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EFFECT OF FOOT INTRINSIC MUSCLE TRAINING IN SUBJECTS WITH PLANTAR FASCIITIS – A RANDOMIZED CLINICAL TRIAL

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ABSTRACT

Background: Flat foot or excessive pronation causes altered biomechanics of lower limb which leads to excessive mobility which puts increased stress on the plantar fascia. It has been found out that there is significant atrophy of foot intrinsic muscles in people with plantar fasciitis. Foot intrinsic muscle training is commonly used to control the excessive pronation. Studies have been done to know the effect of Foot intrinsic muscle training in normal subjects but no study is available in people with plantar fasciitis.

Objective: To evaluate and compare the effectiveness of foot intrinsic muscle training and traditional physiotherapy in subjects with plantar fasciitis.

Methodology: 64 Subjects were participated in study with age group between 18 – 50 years who had met the inclusion criteria. They were randomly divided in to two groups, Foot intrinsic muscle training group and Traditional physiotherapy approach group. Outcome measures were Foot function index and navicular drop test.

Results: Statistical analysis was conducted in order to identify differences between the experimental and the control group. Overall, there were clinical significance difference in Pain score ($p<0.001$), Activity limitation ($p<0.001$), and Navicular drop ($p<0.001$), but Disability has shown no clinically significant differencein both FIMT and TP.

Conclusion: There was a significant difference between foot intrinsic muscle training group with Traditional physiotherapy group in Pain, Activity limitation and Navicular Drop but no significance difference in Disability which indicates intrinsic muscle training of foot is superior to traditional treatment approach in the management of pain, activity limitation and navicular drop plantar fasciitis.

INTRODUCTION

Plantar fascia is the principle static and dynamic stabilizer of foot longitudinal arches and also act as a shock absorber and helps to protect the underlying soft tissue (Ravindra Puttaswamaiah, 2007). Plantar fasciitis is a degenerative syndrome of the plantar fascia resulting from repeated trauma at its origin on the calcaneus (Cornwall, 1999). Degenerative changes can lead to acute and chronic inflammation and may also cause calcification at the origin of the plantar fascia and bony traction spur formation (Ravindra Puttaswamaiah, 2007 and Cornwall, 1999). In normal gait, ground reaction forces travel upward on the meta tarsal heads and the calcaneus which will cause the flattening of arch and also Vertical forces from body weight travel downward via the tibia and tend to flatten the medial longitudinal arch because these forces fall both posterior and anterior to the tibia. But the plantar fascia by virtue of its anatomical arrangement and tensile strength it prevents collapse of the arch (Hicks, 1954; Lori, 2004 and Kim, 1995). Occurrence of plantar fasciitis is often unclear and may be due to many factors. Possible risk factors include obesity, occupations which require prolonged standing prolonged weight bearing. Other risk factors can be broadly divided into extrinsic like training errors and equipment and intrinsic like functional and structural or degenerative (Cornwall, 1999; Riddle, 2003 and Young, 2001). Among extrinsic factors those athletes who have an history of an increased distance, intensity or duration of activity. In addition speed work outs, plyometric, hill workouts are particularly high risk factors. In intrinsic factors faulty bio mechanics such as over pronation of foot and pescavus and pesplanus weak tibialis posterior and decreased dorsiflexion and weak intrinsic foot muscles (Cornwall, 1999 and Kim, 1995). Many previous

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studies investigating risk factors associated with plantar fasciitis have reported a strong relationship between decreased ankle dorsiflexion mobility and plantar fasciitis. Limited ankle dorsiflexion during gait causes over pronation of the foot, placing repetitive longitudinal stress on the plantar fascia may result in plantar fasciitis (Cornwall, 1999 and Riddle, 2003). 10% of the population experience plantar heel pain at some point during their lifetime and plantar fasciitis accounts for approximately 1% of all outpatient visits to orthopaedic clinics. One of the most important factors for plantar fasciitis is weakness of foot intrinsic muscles. Research has suggested that these intrinsic muscles have a functional role in stabilizing the foot during single limb stance and supports medial longitudinal arch. Weakness of these intrinsic muscles may leads to fatigue resulting in over pronation and puts undue stress over the plantar fascia which will result in plantar fasciitis and increased navicular drop (Allen, 2003; Wearing, 2007; Chang, 2012 and Headlee, 2008). A reduced participation by these muscles could prolong the healing process by putting added stress onto the already compromised plantar fascia and thus perpetuating the state of injury. With respect to treatment of plantar fasciitis, 90-95% of the reported patients diagnosed with plantar fasciitis receive conservative treatment. In addition to conservative treatment, 5-10% of plantar fasciitis patients require surgical intervention (Ravindra Puttaswamaiah, 2007; Wearing, 2006; O'Malley, 2000; Headlee, 2008). In the rehabilitation of foot and ankle pain syndromes these muscles are mostly neglected yet which are functionally essential muscles. Till now many experimental studies have been done which focused on various treatment approaches but none of them focused on relevance of these muscles in people with plantar fasciitis. Therefore, the purpose of this study was to investigate the effects of foot intrinsic muscle training infunctional performance of people with plantar fasciitis measuring foot function index and Navicular drop.

MATERIALS AND METHODS

Subjects were recruited from Department of Physiotherapy, Srinivas Hospital Mangalore. Inclusion Criteria includes Age 18 to 50 years that are diagnosed with plantar fasciitis. Pain provoked by first few steps in the morning, by prolonged standing and walking. Tenderness localized to the origin of plantar fascia on the medial tubercle of calcaneus. Excluded if any lower extremity injuries within 6 months. Receiving plantar steroid injection within 3 months. Other painful foot condition such as bunion, corn, or ingrown toe nail. Any other lower extremity neuromuscular condition. Previous foot surgery or recent abrupt trauma on foot. Congenital defects of the lower extremity. Foot pathology other than plantar fasciitis including tendonitis, bursitis, or calcaneus fracture or tarsal tunnel syndrome and Diabetic neuropathy. A priori power analysis calculation established that a sample size of 32 subjects per group would provide 80% power to detect a meaningful clinical difference with a pair wise comparison among the 2 groups at an alpha level of 0.05 (2-tailed test).

Methodology

Eighty one patients were screened for inclusion in the study, with of them 17 not meeting the inclusion criteria. Therefore, 64 patients participated in this study. Following the baseline examination, patients were randomly assigned to either the FIMT Group (n=32), or TP Group (n=32). Allocation was performed by using a randomizedtable of numbers created prior to the beginning of the study. Index cards with the random assignments were prepared and placed in sealed envelopes. A researcher who was blinded to the baseline examination findings opened the envelope and proceeded with treatment according to the group assignment. All participants gave informed consent upon enrollmentin the study.

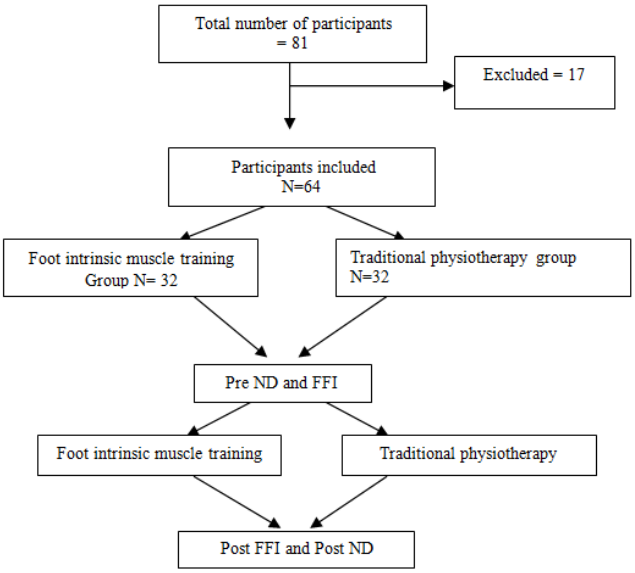

Figure 1. Consort flow chart including randomization of groups

Statistical Analysis

Descriptive analysis was done and then subjected to test of normality. Inferential analysis was carried out by non-parametric tests as the sample size was small which did not show a normal distribution. The confidence interval for the tests was kept at 95%.Mann Whitney test was used to compare the outcomes between the two groups and Wilcox on Signed Rank test was used to compare the outcomes within the same group pre and post intervention.

RESULTS

Table 1. Summary of Participant Demographics

Variables	FIMT group(n=32)	TP group (n=32)
Age (years)*	39.6±5.1	40.1±5.4
Male, female	19,13	17,15
Height (cm)*	164.6±4.2	161.9±4.7
Weight (kg)*	59.1±4.2	60.1±4.9
BMI	21.4±2.3	22.5±1.1
Pain*	51.8±5.5	52.1±6.2
Activity limitation*	57.2±5.4	57.5±5.4
Disability*	7.8±1.3	7.7±1.3
Navicular Drop*	13.9±1.4	13.1±2.4

DISCUSSION

This study is to evaluate the effect of foot intrinsic muscle training on plantar fasciitis. Initial findings support that a simple foot intrinsic muscle training program has an impact on and pain, activity limitation and navicular drop of foot function index in subjects with plantar fasciitis than that of traditional physiotherapy treatment. Not only do these muscles prevent increased ND they may have the capacity to alter the FFI with a simple exercise regimen.

Table 2. Pre - Post Value and Mean Differences of Both The Groups

	FIMT group		TP group		
MEASURES	Mean±SD	Mean difference	Mean±SD	Mean difference	p-value
Pain –pre	51.8±5.5	13.9±3.1	52.1±6.2	9.8±2.1	0.001
Pain –post	37.91±7.1		42.1±5.1		
Activity- pre	57.2±5.4	9.5±2.8	57.5±5.4	6.6±1.9	0.001
Activity- post	47.7±5.9		50.8±5.3		
Disability- pre	7.8±1.3	3.3±0.8	7.7±1.3	3.3±0.7	0.001
Disability- post	4.5±0.8		4.5±0.8		
Nav.Drop- pre	13.9±1.4	8.8±1.3	13.1±2.4	3.8±0.8	0.001
Nav.Drop -post	5.7±1.5		9.3±2.1		

It is important to note that this study is an indirect assessment of the influence of plantar intrinsic foot muscle training as there are currently no gold standards of measuring isolated intrinsic foot muscle strength (Soysa, 2012). Instead in this study it was evaluated the effect of plantar intrinsic foot muscle training in its ability to impact navicular position and influence foot function during taskswith increased postural demands (Kelly, 2012). The results of this study shows there was a significant mean difference in pain score of 13.8 ($p< 0.001$) and 9.8 ($p< 0.001$),activity limitation of 9.4 ($p< 0.001$) and 6.6 ($p< 0.001$) and Navicular drop of 8.2mm ($p< 0.001$) and 3.8mm ($p< 0.001$) with 95% CI in FIMT group and TP group respectively .But no significant difference of 3.2 ($p< 0.001$) and 3.2 ($p< 0.001$) in both FIMT group and TP group. The clinical relevance of these changes has yet to be established with metric assessment of the minimal detectable change (MDC) values.

Hence in this study it found that the standard error of measurement (SEM) for the navicular drop is in the range of 2.4 mm which computes to an MDC of approximately 7 mm. FIMT training targets the plantar intrinsic muscles of the foot. These intrinsic muscles may have a similar functional role as the deep core stabilizers of the spine. They work at segmental levels to stabilize the Medial Longitudinal Arch and have an important neuromuscular role in fine tuning of the position of the arch during weight-bearing functional activities. These findings may be of value to clinicians who attribute excessive pronation as a contributing factor to lower extremity injuries (Edward, 2013; Scott, 2012 and Jung, 2011). The subjects in this study were a symptomatic with a wide range of ND with 16mm but post hoc analysis revealed a significantly greater impact on navicular height drop in those feet whose baseline ND for FIMT intrinsic foot muscle training group as compared to TP group. This amount of ND was chosen as this value is a commonly accepted standard as proposed by Brody as being abnormal or excessive drop.

The overall mean change inND for the study population of FIMT group was approximately 8mm. Conversely, subjects group with TP group was 4 mm drop saw essentially no change in their ND after 4 weeks. Using the somewhat arbitrary, but commonly accepted standard of greater than a 10-15 mm ND one could speculate that the exercise training may have a more specific impact on subjects with abnormal STJ hyperpronation compensation tendencies. The limitation to this present study is effectiveness of treatment for long term duration. Nevertheless, the fact that there was a statistically significant increase in Pain, Activity limitation and Navicular drop for short term duration but for long term duration is inconclusive. Therefore, follow-up studies lasting more than 3 months have been beneficial.

Conclusion

In this study foot intrinsic muscle training and traditional physiotherapy approaches were administered to subjects with plantar fasciitis. It showed significant results for FIMT group in Pain, Activity limitation and Navicular Drop but no significance in Disability. Further research should be conducted for further analysis and better protocol regime for plantar fasciitis management and functional performance enhancement with long term effects.

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