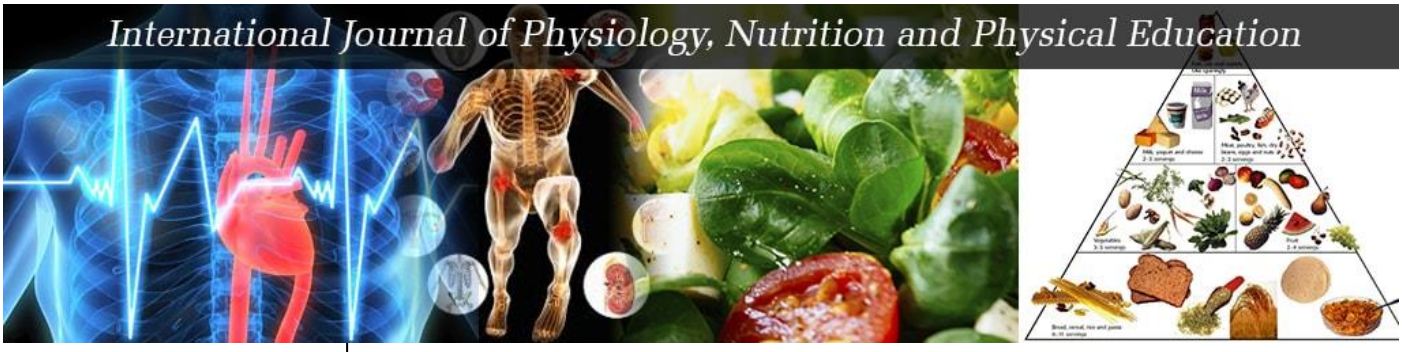

ISSN: 2456-0057
IJPNPE 2020; 5(2): 88-91

www.journalofsports.com
Received: 19-05-2020
Accepted: 22-06-2020

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Effectiveness of hamstring stretching on plantar fasciitis: A pilot study

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Abstract
Background: Plantar fasciitis is a musculoskeletal condition that results from degenerative irritation of the plantar fascia. Though the association between hamstring tightness and plantar fasciitis is established, however the interventional study and its effectiveness is not established. This study aims to find out the effectiveness of hamstring stretching on plantar fasciitis.
Methodology: Twenty patients with plantar fasciitis were divided into 2 groups *viz* group A and group B. Both the group received conventional therapy; plantar fascia stretch, gastrosoleus stretch and transverse frictional massage. In addition to this group A received 3 set of passive hamstring stretching. Visual Analogue Scale (VAS) and Foot and Ankle Ability Measure (FAAM).
Results & Conclusion: Pre and post value comparison of VAS within the group A (p=0.00) and group B (p=0.00) & FAAM within the group A (p=0.00) and group B (p=0.00) was statistically significant. Comparison of pre VAS (p=1.00) and FAAM (p=0.590) between the groups was statistically not significant. Comparison of post VAS (p=0.556) and FAAM (p=0.973) between the groups was statistically not significant. Results indicate that intervention in both the groups was effective in alleviating pain and dysfunction. But neither the group shows statistically significant difference in reducing pain and dysfunction.

Keywords: Hamstring tightness, intervention, plantar fasciitis, stretching

1. Introduction
The plantar fascia is comprised of white longitudinally organized fibrous connective tissue which originates on the periosteum of the medial calcaneal tubercle [1]. The aponeurosis consists of a medial, central and lateral part. Plantar fasciitis (PF) is a musculoskeletal condition that results from degenerative irritation of the plantar fascia origin at the medial calcaneal tuberosity of the heel as well as the surrounding perifascial structures. The fascia itself is important in providing support for the arch and providing shock absorption. Despite the term containing the segment "itis," this condition is notably characterized by an absence of inflammatory cells [2, 3]. It is thought to occur in about 10% of the general population as well, with 83% of these patients being active working adults between the ages of 25 and 65 years old [4].
The hamstring muscle complex is comprised of three individual muscles and plays a critical role in human activities ranging from standing to explosive actions such as sprinting and jumping [5]. Javaid *et al*. found that, there was noteworthy tightness in hamstring and calf muscles in subjects of planter fasciitis [6]. Increase in hamstring tightness may induce prolonged forefoot loading and through the windlass mechanism and also the plantar fascia and hamstings are connected by superficial back line. Hamstring tightness plays a significant role in the presence of plantar fasciitis and should be addressed along with equinus and obesity when providing treatment to patients with this diagnosis [7].
The visual analogue scale (VAS) is commonly used as the outcome measure for pain. Its simplicity, reliability, and validity, as well as its ratio scale properties, make the VAS the optimal tool for describing pain severity or intensity [8]. The intraclass correlation coefficients of the VAS is 0.97, which is of excellent (>0.90) reliability. Minimum detectable change of VAS is 0.08 [9]. The Foot and Ankle Ability Measure (FAAM) is a self-report outcome instrument developed to assess physical function for individuals with foot and ankle related impairments.

It is divided into two subscales: Activities of Daily Living Subscale and Sports subscale. It has a good reliability with ICC value of 0.89 for Activities of Daily Living (ADL) and 0.87 for Sports subscale [10, 11]. Foot and ankle ability measure is a valid and reliable tool for plantar fasciitis.

There have been few studies about the relationship between tightness of the posterior lower limb muscles and PF, and most of them can be interpreted in terms of some contracture of the posterior muscles of the leg or thigh being present in cases of PF [6]. Though the association between hamstring tightness and plantar fasciitis is established, however the interventional study to find out effectiveness of hamstring stretching in plantar fasciitis is not available in literature as per our knowledge. Hence, this study aims to find out the effectiveness of hamstring stretching on plantar fasciitis.

2.Methodology

2.1 Study design and Participants

This two group experimental study design was carried out in a period of 12 months from April 2019 to April 2020. Both the gender, twenty, physician diagnosed plantar fasciitis in tertiary hospital in Mangalore were recruited for this study. Convenient sampling method was used. Ethical clearance was obtained from the Ethical Committee of A J Institute of Medical Sciences, Mangalore. Inform consent was obtained from all the subjects prior to the study.

2.2 Intervention

Physician diagnosed plantar fasciitis patients having were screened by following: Heel pain with first steps in the morning or after long periods of non-weight bearing, tenderness to the anterior medial heel, limited dorsiflexion, achilles tendon tightness and hamstring tightness. Any foot deformities, recent corticosteroid injection to plantar fascia, patients with plantar fasciitis without hamstring tightness were excluded from the study. Patients were divided into 2 groups *viz* group A and group B. Both the group received conventional therapy; plantar fascia stretch, gastrosoleus stretch and transverse frictional massage. In addition to this group A received 3 set of passive hamstring stretching.

Plantar fascia stretching was carried out by therapist; 30 seconds hold with 3 repetitions when patient was in non weight bearing position i.e supine lying, by utilizing the windlass mechanism. Intensity of the stretch was kept to the point where patient complains of slight discomfort and taut plantar fascia on palpation (Figure 1). Gastrosoleus stretching was carried out by therapist with 10 sec hold and 10 repetitions when patient was in supine lying. Intensity of the stretch was kept to the point where patient complains of slight discomfort (Figure 2). Transverse friction massage was applied by therapist manually directly to the origin of the plantar fascia using a repetitive back-and-forth motion, transversely across the affected structure with adequate sweep to cover the affected area. The patient was positioned in half lying and the great toe kept in dorsiflexion throughout the application so as to maintain a stretch to the plantar fascia (Figure 3). Three sets of 30 seconds hold passive hamstring stretching was provided by therapist when the patient was in supine lying. Intensity of the stretch was kept to the point where patient complains of slight discomfort (Figure 4). Treatment duration was; four days per week for two weeks. Pre and post assessment was carried out before and after 2 weeks of intervention programme.

Fig 1: Plantar fascia stretching

Fig 2: Gastrosoleus stretch

Fig 3: Transverse friction massage of plantar fascia

Fig 4: Hamstring stretching

2.3 Outcome Measure
Visual Analogue Scale (VAS) was used to measure pain intensity and Foot and Ankle Ability Measures (FAAM) was used to measure the physical function in patients with plantar fasciitis.

2.4 Data analysis
The collected information about VAS and FAAM score was summarized by using mean and standard deviation. Shapiro-Wilk test was used to test the normality. The pre and post measurement of VAS and FAAM within a group was compared by using paired 't' test. To compare the outcome measures between two groups, independent 't' test was used. Statistical package SPSS ver.16.0 was used to do the analysis. $p< 0.05$ was considered as statistically significant.

3. Results
Mean and standard deviation of age, Body Mass Index (BMI), pre VAS, post VAS, pre FAAM and post FAAM of both the group are presented in Table No. 1. Gender distribution is shown in Figure 5. Pre and post value comparison of VAS within the group A (p=0.00) and group B (p=0.00) & FAAM within the group A (p=0.00) and group B (p=0.00) was statistically significant. Comparison of pre VAS (p=1.00) and FAAM (p=0.590) between the groups was statistically not significant. Comparison of post VAS (p=0.556) and FAAM (p=0.973) between the groups was statistically not significant.

Table 1: Descriptive statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age A	10	24.00	52.00	38.9000	9.76900
Age B	10	19.00	38.00	27.5000	6.65415
BMI A	10	20.51	27.63	24.0400	1.88063
BMI B	10	20.38	26.20	23.3800	2.01731
Pre VAS A	10	5.00	9.00	7.1500	1.15590
Post VAS A	10	3.00	6.50	5.0500	1.11679
Pre FAAM A	10	39.29	85.71	61.4900	13.87281
Post FAAM A	10	54.57	92.59	73.7240	12.26906
Pre VAS B	10	5.00	8.00	6.6000	1.17379
Post VAS B	10	3.00	7.50	5.1000	1.46818
Pre FAAM B	10	43.10	70.29	53.2370	10.58721
Post FAAM B	10	50.21	82.35	66.3720	11.77158
Valid N (listwise)	10				

Gender Distribution

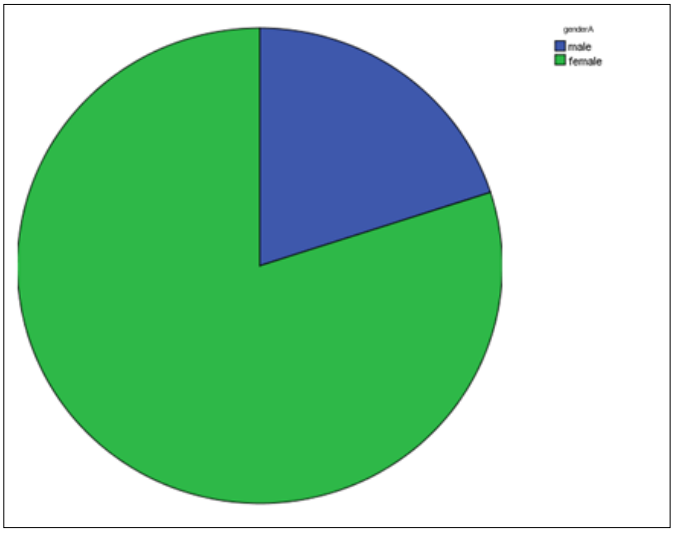

Fig 5: Gender distribution of group A

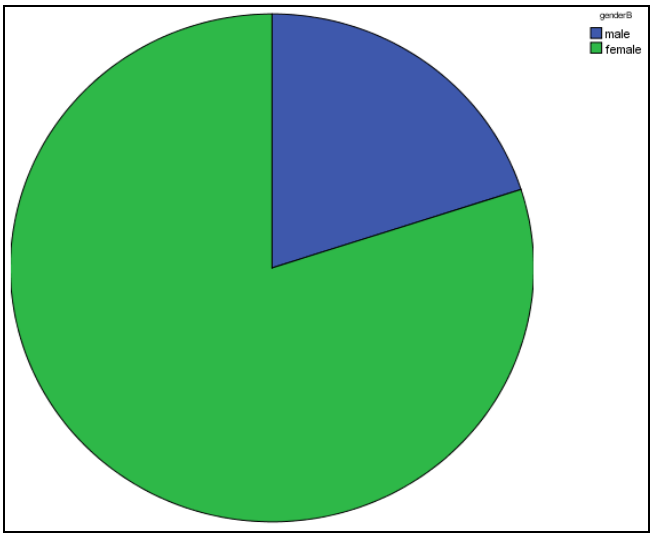

Fig 6: Gender distribution of group B

Table 2: Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pre VAS A – post VAS A	2.10000	.69921	.22111	1.59982	2.60018	9.498	9	.000
Pair 2	Pre FAAM A - post FAAM A	-1.22340E1	2.68056	.84767	-14.15155	-10.31645	-14.433	9	.000
Pair 3	Pre VAS B – post VAS B	1.50000	.57735	.18257	1.08699	1.91301	8.216	9	.000
Pair 4	Pre FAAM B - post FAAM B	-1.31350E1	5.18173	1.63861	-16.84179	-9.42821	-8.016	9	.000

Table 3: Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Pre VAS	Equal variances assumed	.000	1.000	1.503	18	.150	.75000	.49917	-.29871	1.79871
Post VAS	Equal variances assumed	.360	.556	.266	18	.793	.15000	.56396	-1.03484	1.33484
Pre FAAM	Equal variances assumed	.301	.590	1.045	18	.310	5.82500	5.57153	-5.88035	17.53035
Post FAAM	Equal variances assumed	.001	.973	.945	18	.357	5.05500	5.34703	-6.17869	16.28869

4. Discussion

Plantar fasciitis, though a common condition seen by pain specialists, occasionally presents diagnostic dilemmas and very often the management of this condition suffers from lack of awareness of the varied treatment modalities and progressive escalation of treatment options [11]. This study was carried out to find the effectiveness of hamstring stretching in plantar fasciitis. Pre and post value comparison of outcome measures within the group was statistically significant in both the group. VAS was significantly reduced after the treatment in both group, which imply that pain was reduced in both the groups. FAAM was significantly raised, indicating less dysfunction after the treatment. Higher scores represent higher levels of function for each subscale, with 100% representing no dysfunction [9]. Pre and post value comparison of outcome measures between the groups was statistically not significant. Above results indicate that intervention in both the groups was effective in alleviating pain and dysfunction. But neither the group shows statistically significant difference in reducing pain and dysfunction.

Increased hamstring tightness causes early contraction of the posterior leg muscle through the gait cycle and decrease ankle dorsiflexion [12]. This functional biomechanical deficit causes significant increase in the tension of the plantar fascia, which is known to have minimal elasticity [13, 14]. The typical treatment for plantar fasciitis involves decreasing the abnormal mechanics causing overload to the plantar fascia. Lobovitz *et al*. in their correlation study suggested that hamstring tightness should be addressed in the treatment protocol [15]. Comparison between the groups didn't show the significant difference. This might be due to the small effect of hamstring stretching which got masked by other treatment intervention. This might be due to the small sample size to show statistical difference. However, we noticed that, the group which include hamstring stretching found more comfortable and earlier pain relief.

Several limitations of this study should be considered. First, sample size was small. Second, though we excluded patients who exposed to corticosteroid injection, other medication they consumed was not taken into consideration. Lastly, study was not blinded.

Future study to address the sample size and compare with placebo or sham treatment is necessary to find out the effect of isolated hamstring stretching in case of plantar fasciitis. Future study should focus to find out which patients with plantar fasciitis gets benefit with hamstring stretching intervention.

5. Conclusion

This study indicate that intervention in both the groups was effective in alleviating pain and dysfunction. But neither the group shows statistically significant difference in reducing pain and dysfunction. This study was not blinded and sample size was small, hence results of this study should be interpreted with caution.

6. Funding/Support

The authors declare that no funding was provided for this study.

7. Acknowledgement

We would like to express our gratitude to the all the patients and to the teaching staff of our institute for their support and guidance.

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