals who stand on hard unyielding surfaces [7]. Occupations that require prolonged standing [8].

There is a loss of flexibility as the disease progresses due to calcaneal tendon retraction, fatigue, fascia inextensibility, and poor mechanics [5]. Though etiology is unknown in approximately 85% of cases, plantar fasciitis can occur in association with various arthritides. In an athlete, plantar fasciitis appears to be associated with overuse, training errors, training on unyielding surfaces and improper or excessively worn foot wear. Sudden increase in weight bearing activity, particularly those involving running can cause micro-trauma to the plantar fascia. In elderly adults, plantar fasciitis is often attributable to poor intrinsic muscle strength and poor force attenuation secondary to acquired pes-planus and compounded by a decrease in the body's healing capacity [9].

Medical and surgical management for plantar include non-steroidal anti-inflammatory drugs, local cortisone injections, resection of the calcaneal spur or part of the plantar fascia near its origin, stripping off the soft tissue from the plantar surface of the calcaneus and excision of the medial inferior tubercle of the calcaneus. Other therapies include acupuncture, electron generating devices, insoles with magnetic foil, extracorporeal shock wave therapy [10].

Various physiotherapy treatment protocols have been advocated in the past such as rest, taping, orthotics, silicon heel cups, stretching, myofascial release and positional release therapy. Electrotherapy modalities like therapeutic ultrasound, phonophoresis, laser, microwave diathermy, iontophoresis, cryotherapy, contrast bath have been tried in past. Non-weight-bearing stretching exercises have shown too helpful in reducing severe pain which occurs in the morning [11].

Iontophoresis is a method of applying ion transfers which plays an important role in relieving plantar heel pain by both thermal and mechanical effect on target tissue resulting in increased local metabolism, circulation and extensibility of connective tissue and tissue regeneration. To obtain increase in the viscoelastic properties of collagen, an elevation in tissue temperature of greater than 3° to 4 °C is indicated [12].

Myofascial Release Technique (MFR), is a soft tissue manipulation technique, Myofascial release techniques stem from the foundation that fascia, a connective tissue found throughout the body, reorganizes itself in response to physical stress and thickness along the lines of tension. By Myofascial release, there is a change in the viscosity of the ground substance to a more fluid state which eliminates the fascia's excessive pressure on the pain sensitive structure and restores proper alignment. Hence, this technique is proposed to act as a catalyst in the resolution of the chronic plantar fasciitis [13].

Positional Release Technique (PRT), is an indirect myofascial technique focused on the neurologic component of the neuro-vascular myofascial somatic dysfunction. This technique is proposed to increase muscle flexibility by placing the muscle in a shortened position to promote muscle relaxation in contrast to placing in the muscle in lengthened or stretched position [14].

Stretching of the shortened and contracted plantar flexors may positively influence an individual's functional activities of daily living and decrease the risk of injury. Regardless of the type of fitness and rehabilitation program, the goal of stretching is to change the physical characteristics of connective tissue [15].

There are numerous studies on the effects of different soft tissue manipulation techniques in improving pain response, function and flexibility in subjects with chronic plantar fasciitis.

There is dearth of literature regarding long-term effect of different soft tissue manipulation techniques on function and range of motion in chronic plantar fasciitis, hence this study is carried out to find-out the long-term effects of different soft tissue manipulation technique (myofascial release, positional release, passive stretching).

2. Materials and Methods

The study was conducted at ESI hospital, Rajajinagar, Padmashree Physiotherapy Clinic, Nagarbhavi & Padmashree Diagnostics, Vijayanagar and Bangalore. Ethical clearance was obtained from institutional ethical committee, Florence college of Physiotherapy, Bangalore as per ethical guidelines for biomedical research on Human subjects, 2000 ICMR, New Delhi. The study design was a pre-post experimental study, 45 participants with age ranging 30-45 years, subjects diagnosed with chronic plantar fasciitis in Traffic Police by Orthopedician, Onset of duration greater than 3 months, Both male and female subjects & subjects with unilateral chronic plantar fasciitis were included. Subjects with clinical disorders where Iontophorosis was contraindicated such as infective conditions of foot, tumors and calcaneal fracture, Metal implants around ankle, Subjects with clinical disorders where myofascial release is contraindicated such as dermatitis, ankle ankylosis, congenital foot deformities, Cortisone injection in heel in past 3 months, Subjects with referred pain due to sciatica, Any neurological disorders were excluded.

The subjects who fulfill the inclusion and exclusion criteria were selected for the study and informed consent was taken from the subjects. Subjects were randomly assigned in to three groups. Demographic variables such as age, gender, BMI and etc., were documented. Participants were explained about the MFR, positional release therapy, passive stretching prior to the interventions that the subjects need to practice during the treatment.

Group A: Myofascial release group-Participants were placed in supine lying position with foot placed outside the plinth. Subjects underwent myofascial release manually by using thumb and plantar cupping by using heel of hand and fingers just proximal to metatarsal heads technique for 10 minutes for single session [16]. Duration of this session was given twice a week for 8 weeks and follow up was done after 4 weeks.

Group B: Positional release group-Subjects were given positional release technique in supine lying position. Mechanical pressure was given manually on the tender point with one fingertip in order to determine tenderness. Then the foot was positioned, into plantar flexion and gentle fine-tuned by rotation, until the score in the tender point was reduced to at least 70%. This position was held for 90 seconds following which slow release of pressure was applied and returned to neutral position; this was carried through-out the sessions.[16] Duration of this session was given twice a week for 8 weeks and follow up was done after 4 weeks and follow up was done after 4 weeks.

Group C: Passive stretching group-for stretching ankle plantar flexors, the subjects were placed in supine lying position. Firstly, the soleus muscle was stretched with knee flexed and then gastrocnemius muscle was stretched with knee extended. Over pressure was placed up on the bottom of the foot while the ankle was in dorsi-flexion. Passive plantar fascia stretching was performed in by application of force distal to the metatarsophalangeal joints on the affected side, pulling the toes upward towards the shin until a stretch was felt in the sole of the foot. These stretches were performed for three repetitions and each stretch was held for count of 30 sec for a single session [16]. Duration of this session was given twice a week for 8 weeks and follow up was done after 4 weeks.

Iontophoresis

The subject position was in long-sitting position. The surface was cleaned with 70% of alcohol to minimize the risk of burns. Glucosamine sulphate was placed on active electrode. The active electrode was placed on the plantar surface of the heel and inactive electrode was placed on plantar surface meta-tarsal head of the foot. Both electrodes were held in place by an adhesive strap then the stimulator was switched on, turned to DC mode and then the intensity was gradually increased and maintained at the subject pain threshold for 15 minutes. Duration of this session was given twice a week for 8 weeks and follow up was done after 4 weeks.

The data were carefully collected and analysis through statistical software SPSS 20.0 version. The significant level was at 0.05. Frequency and percentage were used to describe the demographic characteristics of the subjects with chronic plantar fasciitis. Mean, range and SD was used to assess the outcome measure of FFI and range of motion. The Wilcoxon test was used to test the significance of pre and post-test FFI in each group. Paired T-test was used to test significance of outcome measures of range of motion in each group. The Kruskal-Wallis test, the non-parametric ANOVA was used to test the significance of out-come measures of FFI in between the groups. The parametric ANOVA was used to test the significance of outcome measures of range of motion in between the groups. The parametric ANOVA was used to test the significance of difference between ages of subjects in between the three groups. Chi-square test was used to test the gender proportion in between the groups.

3. Results and Discussion

3.1 Results

Table 1: Distribution of subjects with unilateral chronic plantar fasciitis according to gender over the groups

S. No	Gender	Group-A No. (%)	Group-B No. (%)	Group-C No. (%)	Chi-Square Value
1	Male	9(60.0%)	11(32.1%)	9(60.0%)	2.389, DF=2, NS, p>0.05
2	Female	6(40.0%)	4(26.7%)	6(40.0%)	

Table 2: Mean and SD of age of the subjects with unilateral chronic plantar fasciitis in between the groups

S. No	Variables	Group-A		Group-B		Group-C	
		Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD
1	Age in years	30-45	38.60±4.88	33-45	40.40±3.62	31-45	39.07±4.20
2	BMI	21-30	24.69±1.97	23-30	25.96±2.02	23-28	25.36±1.23
3	Onset duration (months)	3-12	5.60±2.60	3-16	7.20±4.16	3-15	7.27±3.75
F-Test for ANOVA		Age: F-Ratio=1.042, p>0.05, NS, BMI: F-Ratio=0.948, p>0.05, NS, Onset: F-Ratio=1.476, p>0.05					

Table 3: Comparison of pre, post and follow up outcome measure of plantar flexion of subjects with unilateral chronic plantar fasciitis in between the groups

S. No	Groups	Plantar flexion			F-Test (ANOVA)
		Group-A	Group-B	Group-C	
		Mean ± SD	Mean ± SD	Mean ± SD	
1	Pre test	46.20±0.84	46.40±1.50	46.60±1.33	F-Ratio=0.946, p>0.05, NS
2	Post test	49.07±0.96	48.33 ± 0.83	48.73 ± 0.52	F-Ratio=1.439, p>0.05, NS
3	Follow up	49.40 ± 0.82	49.00± 0.53	48.93± 0.79	F-Ratio=0.425, p>0.05, NS

Table 4: Comparison of pre, post and follow up outcome measure of dorsiflexion of subjects with unilateral chronic plantar fasciitis in between the groups

S. No	Groups	Dorsiflexion			F-Test (ANOVA)
		Group-A	Group-B	Group-C	
		Mean ± SD	Mean ± SD	Mean ± SD	
1	Pre test	17.33±1.79	16.80±1.37	16.80±1.26	F-Ratio=1.027, p>0.05, NS
2	Post test	19.47 ± 0.64	19.00 ± 0.56	18.93 ± 0.45	F-Ratio=1.456, p>0.05, NS
3	Follow up	19.73 ± 0.45	19.20 ± 0.45	19.13 ± 0.64	F-Ratio=0.329, p>0.05, NS

Table 5: Comparison of pre, post and follow up outcome measure of FFI of subjects with unilateral chronic plantar fasciitis in between the groups

S. No	Groups	FFI			Krushkal Wallis test
		Group-A	Group-B	Group-C	
		Mean ± SD	Mean ± SD	Mean ± SD	
1	Pre test	41.28±17.46	41.44±17.79	41.19±12.22	Chi-square=0.472, p>0.05, NS
2	Post test	14.52±6.94	17.28±7.54	19.77±5.34	Chi square=12.906, p>0.05, NS
3	Follow up	12.00±5.03	14.36±5.75	17.52±5.65	Chi-square=6.894, p>0.05, NS

3.2 Results

- The interventions in each group were individually effective in reducing chronic plantar fasciitis.
- But, the interventions in group-A was better than the interventions in other groups among subjects with unilateral chronic plantar fasciitis.

4. Discussion

This study aimed at comparing long term effect of different soft tissue manipulation technique on function and range of motion in chronic plantar fasciitis in traffic police.

In this study, 45 subjects with chronic plantar fasciitis between the age group of 30-45 years, both genders were taken after fulfilling the inclusion and exclusion criteria. The subjects were assigned into three groups randomly. Group A received Myofascial Release technique and Group B received Positional Release technique and Group C received Passive Stretching. Function and range of motion were assessed prior to and after the training in three groups using FFI and Goniometer.

The possible explanation could be that MFR is used to release fascia restriction and restore its tissue. MFR technique have been shown to stimulate fibroblast proliferation, leading to collagen synthesis that may promote healing of plantar fasciitis by replacing degenerated tissue with a stronger and more functional tissue which indirectly helps in improving range of motion and foot function. Hence, MFR is an effective therapeutic option in the treatment of plantar fasciitis. This might be one of the important factors that lead to faster, better and long-lasting effects that gives stronger stability and support to the joint for faster healing [16].

The potential mechanisms for improvement in foot function in group A might be due to improvement in the ROM and increases in the skin proprioceptive receptors due to the influence of MFR and also due to the awareness of the foot position and the direction of motion, resulting in increases in confidence and stability.

5. Limitations

- Sample size was small.
- Long term follow-up of the subjects, was not possible to see the effects retained even after few months.

6. Recommendations

- Duration of the standing can be considered to know the extent of recovery.
- Future study should consider using a larger sample size in different populations like athletes, teachers and elderly population along with different electrical modalities.

7. Conclusion

The objective of the study was to know the long-term effect of different soft tissue manipulation technique on function and range of motion in chronic plantar fasciitis in traffic police. The treatment procedures of myofascial release technique, positional release technique and passive stretching shown individual effect on improving range of motion and function of subject with unilateral chronic plantar fasciitis. While comparing the post test scores in between the three groups, scores observed in positional release technique and passive stretching was comparatively less than the post test scores of myofascial release technique. Hence it concludes that myofascial release technique was effective in improving range of motion and function in unilateral chronic plantar fasciitis there by rejecting Null Hypothesis and accepting Alternate Hypothesis.

8. Acknowledgement

We thank the Out Patient Department of ESI hospital, Rajajinagar, Padmashree Physiotherapy Clinic, Nagarbhavi & Padmashree Diagnostics, Vijayanagar, and Bangalore.

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