COMBINED EFFECT OF FOAM ROLLER AND GASTROCNEMIUS RELEASE ONPLANTAR FASCIITIS

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ABSTRACT

Background *: Plantar fasciitis is an inflammatory condition of plantar fascia with a classical sign that worst pain occurs in the first step in the morning. Gastrocnemius tightness has been long associated with plantar fasciitis. Foam roller showed effectiveness in increasing pain pressure threshold at gastrocnemius. Purpose To investigate the combined effect of foam roller and gastrocnemius release on pain intensity, ankle and big toe dorsiflexion range of motion (ROM) and foot function. Subjects and Methods A total of 60 patients complaining from heel pain in the morning with first step, tenderness on medial calcaneus and symptoms decreasing with slight activity and worsening toward the end of the day. patients assigned into 2 equal groups, Group A: 30 patients received only conventional treatment (Ultrasound therapy (US), Active plantar stretching, Rest) Group B: 30 patients received same as group A plus combining both foam roller and gastrocnemius release.* ***Results:*** *There was a statistical significant difference post treatment between both groups in pain intensity measured by (VAS), ankle and big toe dorsiflexion (ROM) using electro goniometer and foot function using foot function index (FFI) (p=0.001), mean value of pain were decreased more significantly in group B than group A, mean values of ankle and big toe dorsi flexion ROM were increased more significantly in group B than group A, mean values of (FFI) were decreased more significantly in group B than group A.* ***Conclusion*** *: It was concluded that combining both foam roller and gastrocnemius release along with conventional treatment is more effective on pain intensity, ankle and big toe dorsiflexion ROM and foot function than using conventional treatment only.*

Key Words: *Plantar Fasciitis, Foam Roller, Gastrocnemius Release.*

INTRODUCTION

Plantar fasciitis refers to degeneration and inflammation of the proximal plantar fascia. The condition presents with plantar medial heel pain, often exacerbated following periods of inactivity, such as upon waking in the morning [1].

The characteristic nature of plantar fasciitis is usually with pain felt on the bottom of the heel and is most intense with the first steps during day. Individuals with plantar fasciitis often have difficulty with dorsiflexion of the foot, an action in which the foot is brought toward the shin. This difficulty is usually due to tightness of the calf muscle or Achilles tendon, the latter of which is connected to the back of the plantar fascia [2].

Plantar fascia acts as static and dynamic stabilizer of the longitudinal arch of the foot and acts as a dynamic shock absorber. It is connected via the posterior kinetic chain of the superficial backline fascial meridian with the fascias of gastrocnemius, hamstring, and erector spinae up to the scalp [3]. Stretching of calf muscles is known as integral part of plantar fasciitis treatment but the calf muscle stretching alone was not effective as compared to stretching and myofascial trigger point release therapy combined [4].

Many studies stated that foam rolling or roller massager tools have demonstrated multiple positive therapeutic effects like vascular plasticity and soft tissue restoration on performance and recovery by enhancing joint range of motion and decreasing muscle soreness [5]. The exerted pressure of the foam rollers stimulates the Golgi tendon unit and decreases muscle tension [6].

Researches found that both stretching and foam rolling techniques helped in reducing pain and increasing the ROM. However, the effectiveness of foam rolling was superior to stretching in terms of increase in the pressure pain thresholds (PPTs) at gastrocnemius and soleus [7].

Evidence indicates the integration of Gastrocnemius release in plantar fasciitis treatment, it also showed that the effectiveness of foam rolling was superior to many conservative treatments in management of plantar fasciitis but no previous studies conducted the combined effect of gastrocnemius release and foam roller in managing plantar fasciitis and assessing dorsi flexion range of motion of both big toe and ankle joint along with pain assessment and foot function.

Materials and methods:

Study design

A pre-post randomized experimental controlled design was used.It was accepted by the ethical committee of faculty of physical therapy , Cairo university with identifier P.T.REC/012/004276.This study was conducted at Al-Menoufia ministry of health hospitals.

Participants

Sample size calculation was done using pain (VAS), with 80% power at $\alpha = 0.05$ level, number of measurements 2, for 2 groups and effect size = 0.4 using F-test MANOVA within and between interaction effects. The minimum proper sample size was 52 subjects, adding 8 (15%) subjects as drop out, so total sample size is 60 subjects, 30 participants in each group. The sample size was calculated using the G*Power software (version 3.0.10).Group A: (Control):30 patients received only conventional treatment. Group B: (Experimental):30 patients received same as group A plus combining both gastrocnemius release with foam roller, who were enrolled from Al-Menoufia ministry of health hospitals, in the period from January 2024 to April 2024. Before the experiment, the purpose and procedures of the study were fully explained to all patients,and all patients subsequently voluntarily agreed to enroll

in the present study, and signed consent form.

PATIENTS AND METHODS

Measurement procedures

For enrollment in the study

Patients were referred from orthopedist, with age between 18 years and 60 years with heel pain having such clinical features as heel pain in the morning with first step, insidious sharp pain under the heel, tenderness on medial calcaneus and symptoms decreasing with slight activity (like walking) and worsening toward the end of the day [7].

A positive windlass test: heel pain reproduced with passive dorsiflexion of the toes [8]. The difference between bearing weight and non-weight is that the sensitivity is higher in weightbearing [9]. A previous study showed 100% specificity for weight-bearing and sensitivity of 32 % for non- weight bearing tests [10].

The patient stands on a step stool and positions the metatarsal of heads of the foot to be tested just over the edge of the step.

The subject is instructed to place equal weight on both feet.

The examiner then passively extends the first metatarsophalangeal joint while allowing the interphalangeal joint to flex.

Passive extension (i.e., dorsiflexion) of the first metatarsophalangeal joint is continued to its end of range or until the patient's pain is reproduced [11].

Primary outcomes

Pain the magnitude of pain of all subjects was assessed by a 10 cm visual analogue scale (VAS)

Dorsiflexion (ROM).

Electro-goniometer was used to measure ankle dorsi flexion (ROM). With one lever of the goniometer placed on the proximal fibular head, while the other was placed on the fifth metatarsal. The pivot was positioned on the lateral malleolus. The ROM was recorded based on the position of the lever on the fifth metatarsal [12].

conducted for comparison between pre and post treatment in each group. The level of significance for all statistical tests was set at $p < 0.05$. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 22 for windows (IBM SPSS, Chicago, IL, USA).

Foot function assessment: using Foot Function Index (FFI) which developed to measure the impact of foot pathology on function in terms of pain, disability and activity restriction. The FFI is a self-administered index consisting of 23 items divided into 3 sub-scales

Secondary outcomes

Big toe dorsiflexion ROM participant seated on the examination table with the knee extended and the foot in a relaxed position. In this relaxed position of the foot, the center of the goniometer was placed on the center of the metatarsal head. The proximal arm was placed parallel to the bisection of the first metatarsal and the foot was held steady with one hand. The distal or mobile arm was placed parallel to the bisection of the proximal phalanx and held fixed to the toe with the other hand [13].

Treatment procedure

Study protocol: 3 times weekly for 4 weeks (weeks 1–4), with a minimum of a 1-day gap between the 2 sessions, Outcome measures were captured at Week 1 (pretest score), Week 4 (posttest score) [14].

Foam roller technique:

Calf muscles: This involved long sitting, with the affected leg extended on

the foam roller and foot relaxed. The non-affected leg flexed at knee so that the foot rested on the floor. Patients instructed to use their arms and non_affected foot to propel their body back and forth from the popliteal fossa to Achilles tendon in continuous motion.

Plantar fascia:

This involved standing, with the non-affected foot on the floor and affected foot on the foam roller patients instructed to move their foot back and forth from heel to toes in continuous motion while exerting pressure on the foam roller. They asked to stop at the point where they felt maximum pain.

Foam rolling was performed by the participants for 45 s followed by a 15-s rest with five repetitions [15].

Gastrocnemius release:

The patient is prone lying and the therapist standed at the side of the patient's leg. Both hands in cross-hand pattern. Myofascial Release performed for 20 repetitions [16].

Conventional treatment:

UltraSound Therapy; Patients were treated with 8 minutes of therapeutic ultrasound at a frequency of 1 MHz and continuous current at a pulse intensity of 1.8 W/cm2 (when the sensitivity level was too high and the procedure hurt the patient, the therapist reduced the intensity) [17].

Active plantar stretching:

Patients instructed to do stretching exercises twice a day; First in the morning, before getting out of the bed and second at the night time while sleeping. They were instructed to dorsi flex the ankle joint, hold theposition for 12-15 seconds and repeats 10 times; followed by Plantar flexion and repeat the same.

Rest:

Rest is actually in form of activity modification. Patients instructed to at least take rest for 5 minutes in form of sitting after standing for 30 minutes if their jobs/work demanded it. Bed rest was neither advised nornecessary [18].

Data analysis

Data were expressed as mean± SD. Unpaired t-test was used to compare between subjects Characteristics of the two groups and chi square was used for sex distribution comparison. Shapiro- Wilk test was used for testing normality of data distribution. MANOVA was performed to compare within and between groups' effects for measured variables (pain intensity, dorsi flexion ROM of ankle joint and big toe, and foot function). Statistical package for the social sciences computer program (version 20 for Windows; SPSS Inc., Chicago, Illinois, USA) was used for data analysis. P less than or equal to 0.05 was considered significant.

RESULTS

Results: A total of 60 patients with plantar fasciitis participated in this study; they were assigned into 2 equal groups; group (A), Control, consisted of 30 patients received conventional treatment only and group (B), Experimental, consisted of 30 patients received conventional treatment plus combining both foam roller and gastrocnemius release.

Table (1): Demographic data of subjects of both groups

As shown in table (1) There were no significant difference between the mean value of subjects age, weight, height and BMI of both groups (p=0.345, 0.951, 0.858 and 0.965) respectively. The number (%) of males of both groups was 10 (33.3%) and the number (%) of females was 20 (66.7%), there were no significant difference between both groups (p= 1).

Demographic data	Group A mean±SD	Group B mean±SD	t-value	p-value
Age (years)	44.7±10.9	41.8±12.4	0.95	0.345
Weight (kg)	75.8±7.2	76±9.4	-0.06	0.951
Height (cm)	165.7±7.1	166±7.3	-0.18	0.858
BMI (kg/m2)	27.7 ±3	27.6±4	0.04	0.965
Sex	N (%)	N (%)		
Males	10 (33.3%)	10 (33.3%)	$\chi 2 = 0$	1
Females	20 (66.7%)	20 (66.7%)		

$\chi 2$: chi square, p- value: significance

Data were screened for normality assumption, homogeneity of variance, and presence of extreme scores. Shapiro-Wilk test for normality showed that all measured variables were normally distributed ($p>0.05$).

The impact of treatment on pain:As shown in table (2) There was no statistical significant difference in the mean values of pain pre treatment between both groups ($p= 0.478$), while There was statistical significant difference post treatment ($p=0.001$) mean values of pain were decreased more significantly in group B than group A.

Table (2): Mean ±SD of pain pre and post treatment of both groups.

Pain (cm)	Group A Mean ±SD	Group B Mean ±SD	Mean difference	f-value	P-value1
Pre-treatment	9.16 ± 0.47	9.05 ± 0.64	0.11	3.49	0.478
Post-treatment	5.55 ± 0.53	1.4 ± 0.74	4.15	620	0.001*
% of change	39.4%	84.5 %			
P-value	0.001*	0.001*			

SD: standard deviation, p-value: level of significance within group, p-value1: level of significance between groups, *: significant

The impact of treatment on ankle dorsi flexion ROM:

As shown in table(3) There was no statistical significant difference in the mean values of ankle dorsi flexion ROM pretreatment between both groups ($p= 0.844$), while There was statistical significant difference post treatment ($p=0.001$); mean values of ankle dorsi flexion

ROM were increased more significantly in group B than group A.Table (3): Mean ±SD of ankle dorsi flexion ROM pre and post treatment of both groups.

Ankle dorsi flexion ROM (degrees)	**Group A Mean ±SD**	**Group B Mean ±SD**	**Mean difference**	**f-value**	**P-value[1]**
Pre-treatment	15.18 ± 1.65	15.1 ± 1.6	0.08	0.39	0.844
Post-treatment	17.5 ± 1.75	24.27 ± 1.14	-6.73	310	0.001*
% of change	15.3%	60.7 %			
P-value	0.001*	0.001*			

SD: standard deviation, p-value: level of significance within group, p-value[1]: level of significance between groups, *:significant

The impact of treatment on big toe dorsi flexion ROM:

As shown in table (4) There was no statistical significant difference in the mean values of big toe dorsi flexion ROM pretreatment between both groups (p= 0.068), while There was statistical significant difference post treatment (p=0.001); mean values of big toe dorsi flexion ROM were increased more significantly in group B than group A.

Table (4): Mean ±SD of big toe dorsi flexion ROM pre and post treatment of both groups.

Big toe dorsi flexion ROM (degrees)	**Group A Mean ±SD**	**Group B Mean ±SD**	**Mean difference**	**f-value**	**P-value[1]**
Pre-treatment	22.64 ± 1.37	21.96 ± 1.49	0.68	3.47	0.068
Post-treatment	25.24 ± 1.55	36.89 ± 1.9	-11.65	674	0.001*
% of change	11.5%	68 %			
P-value	0.001*	0.001*			

SD: standard deviation, p-value: level of significance within group, p-value[1]: level of significancebetween groups, *: significant

The impact of treatment on foot function index:

As shown in table (5)There was no statistical significant difference in the mean values of FFI pretreatment between both groups (p= 0.374), while There was statistical significant difference post treatment (p=0.001); mean values of FFI were decreased more significantly in group B than group A.

Table (5): Mean ±SD of FFI pre and post treatment of both groups.

Foot function index	Group A Mean ±SD	Group B Mean ±SD	Mean difference	f-value	P-value[1]
Pre-treatment	77.57 ± 2	78.1 ± 2.5	-0.53	0.8	0.374
Post-treatment	63.5 ± 2.2	8.3 ± 1.7	55.2	11604	0.001*
% of change	18.1%	89.4 %			
P-value	0.001*	0.001*			

SD: standard deviation, p-value: level of significance within group, p-value[1]: level of significancebetween groups, *: significant

Discussion

This study was conducted to investigate the effects of combining foam roller and gastrocnemius release on pain intensity , dorsi flexion ROM of ankle joint and big toe and foot function in patients with plantar fasciitis. Sixty patients with chronic plantar fasciitis participated in this study, they were selected and assigned randomly into two equal groups; Group A: (Control) received only conventional treatment Group B: (Experimental) received same as group A in addition to combining both foam roller and gastrocnemius release.

This study revealed that , pain intinsity were decreased more significantly in group B than group A, ankle and big toe dorsi flexion ROM were increased more significantly in group B than group A and foot function improved more significantly in group B than group A.

This result is supported by previous conducted researhes as many researches found that both stretching and foam rolling techniques helped in reducing pain and increasing the ROM. However, the effectiveness of foam rolling was superior to stretching in terms of increase in the pressure pain thresholds (PPTs) at gastrocnemius and soleus [7].

foam rolling combined with vibration increases dorsiflexion ROM and a cross-over transfer effect was observed in the contralateral limb. However, the addition of the vibration stimulus with foam rolling did not further increase ROM compared to foam rolling alone[19]. foam rolling and roller massage may be effective interventions for enhancing joint ROM and pre and post exercise muscle performance [20].

Myofascial trigger point technique was seen effective in relation to improve pain in patients of

plantar fasciitis [21]. Manual therapy in the form of myofascial release showed overall significant improvement in Pain and Functional status.Hence it can be concluded that myofascial release is an effective therapeutic option in the treatment of plantar fasciitis [22]. This study also conducted improvement on ankle dorsi flexion ROM which was agreed by previous researches a single foam roller intervention on the calf can increase the ankle dorsiflexion ROM and reduce the stiffness of the gastrocnemius [23]. All studies reported excellent outcomes associated with the use of gastrocnemius release for chronic plantar fasciitis [24].

Big toe dorsi flexion ROM improvment was explained by previous researches as increased tension of the plantar fascia results in a decrease of first MTPJ dorsiflexion [25].When windlass mechanism is activated it is shown that the arch appears to rise and appears to be a tight band in the region of plantar fascia. it was discovered that the arch rising durig

propulsion is not depend on muscle action and it is related to extention (dorsiflexion) of toes [26].

Chen,et al,2013 conducted a study that Individuals with unilateral chronic plantar fasciitis demonstrated significantly greater vascularity and thickened fascia on the affected side compared to the unaffected side and also to healthy controls. Fascia vascularity was associated independently with self-perceived pain, and both fascia vascularity and thickness were associated with foot dysfunction in patients with chronic plantar fasciitis[27].

our current study also conducted improvement in foot function and this result was approved by Cole, G. 2018 who conducted a study said that Manual therapy has become increasingly popular amongst sports medicine practitioners, strength and conditioning coaches and athletes all over the world. The aim is to promote efficient movement by improving ROM and muscular function, as better movement efficiency is associated with a lower risk of injury. More and more athletes and coaches are using manual therapy in the form of SMR or foam rolling as an easy and cost-effective way to achieve this aim [28].

Some researches disagreed with this result such as a pervious study conductet that Foam rolling increase flexibility, but this only lasts less than 10 minutes [29] . Further, one study showed that an 8 week course of foam rolling produced no long term increase in flexibility [30]. This conflict could be due to using a small sample size with small averege of ages in patients concluded.

Conclusion: combining both foam roller and gastrocnemiuos release in management of planter fasciitis showed great improvement in pain intinsity, increasing ankle and big toe dorsiflexion ROM and improving foot function.

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