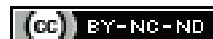


Effect of Foam Rolling along with Self-stretching on Pain and Range of Motion in Plantar Fasciitis Patient- A Quasi-experimental Study

SUNNY YADAV¹, SHIKHA MALIK², SARU BANSAL³

ABSTRACT

Introduction: The most common cause of heel pain is plantar fasciitis. Previous literature suggests that stretching exercise had shown better results in the non surgical treatment options available, due to this technique muscle strength and the force production capacity is reduced. Myofascial release is an alternate technique which can improve Range Of Motion (ROM) and reduce pain without compromising the muscle performance.

Aim: To evaluate the effect of foam rolling along with self-stretching on pain and ROM in plantar fasciitis patients.

Materials and Methods: This quasi-experimental study was conducted between May 2020 to May 2021, at Kailash Institute of Nursing and Paramedical Sciences, Greater Noida, Uttar Pradesh, India. Thirty participants with plantar fasciitis meeting the inclusion criteria of age between 24-60 years were included and allocated into two groups by convenience sampling. Group A received self-stretching of calf and plantar fascia whereas group B received foam rolling along with self-stretching of calf and plantar fascia for three weeks. Visual Analog Scale (VAS) and

Weight Bearing Lunge Test (WBLT) were recorded at baseline and by the end of 3rd week for both the groups to measure pain and ankle ROM. Data was analysed using Statistical Package for the Social Sciences (SPSS) version 16.0 statistical software. The independent sample t-test was used for intergroup comparison and student's paired t-test was utilised for within group comparison. The statistical difference significance was set at p-value <0.05 for all the test performed.

Results: Within group analysis has shown that there was a statistically significant difference ($p < 0.001$) in all the outcome measures in both the groups. The between-group analysis showed no statistically significant difference in VAS ($p = 0.405$) however significant difference were found in WBLT ($p = 0.003$).

Conclusion: The present study proved that both self-stretching and foam rolling with self-stretching showed significant improvement on pain and increasing ROM in plantar fasciitis. However, effectiveness of foam rolling with self-stretching was superior to self-stretching in terms of increasing WBLT.

Keywords: Heel pain, Visual analog scale, Weight bearing lunge test

INTRODUCTION

The most commonly known cause of heel pain is plantar fasciitis, which is seen around in 10% of non athletic and athletic population. Plantar fasciitis is commonly considered as the degeneration of the plantar fascia and could be classified as "fasciosis" or "fasciopath" [1]. The most common clinical signs are first step pain after a period of rest, local tenderness mostly over the medial calcaneum, decreased pain after some activity and decreased ROM to some extent at ankle joint [2]. The calf muscle plays a role in the development of plantar fasciitis as it becomes tight and reduce the dorsiflexion movement at ankle joint [3]. As the condition becomes chronic it affects the quality of life of a person including the general health, foot specific quality, reduction in the physical activities, isolation from the society and less energetic to participate in the activities. The biomechanical alterations are because of the calf muscle tightness which leads to excessive tensile forces on the planter fascia during the stance phase [2]. The treatment option available for plantar fasciitis has a wide range and variety. Some physiotherapy treatment options are stretching and strengthening exercise, manual therapy, proper foot wear, orthotic devices, electrotherapy [1,2,4]. Non Steroidal Anti-Inflammatory Drugs (NSAIDs) and local corticosteroid injections may be recommended by the physicians [4].

Based on the previous literature findings, stretching exercises had shown the better results among all the available non surgical treatment options [2,5]. Stretching exercise have some advantages over the other treatments as it is time saving for the patient, a low cost treatment, and it can be practiced at any place or time by the patient itself. It is found that the achilles tendon stretching along with the plantar fascia stretching has almost the double effect on

the pain reduction and the improvement in the dorsiflexion range of movement at ankle joint when compared with the achilles tendon stretching alone [6]. Thus, static stretching is recommended for the pain reduction and increase flexibility but it is found that static stretching is associated with decreased muscle strength and immediate sporting activities or movements [7,8].

Myofascial release or Self-Myofascial Release (SMR) is an alternate treatment option available and known for increasing flexibility and pain reduction and that too without compromising the muscle strength and force production ability. With the gaining popularity, the SMR methods like using foam roller has significantly increase the flexibility, improve arterial function, improvement in vascular endothelial function, reduction in arterial stiffness [9] and decrease in soreness of muscle [10] which makes their use more popular in general population as well as athletic population.

The Golgi Tendon Organ (GTO) reflex arc model and other mechanoreceptors are the possible mechanisms to increase fascia flexibility using SMR. As there is an increase in the pressure on the fascia by the SMR, the GTOs are stimulated and there is a reduction in the firing rate of motor unit which is responsible for reduction of muscle tone [11,12].

However, it is unclear that how long the acute effect of SMR lasts but is shown in previous studies that it lasts atleast for 10 minutes [7,13,14]. Jay K et al., 2014 found that there is no significant difference in flexibility at 30 minutes after the treatment between fascial release and control group [14]. It was also postulated in previous study that there is a reduction in the pain immediately after the intervention but for how long this effect can last and whether it will be beneficial for patient in home-based rehabilitation on a long

run is still unclear [13]. Therefore, it was hypothesised that foam rolling with self-stretching can be effective in plantar fasciitis in a home-based rehabilitation. Hence, this study was undertaken to assess the effect of foam rolling along with self-stretching on pain and ROM in plantar-fasciitis patients.

MATERIALS AND METHODS

This quasi-experimental study was conducted at Kailash Institute of Nursing and Paramedical Sciences, Greater Noida, Uttar Pradesh, India, from May 2020 to May 2021. An Ethical Clearance was obtained from the Institutional Review Board before the commencement of the study (Ref no. KI/MPT/19/044). Prior written explanation was given to the patients about the study and consent was obtained for participating in the study.

Inclusion criteria: Participants with age between 24-60 years having symptoms of heel pain and clinical feature such as medial calcaneal pain, morning first step pain, tenderness on medial calcaneal and symptoms decreases with activity and increases with rest were included in the study.

Exclusion criteria: Patients with any other musculoskeletal condition or disorder such as inflammatory joint disorder, abnormal sensation of lower extremities were excluded from the study.

A total of 30 participants were screened for plantar fasciitis and they were assigned to either group A (self-stretching) or group B (foam rolling with self-stretching) by convenience sampling.

Group A: Self-stretching Group

Calf muscles: In standing position, the affected foot is placed away from the wall, then subject was asked to lean forward and making sure not to lift the heel from the floor [Table/Fig-1]. To focus on the stretching of soleus, the affected leg was placed backward with knee bent whereas for the gastrocnemius, the affected leg was kept backward with knee in full extension. Subjects were asked to maintain this position till 30 second, until they feel stretch [15].



[Table/Fig-1]: Patient performing self-stretching of calf-muscle.

Plantar fascia: This stretching was performed in sitting position with affected foot placed over the other side thigh. Subjects were asked to place one hand over the base of toes and other at the heel and pull the toes towards shin slowly until they feel stretch at plantar fascia. The intensity of the stretch was increased as tolerable by the individual subject. This stretch was also maintained for 30 sec. [15]. All the patients are asked to do 3 sets of 30 sec and 2 times a day for both the muscles. This procedure was continued for three weeks and the measurements were taken after three weeks.

Group B: Foam Rolling with Self-stretching Group

Calf muscles: The subjects were in long sitting position with the affected leg extended on the foam roller and foot relaxed. The non affected leg was used for the support purpose with placed on ground with knee flexed in a comfortable position [Table/Fig-2]. Instructions were given to use their hands and non affected leg or opposite side leg to roll the foam roller from popliteal fossa to achilles tendon [7].



[Table/Fig-2]: Patient performing foam rolling on calf muscles.

Plantar fascia: In this subject were in standing position with the affected foot on the foam roller and the non affected foot on the floor [Table/Fig-3]. The subjects were instructed to do a back-and-forth motion from heel to toes of foot on foam roller while exerting pressure on the foam roller [7].



[Table/Fig-3]: Patient performing foam-roller on plantar fascia.

The self-stretching was performed in a similar manner to that of self-stretching group. Three sets of 30 sec for each muscle was performed once a day and same sets of self-stretching once a day for three weeks. This was done to equalise the number of sets and repetition of both the groups to make result fair for both groups.

Outcome Measures

Outcome measures were assessed at baseline and by the end of 3rd week after intervention.

Pain: Pain intensity was measured by VAS. It is a 10 cm long horizontal line with no pain and worst pain possible both ends on line respectively [1].

ROM: ROM of ankle dorsiflexion was measured by WBLT. In this test, the subjects were made to stand on the measurement

tape placed perpendicular to the wall to measure the linear distance between big toe and the wall [Table/Fig-4]. Subjects were given instruction to lunge their knee towards the wall to make contact without lifting their heel [7]. It has been shown that this test has high inter-rater and intra-rater reliabilities [intra-rater ICC=0.97-0.98; inter-rater ICC=0.97 (angle) and 0.99 (distance)] [16].



[Table/Fig-4]: Patient performing WBLT.

STATISTICAL ANALYSIS

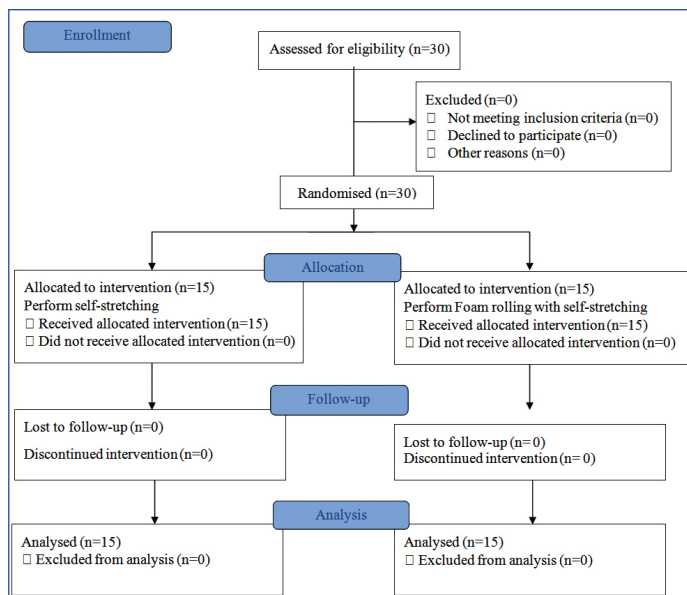
The collected data was analysed using statistical software, SPSS (IBM SPSS, version 16.0, NY: IBM Corp) for windows 10 Home edition. The normality of the collected data was verified using Shapiro-Wilk test. Gender and the affected side were analysed using Chi-square test. As the demographic data of the participants follow normal distribution, all the values of the descriptive statistics were expressed in terms of the mean and Standard Deviation (SD). To evaluate the mean difference between the groups, independent sample t-test was used. The within group analyses for all the outcome measures were analysed using Student's paired t-test. The level of significance was set at ≤ 0.05 .

RESULTS

The flow chart [Table/Fig-5] shows the progress of participants at each stage of the study. A total number of 12 males (40%) and 18 females (60%) have participated in the study. The mean age of participants in self-stretching group was 40.53 ± 7.72 years) and in foam roller with self-stretching group (37.73 ± 8.22 years) was found to be statistically insignificant ($p=0.34$). There were no statistically significant difference in age, gender, height, weight, Body Mass Index (BMI) and affected side in both groups, suggesting that the both groups were homogeneous with respect to those baseline values and comparison of the result was reasonable ($p > 0.05$) [Table/Fig-6]. After the analysis, it was found that within-group analysis showed all the outcome measures (VAS, WBLT) had statistically significant difference ($p < 0.001$) in both the groups [Table/Fig-7,8]. The between-group analysis showed no significant difference for VAS ($p=0.405$) however, statistically significant difference was found for WBLT ($p=0.003$) [Table/Fig-9].

DISCUSSION

The purpose of the present study was to evaluate the effectiveness of foam rolling with self-stretching compared to self-stretching alone on pain and ROM in patients with plantar fasciitis. The study showed that both self-stretching as well as foam rolling with self-stretching is effective in reducing pain and improving ROM in plantar



[Table/Fig-5]: Flow chart of the participants.

Variables	Self-stretching group (n=15) Mean±SD	Foam roller+self-stretching group (n=15) Mean±SD
Age (years)	40.53±7.72	37.73±8.22
Height (cm)	166.07±8.09	168.73±8.63
Weight (kg)	71.73±12.05	70.67±8.60
BMI (kg/m ²)	25.87±2.75	24.74±1.28
Affected side	Left	9
	Right	6

[Table/Fig-6]: Demographic characteristics of participants in both groups. SD: Standard deviation; BMI: Body mass index

Variables	Pretreatment Mean±SD (n=15)	Post-treatment Mean±SD (n=15)	Mean difference (SEM)	t-value (p-value)
VAS (cm)	6.87±0.91	5.67±0.81	1.2 (0.107)	11.225 (<0.001)
WBLT (cm)	8.71±0.83	9.207±0.61	-0.49 (0.104)	-4.70 (<0.001)*

[Table/Fig-7]: Comparison of outcome measures within self-stretching group. VAS: Visual analog scale; WBLT: Weight bearing lunge test; SD: Standard deviation; SEM: Standard error mean; *indicates p-value <0.05 (calculated using Student's paired t-test)

Variables	Pretreatment Mean±SD (n=15)	Post-treatment Mean±SD (n=15)	Mean difference (SEM)	t-value (p-value)
VAS (cm)	7.33±0.72	5.40±0.91	1.93 (0.153)	12.61 (<0.001) *
WBLT (cm)	8.32±0.88	9.8±0.376	-1.49 (0.183)	-8.13 (<0.001) *

[Table/Fig-8]: Comparison of outcome measures within foam-roller+self-stretching group. VAS: Visual analog scale; WBLT: Weight bearing lunge test; SD: Standard deviation; SEM: Standard error mean; *indicates p-value <0.05 is considered statistically significant (calculated using Student's paired t-test)

Variables	Group	Pre-treatment Mean±SD	Post-treatment Mean±SD
VAS (cm)	Self-stretching (n=15)	6.87±0.91	5.67±0.81
	Foam-roller+self-stretching group (n=15)	7.33±0.72	5.40±0.91
	p-value	0.133	0.405
WBLT (cm)	Self-stretching (n=15)	8.71±0.83	9.20±0.61
	Foam-roller+self-stretching (n=15)	8.32±0.88	9.82±0.37
	p-value	0.228	0.003*

[Table/Fig-9]: Comparison of outcomes between the groups. VAS: Visual analog scale; WBLT: Weight bearing lunge test; SD: Standard deviation; *indicates p-value <0.05 is considered statistically significant (calculated using independent sample t-test)

fasciitis individuals. These findings were similar with the results of Ranbhor AR et al., Cheatham SW et al., who showed that patients

with plantar fasciitis have benefitted with both self-stretching and foam rolling techniques [1,17].

In the present study, it was found that stretching had a significant effect in the reduction of pain. The reduction of pain may be due to Golgi tendon organ (GTO) stimulation which results in inhibition of alpha motor neurons pathway, which results in the relaxation of the muscle [6,18,19]. The failure of collagen bonds at the microstructural level are also responsible for reduction of pain and stiffness by altering the length of musculotendinous unit [8, 20]. Stretching also had a significant effect in increasing the WBLT score and thus improving ROM. Stretching causes change in the viscoelastic properties of the musculotendinous unit and make it to relax and lengthen. The reduction in the perception of pain could also be the reason for the increased ROM [21].

The present study also showed that foam rolling with self-stretching had a significant effect in the reduction of the pain. The increased blood flow to the muscles results in removal of the waste products which are responsible for pain reduction. It also activates the cutaneous receptors which are responsible for blocking of nociceptive stimulus. Foam rolling also causes a noticeable reduction in the tissue adhesions and stiffness which causes increase in muscle tendon compliance. Due to this there is a decrease in the cortisol level and increase in the dopamine and serotonin levels, which are responsible for pain reduction [22,23].

It is also found that foam rolling with self-stretching improved ROM. This is possibly because of the change in fascia properties. The frictional movement between the foam roller and fascia tissues causes a warming effect on the fascia, resulting in breakage of adhesions due to which extensibility and flexibility of fascia is restored [24]. The foam roller causes back and forth motion of soft tissues and causes pressure on it which causes overloading of the cutaneous receptors. The end result of the friction created between foam roller, fascia and muscle is a stretch which may decrease the sensations of stretch end points [25, 26]. These findings are in line with study which stated that foam rolling was effective in increasing ROM [17]. Further additional studies are needed to provide more information about the effect of foam rolling along with self-stretching on muscle strength in plantar fasciitis. Future studies can be conducted to see the long-term effects of foam-rolling along with self-stretching in plantar fasciitis.

Limitation(s)

A small sample size affected the generalisability of result. Patients might have poor compliance towards exercise which can affect the result. This study lacked control group.

CONCLUSION(S)

Stretching was effective in reducing the pain and increasing ROM but stretching when performed with foam roller was more effective and had a significant effect on improving ROM as compared to stretching alone.

REFERENCES

[1] Ranbhor AR, Prabhakar AJ, Eapen C. Immediate effect of foam roller on pain and ankle range of motion in patients with plantar fasciitis: A randomized controlled trial. *Hong Kong Physiother J.* 2020;41(1):01-09.

- [2] Boonchum H, Bovonsunthonchai S, Sinsurin K, Kunanusornchai W. Effect of a home-based stretching exercise on multisegmental foot motion and clinical outcomes in patients with plantar fasciitis. *J Musculoskelet Neuronal Interact.* 2020;20(3):411-20.
- [3] Nakale NT, Strydom A, Saragas NP, Ferrao PNF. Association between plantar fasciitis and isolated gastrocnemius tightness. *Foot Ankle Int.* 2018;39(3):271-77.
- [4] Çil ET, Şaylı U, Subaşı F. Outpatient vs home management protocol results for plantar fasciitis. *Foot Ankle Int.* 2019;40(11):1295-303.
- [5] Davis PF, Severud E, Baxter DE. Painful heel syndrome: Results of nonoperative treatment. *Foot Ankle Int.* 1994;15:531-35.
- [6] Engkananuwat P, Kanlayanaphotporn R, Purepong N. Effectiveness of the simultaneous stretching of the achilles tendon and plantar fascia in individuals with plantar fasciitis. *Foot Ankle Int.* 2018;39(1):75-82.
- [7] Škarabot J, Beardsley C, Štirn I. Comparing the effects of self-myofascial release with static stretching on ankle range-of-motion in adolescent athletes. *Int J Sports Phys Ther.* 2015;10(2):203-12.
- [8] Kay AD, Blazeovich AJ. Effect of acute static stretch on maximal muscle performance: A systematic review. *Med Sci Sports Exerc.* 2012;44(1):154-64.
- [9] Okamoto T, Masuhara M, Ikuta K. Acute effects of self-myofascial release using a foam roller on arterial function. *J Strength Cond Res.* 2014;28(1):69-73.
- [10] Macdonald GZ, Button DC, Drinkwater EJ, Behm DG. Foam rolling as a recovery tool after an intense bout of physical activity. *Med Sci Sports Exerc.* 2014;46(1):131-42.
- [11] Stecco C, Gagey O, Belloni A, Pozzuoli A, Porzionato A, Macchi V, et al. Anatomy of the deep fascia of the upper limb. Second part: Study of innervation. *Morphologie.* 2007;91(292):38-43.
- [12] Schleip R. Fascial plasticity- A new neurobiological explanation: Part 1. *J Bodyw Mov Ther.* 2003;7(1):11-19.
- [13] Halperin I, Aboodarda SJ, Button DC, Andersen LL, Behm DG. Roller massage improves range of motion of plantar flexor muscles without subsequent. *Int J Sports Phys Ther.* 2014;9(1):92-102.
- [14] Jay K, Sundstrup E, Sondergaard SD, Behm D, Brandt M, Sørvoll CA, et al. Specific and cross over effects of massage for muscle soreness: Randomized controlled trial. *Int J Sports Phys Ther.* 2014;9(1):82-91.
- [15] Renan-Ordine R, Albuquerque-Sendin F, de Souza DPR, Cleland JA, Fernández-de-Las-Peñas C. Effectiveness of myofascial trigger point manual therapy combined with a self-stretching protocol for the management of plantar heel pain: A randomized controlled trial. *J Orthop Sports Phys Ther.* 2011;41(2):43-50.
- [16] Bennell K, Talbot R, Wajswelner H, Techovanich W, Kelly D, Hall AJ. Intra-rater and inter-rater reliability of a weight-bearing lunge measure of ankle dorsiflexion. *Aust J Physiother.* 1998;44 (3):175-80.
- [17] Cheatham SW, Kolber MJ, Cain M, Lee M. The effect of self-myofascial release using a foam roll or roller massager on joint range of motion, muscle recovery, and performance: A systematic review. *Int J Sports Phys Ther.* 2015;10(6):827-38.
- [18] Nishikawa Y, Aizawa J, Kanemura N, Takahashi T, Hosomi N, Maruyama H, et al. Immediate effect of passive and active stretching on hamstrings flexibility: A single-blinded randomized control trial. *J Phys Ther Sci.* 2015;27(10):3167-70.
- [19] Sweeting D, Parish B, Hooper L, Chester R. The effectiveness of manual stretching in the treatment of plantar heel pain: A systematic review. *J Foot Ankle Res.* 2011;4:19.
- [20] Phadke A, Bedekar N, Shyam A, Sancheti P. Effect of muscle energy technique and static stretching on pain and functional disability in patients with mechanical neck pain: A randomized controlled trial. *Hong Kong Physiother J.* 2016;35:05-11.
- [21] Hanney WJ, Puentedura EJ, Kolber MJ, Liu X, Pabian PS, Cheatham SW. The immediate effects of manual stretching and cervicothoracic junction manipulation on cervical range of motion and upper trapezius pressure pain thresholds. *J Back Musculoskelet Rehabil.* 2017;30(5):1005-13.
- [22] Cavanaugh MT, Döweling A, Young JD, Quigley PJ, Hodgson DD, Whitten JHD, et al. An acute session of roller massage prolongs voluntary torque development and diminishes evoked pain. *Eur J Appl Physiol.* 2017;117(1):109-17.
- [23] Weerapong P, Hume PA, Kolt GS. The mechanisms of massage and effects on performance, muscle recovery and injury prevention. *Sports Med.* 2005;35(3):235-56.
- [24] Couture G, Karlik D, Glass SC, Hatzel BM. The effect of foam rolling duration on hamstring range of motion. *Open Orthop J.* 2015;9:450-55.
- [25] Griefahn A, Oehlmann J, Zalpour C, von Piekartz H. Do exercises with the foam roller have a short-term impact on the thoracolumbar fascia? A randomized controlled trial. *J Bodyw Mov Ther.* 2017;21(1):186-93.
- [26] Sullivan KM, Silvey DBJ, Button DC, Behm DG. Roller-massager application to the hamstrings increases sit-and-reach range of motion within five to ten seconds without performance impairments. *Int J Sports Phys Ther.* 2013;8(3):228-36.

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