Comparative study of Stretching of Foot & Hip Muscles along with Myofascial release (MFR) V/S Strengthening of Foot & Hip Muscles along with MFR for the Treatment of Plantar Fasciitis

Abstract:

Background: Plantar fasciitis causes heel pain in active as well as sedentary adults of all ages. The condition is more likely to occur in persons who are obese or in those who are on their feet most of the day. The muscles that help to invert and evert the ankle are much weaker in a person who is experiencing the symptoms of plantar fasciitis. The lack of adequate hip strength can lead to excess motion in the lower extremity that can place too much stress on the foot and cause plantar fasciitis. **Objective**: The aim of this study is to compare effectiveness of Strengthening of foot intrinsic and extrinsic muscles with hip abductors & lateral rotators along with Myofascial release vs Stretching of foot intrinsic and extrinsic muscles with hip abductors & lateral rotators along with Myofascial release. **Methods and Material:** Randomised comparative case-controlled study. A randomized controlled trial was performed on 80 subjects (both gender) age group 25-55 years with diagnosis of planter fasciitis were divided into 2 equal groups. Group A subjects received MFR with Stretching. MFR technique was applied on sole of the foot by knuckles and by using tennis ball, 5 times/week for 2 mins. In stretching, static stretching was given by maintaining the position for 30 secs and rest of 10 sec is given, for 5 repetitions. This protocol was performed for 8 weeks. In group B, subjects received MFR techniques with strengthening exercise. MFR was given by knuckles for 1 min followed by MFR by using tennis ball for another 1 min. Strengthening was done for both intrinsic and extrinsic muscles, Hip (Abductors & Lateral Rotators) by using TheraBand and weight-cuffs. TheraBand of different colours were used ranging from medium to high resistance. Weight-cuffs of 1kg and above is used according to patients' condition for strengthening of abductors & lateral rotators of hip. Protocol was followed 5 times/week for 8 weeks. Data was collected on Day 1st (pre-test), 4th week (mid) and at the end of 8 weeks (post-test), for outcome measures of pain on VAS Scale and Foot Function on FFI Scale. Comparison between 2 groups was done on paired t-test. **Statistical analysis used:** Comparison between the two groups was done on Paired T test. SPSS statistical software was used for data analysis. **Results:** Results suggested that both form of exercises are effective in relief of pain & improvement in function but patients in Group B, which were given strength training with myofascial release were more improved in achieving pain relief and foot function as compare to group-A.

Conclusions: After 8 week of training it was found that Strengthening of foot intrinsic and extrinsic muscles with hip abductors & lateral rotators along with Myofascial release has good results in patients with plantar fasciitis as compared to Stretching of foot intrinsic and extrinsic muscles with hip abductors & lateral rotators along with Myofascial release.

Key-words: Plantar Fasciitis, Strengthening, Stretching, Myofascial Release

Introduction: "Plantar fasciitis is the result of degenerative irritation of the plantar fascia origin at the medial calcaneal tuberosity of the heel as well as the surrounding perifascial structures. The plantar fascia is a long, thin ligament that lies directly beneath the skin on the bottom of the foot which connects the heel to the front of the foot, and supports the arches. Plantar fasciitis causes heel pain in active as well as sedentary adults of all ages. The condition is more likely to occur in persons who are obese or in those who are on their feet most of the day". [1] Plantar Fasciitis is found in people in India at a rate of 20%.[2] "It is estimated that 1 in 10 people will develop Plantar fasciitis during their lifetime".[3] "Plantar fasciitis commonly causes stabbing pain that usually occurs with first few steps in the morning. As you get up and move, the pain normally decreases, but it might return after long periods of standing or when the person stand up after sitting. It is more common in runners and in people who are overweight, and who assumes sedentary lifestyle. People who wear wrong footwear (with high heels, shoes with hard sole) or people having flat foot are more prone to Plantar fasciitis".[4]

"Patients with plantar fasciitis tend to walk slowly than healthy individuals in order to avoid or reduce pain. They show significant decrease in cadence, gait speed, stride length, and increases in stride time".[5] "On physical examination, patients may walk with their affected foot in an equine position to avoid placing pressure on the painful heel. Palpation of the medial plantar calcaneal region will elicit a sharp, stabbing pain".[6]
"Causes of Plantar Fasciitis, Inflammation and pain in the fascia can be caused by: Increased activity level (like starting a walking or running program), the structure or shape of the foot, the surface on which you are standing, walking or running, the type shoes we wear, the weight we carry. The less commonly, Plantar Fasciitis may develop due to other medical conditions, such as Lupus or Rheumatoid Arthritis. Histology shows minimal inflammatory changes, and some experts advocate the term plantar fasciosis to counter the misperception that it is primarily an inflammatory condition".[7]
"Myofascial Release is a hands-on approach to manage pain and discomfort in Planter fascitis. In this technique pressure is applied to tight or sore areas to get them to relax. Myofascial practitioners believe that by restoring the length and health of restricted connective tissue, pressure can be relieved on pain sensitive structures such as nerves and blood vessels".[8] "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 plantar fasciitis".[9]
"The stretching method is generally safe and can provide benefits, such as prevention, enhancing the sport performance and improving the ROM and activities in patients with plantar fasciitis".[10]. "Feet that are tight can lead to less flexibility and make us more prone to injury. Stretching can help in reducing pain in plantar fasciitis and also helps to prevent it as well. Gastrocnemius-soleus stretches are thought to be advantageous in the early stages of a plantar fasciitis therapy or rehabilitation program".[11]
"In recent studies, the muscles that help to invert and evert the ankle are much weaker in a person who is experiencing the symptoms of plantar fasciitis. The lack of adequate hip strength can lead to excess motion in the lower extremity that can place too much stress on the foot and cause plantar fasciitis".[12]. "Recently there is one case study that reported that Manual Therapy and strengthening of the hip abductors effectively reduce pain in plantar fasciitis".[13]
There are very few studies done on the effect of Stretching & Strengthening of intrinsic, extrinsic muscles of foot and hip abductors & lateral rotator muscles. Therefore, the

purpose of the study is to find out the efficacy of Stretching along with MFR v/s Strengthening along with MFR in the treatment of Plantar Fasciitis

Subjects and Methods: **Evaluation of Study Subjects:** A sample of convenience of 80 subjects both male & female with diagnosis of Plantar Fasciitis by Orthopaedics surgeon were referred to Physiotherapy OPD of Mahatma Gandhi Hospital, Jaipur were recruited for this study. Subjects were randomly assigned in to two groups i.e. 40 subjects in each group. Informed consent of subjects was taken before the participation for this study. Subjects those were fulfilled the inclusion criteria were selected for this study.

Inclusion Criteria – Male and Female with 25-55 years of age, having heel pain for more than 3 months with first heel strike in the morning.

Exclusion Criteria – Corticosteroid injections, any other injuries around calcaneum, any other neurological, musculoskeletal disorders, prior calcaneum surgery.

Outcome measures: Visual analogue scale: Pain of Planter fasciitis was measured on VAS scale. VAS consists of a line, often 10 cm long, with verbal anchors at either end, similar to an NRS (e.g., "no pain" on the far left and "the most intense pain imaginable" on the far right). The patient places a mark at a point on the line corresponding to the patient's rating of pain intensity. [14] The visual analogue scale (VAS) is a valid and reliable measure of chronic pain intensity. [15]

Foot function index: "A Foot Function Index (FFI) scale is used to measure the impact of foot pathology on function in terms of pain, disability and activity restriction".[16] It is a self-administered index consisting of 23 items divided into 3 sub-scales.

Procedure: After through assessment, patients were divided into two groups.

Group A (MFR with Stretching) subjects received MFR with Stretching. MFR technique was applied with gentle pressure on sole of the foot by knuckles and by using tennis ball, 5 times/week for 2 mins. In stretching, static stretching was given by maintaining the position for 30 secs and rest of 10 sec is given, for 5 repetitions. This protocol was performed for 8 weeks.

In group B, (MFR with Strengthening) subjects received MFR techniques with strengthening exercise. MFR was given by applying gentle pressure with knuckles on the sole of foot for 1 min followed by MFR by using tennis ball for another 1 min. Strengthening was done for both intrinsic and extrinsic muscles of the foot by using TheraBand, Hip (Abductors & Lateral Rotators) by using TheraBand and weight-cuffs in supine position. Exercises was performed under the supervision of the therapist. TheraBand of different colours were used ranging from medium to high resistance. Weight-cuffs of 1kg and above is used according to patients' condition for strengthening of abductors & lateral rotators of hip. Protocol was followed 5 times/week for 8 weeks.

Statistical Analysis: Outcome measures of all the individuals were analysed on day 1 before the start of therapy, at the end of 4^{th} week and at the end of 8^{th} week, i.e., end of therapy. Comparison between the two groups was done on Paired T test. SPSS statistical software was used for data analysis.

Results: In this study, the mean age of Group A was 36.07 ± 2.28 and that of Group B was 37.67 ± 1.05 years (Figure). There is no significant difference in mean age between the selected groups.

Table 1: Demographic profile Group A & Group B

Demographic	Group A	Group B

	Mean	SD	Mean	SD
Age	36.07	2.28	37.67	1.05

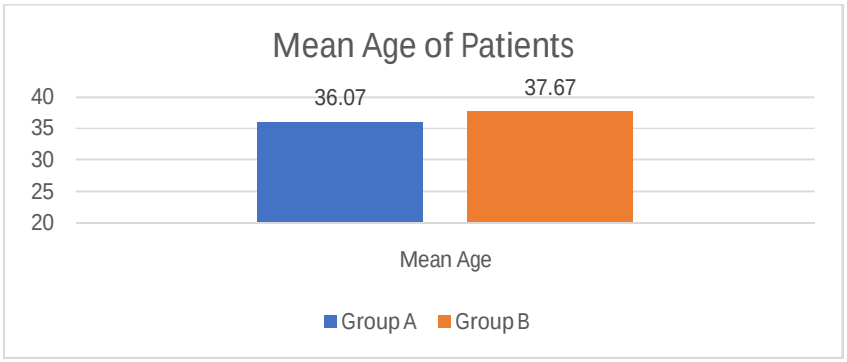

Fig 1: Comparison of Group A & Group B age mean value.

In this study Paired t- test was used for both the variables, namely VAS & FFI score.
Intergroup Analysis of VAS Score: There was no significant difference in MFR with stretching (Group A) and MFR with strengthening group (Group B) on VAS score (M=6.9, SD = 0.8) on 1st day t (19) = 0.133, p = 0.25. At the end of 4th week there was significant difference between MFR with stretching group (M =4.5750, SD =0.5006) and MFR with strengthening group (M=3.45, SD =0.5038) in VAS score t (19) = 9.9736, p <0.001. At the end of 8th week there was highly significant difference between MFR with stretching group (M =2.875, SD =0.853) and MFR with strengthening group (M=1,750, SD =0.869) in VAS score, t (19) = -5.843, p = 0.000. Therefore, the results suggest that at the end of 8th week pain level has more decreased in the MFR with strengthening group as compare to MFR with stretching group.

Groups	VAS	Mean	SD	N	T value	df	P value
Group A	Before	6.925	0.828	40	21.539	39	<0.001
	After 2 weeks	2.875	0.853	40		39	
Group B	Before	6.950	0.815	40	27.606	39	<0.001
	After 2 weeks	1.750	0.869	40		39	

Table 2: Comparison of mean value of Visual Analog Scale along with standard deviation, t-value and p-value for both groups.

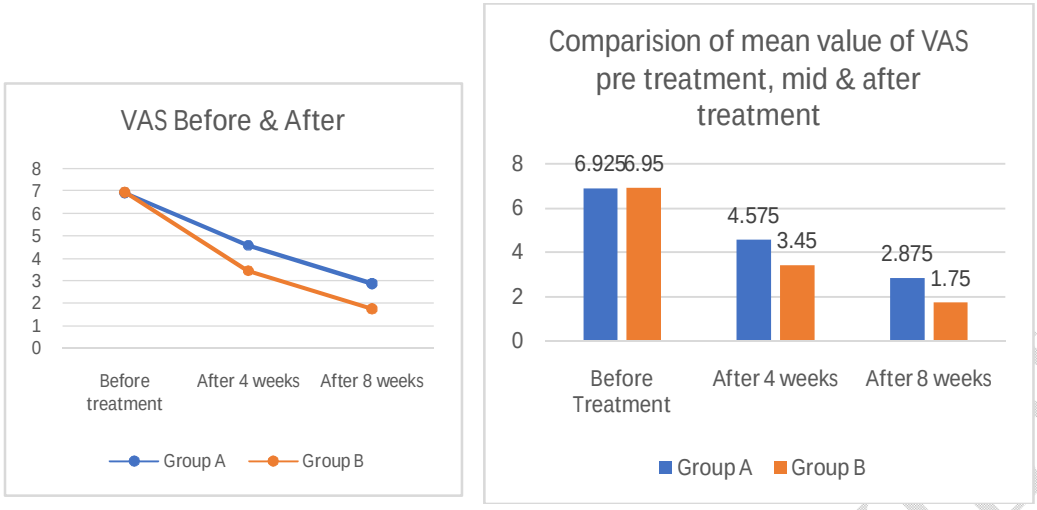

Fig 2: Inter-group analysis of VAS Score

Intergroup Analysis of FFI Score: There was no significant difference in MFR with stretching (Group A) and MFR with strengthening group (Group B) on VAS score (M=22.6, SD = 1.387) on 1st day t (19) = -1.83, $p > 0.05 < 0.1$. At the end of 4th week there was significant difference between MFR with stretching group (M =15.525, SD =0.5057) and MFR with strengthening group (M=14.450, SD =0.5038) in VAS score t (19) = 9.524, $p < 0.001$. At the end of 8th week there was highly significant difference between MFR with stretching group (M =12.025, SD =0.862) and MFR with strengthening group (M=10.862, SD =0.850) in VAS score, t (19) = 6.0759, $p < 0.001$. Therefore, the results suggest that at the end of 8th week Foot Function has more improved in the MFR with strengthening group as compare to MFR with stretching group.

Groups	FFI	Mean	SD	T value	P value
Group A	Before Treatment	22.6	1.387	40.955	<0.001
	After 2 weeks	12.025	0.862		
Group B	Before treatment	23.2	1.540	44.361	<0.001
	After 2 weeks	10.862	0.850		

Table 3: Comparison of mean value of Foot Function Index along with standard deviation, t-value and p-value for both groups.

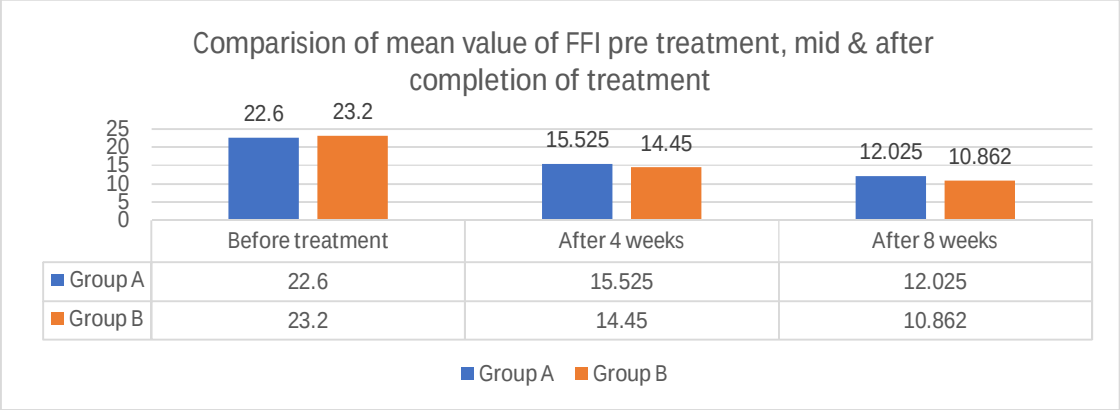

Fig 3: Inter group analysis of FFI Score

Discussion: Upon Inter-group analysis of mean difference in improvement of pain on VAS and function on FFI, result shows that in both Groups VAS Score and FFI Score decreases but it more decreases in MFR with strengthening exercises group in comparison to MFR with stretching exercises group.

Lack of strengthening of abductors and lateral rotators of hip muscles may cause Plantar Fasciitis.[17] A reduction in strength of these muscles can lead to adduction and medial rotation of hip which is related to pronation of foot. Thus, strengthening the abductor and lateral rotators of hip improves dynamic alignment of foot and improves its function.[18]

In the study conducted by Cook & Purdam it was suggested that high-load strength training that causes high tensile loads across the tendon has shown promising results in plantar fasciitis.[19]

According to a recent systematic study, there is a notable correlation between weakened intrinsic foot muscles and plantar fasciitis. Therefore, strengthening both the intrinsic and extrinsic foot muscles can alleviate pain and enhance foot function.[20]

Findings of all the above-mentioned studies supports the result of our study that, strengthening exercises of hip & foot muscles are very much effective in relieving of pain & improving function in case of plantar fasciitis.

In another study, strengthening programs were cited as the most helpful treatment by 34.9 percent of the subjects, compared with exercise, night splints, orthotics, heel cups, NSAIDs, steroid injection or surgery.[21]

"Compared to a stretching exercise program, a strengthening exercise program for the intrinsic and extrinsic foot muscles resulted in greater improvements in both pain and gait parameters. While the stretching exercises provided significant benefits during the first month of the intervention, the strengthening exercises produced more long-term benefits, as evidenced by improvements that were still present at the 2-month follow-up". [5]

"The intrinsic and extrinsic foot muscles play an important role in maintaining the arches of the foot while walking. The strengthening exercise program for these muscles was expected to have better improvements in pain and gait parameters than the stretching exercise program". [22,23]

Results of all these studies reveals the efficacy of strengthening exercises over stretching exercises in the management of pain & function in case of plantar fasciitis.

"It is possible that treatment with MFR in Plantar heel Pain may result in a halt in the degenerative process of the plantar fascia by facilitating the healing process and the fascial

architecture to return toward normality [24] In one study it was found that MFR is more efficient as compared to sham ultrasound therapy in the treatment of plantar fasciitis". [25]
Study done by Shirat Ling, DO, 1999, concluded that "direct MFR is a highly effective technique for plantar fasciitis patients who need to recover quickly".[26] "MFR technique is used to ease pressure in the fibrous bands of the connective tissue function, or fascia which is given in chronic conditions. 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" [27,28] Results of all these studies also supports the findings of our study.

Conclusion

Myofascial release technique with Strengthening exercises are more effective in relieving pain and improving function as compared to MFR with stretching exercises in case of plantar fasciitis.

After 8 week of training it was found that Strengthening of foot intrinsic and extrinsic muscles with hip abductors & lateral rotators along with Myofascial release has good results in patients with plantar fasciitis as compared to Stretching of foot intrinsic and extrinsic muscles with hip abductors & lateral rotators along with Myofascial release.

Ethical Approval:

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

Consent

As per international standard or university standard, patient(s) written consent has been collected and preserved by the author(s).

References:

1. Goff, J. D., & Crawford, R. (2011). Diagnosis and treatment of plantar fasciitis. *American family physician*, *84*(6), 676-682.
2. Bijur, P. E., Silver, W., & Gallagher, E. J. (2001). Reliability of the visual analog scale for measurement of acute pain. *Academic emergency medicine*, *8*(12), 1153-1157
3. Irving, D. B., Cook, J. L., Young, M. A., & Menz, H. B. (2008). Impact of chronic plantar heel pain on health-related quality of life. *Journal of the American Podiatric Medical Association*, *98*(4), 283-289.
4. Tahririan, M. A., Motififard, M., Tahmasebi, M. N., & Siavashi, B. (2012). Plantar fasciitis. *Journal of research in medical sciences : the official journal of Isfahan University of Medical Sciences*, *17*(8), 799–804.
5. Thong-On, S., Bovonsunthonchai, S., Vachalathiti, R., Intiravoranont, W., Suwannarat, S., & Smith, R. (2019). Effects of strengthening and stretching exercises on the temporospatial gait parameters in patients with plantar fasciitis: A randomized controlled trial. *Annals of rehabilitation medicine*, *43*(6), 662-676
6. Dos Santos, B., Corrêa, L. A., Santos, L. T., Meziat Filho, N. A., Lemos, T., & Nogueira, L. A. C. (2016). Combination of hip strengthening and manipulative therapy for the treatment of plantar fasciitis: a case report. *Journal of Chiropractic Medicine*, *15*(4), 310-313.
7. Covey, C. J., & Mulder, M. D. (2013). Plantar fasciitis: How best to treat. *J Fam Pract*, *62*(9), 466-71.
8. Schleip, R. (2003). Fascial plasticity–a new neurobiological explanation: Part 1. *Journal of Bodywork and movement therapies*, *7*(1), 11-19.
9. AM, H., Kage Vijay, B., & Basavaraj, C. (2010). Comparison of myofascial release and positional release therapy in plantar fasciitis–A clinical trial. *Physiotherapy and Occupational Therapy*, *4*(4), 8.
10. Engkananuwat, P., Kanlayanaphotporn, R., & Purepong, N. (2018). Effectiveness of the simultaneous stretching of the Achilles tendon and plantar fascia in individuals with plantar fasciitis. *Foot & ankle international*, *39*(1), 75-82.
11. Garrett, T. R., & Neibert, P. J. (2013). The effectiveness of a Gastrocnemius–Soleus stretching program as a therapeutic treatment of plantar fasciitis. *Journal of sport rehabilitation*, *22*(4), 308-312.
12. Alshami, A. M., Souvlis, T., & Coppieters, M. W. (2008). A review of plantar heel pain of neural origin: differential diagnosis and management. *Manual therapy*, *13*(2), 103-111.
13. Lee, J. H., Park, J. H., & Jang, W. Y. (2019). The effects of hip strengthening exercises in a patient with plantar fasciitis: A case report. *Medicine*, *98*(26).
14. Gosnell, E. S., & Thikkurissy, S. (2019). Assessment and management of pain in the pediatric patient. In *Pediatric Dentistry* (pp. 97-115). Elsevier.
15. Thomas, M. J., Whittle, R., Menz, H. B., Rathod-Mistry, T., Marshall, M., & Roddy, E. (2019). Plantar heel pain in middle-aged and older adults: population prevalence, associations with health status and lifestyle factors, and frequency of healthcare use. *BMC musculoskeletal disorders*, *20*(1), 1-8.
16. Budiman-Mak, E., Conrad, K. J., & Roach, K. E. (1991). The Foot Function Index: a measure of foot pain and disability. *Journal of clinical epidemiology*, *44*(6), 561-570.
17. Martin, R. L., Davenport, T. E., Reischl, S. F., McPoil, T. G., Matheson, J. W., Wukich, D. K., ... & Godges, J. J. (2014). Heel pain—plantar fasciitis: revision 2014. *Journal of Orthopaedic & Sports Physical Therapy*, *44*(11), A1-A33.
18. Kamonseki, D. H., Gonçalves, G. A., Liu, C. Y., & Júnior, I. L. (2016). Effect of stretching with and without muscle strengthening exercises for the foot and hip in patients with plantar fasciitis: A randomized controlled single-blind clinical trial. *Manual therapy*, *23*, 76-82.

19. Cook, J. L., & Purdam, C. R. (2009). Is tendon pathology a continuum? A pathology model to explain the clinical presentation of load-induced tendinopathy. *British journal of sports medicine*, *43*(6), 409-416.
20. Huffer, D., Hing, W., Newton, R., & Clair, M. (2017). Strength training for plantar fasciitis and the intrinsic foot musculature: A systematic review. *Physical Therapy in Sport*, *24*, 44-52.
21. Young, C. C., Rutherford, D. S., & Niedfeldt, M. W. (2001). Treatment of plantar fasciitis. *American family physician*, *63*(3), 467.
22. Sullivan, J., Burns, J., Adams, R., Pappas, E., & Crosbie, J. (2015). Musculoskeletal and activity-related factors associated with plantar heel pain. *Foot & ankle international*, *36*(1), 37-45.
23. Mulligan, E. P., & Cook, P. G. (2013). Effect of plantar intrinsic muscle training on medial longitudinal arch morphology and dynamic function. *Manual therapy*, *18*(5), 425-430.
24. Meltzer, K. R., Cao, T. V., Schad, J. F., King, H., Stoll, S. T., & Standley, P. R. (2010). In vitro modeling of repetitive motion injury and myofascial release. *Journal of bodywork and movement therapies*, *14*(2), 162-171.
25. Joshi, D. G., Balthillaya, G., & Prabhu, A. (2018). Effect of remote myofascial release on hamstring flexibility in asymptomatic individuals–A randomized clinical trial. *Journal of bodywork and movement therapies*, *22*(3), 832-837.
26. AM, H., Kage Vijay, B., & Basavaraj, C. (2010). Comparison of myofascial release and positional release therapy in plantar fasciitis–A clinical trial. *Physiotherapy and Occupational Therapy*, *4*(4), 8.
27. Dyck Jr, D. D., & Boyajian-O'Neill, L. A. (2004). Plantar fasciitis. *Clinical Journal of Sport Medicine*, *14*(5), 305-309.
28. Leadbetter, W. B. (1992). Cell-matrix response in tendon injury. *Clinics in sports medicine*, *11*(3), 533-578.