Journal of Research Administration
Society of Research Administrators International

EFFECTIVENESS OF INTRINSIC AND EXTRENSIC MUSCLE STRENGTHENING EXERCISES WITH MFR OF PLANTAR FASCIA IN INDIVIDUAL WITH PLANTAR FASCIITIS

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Abstract
The plantar fascia is a thick band of tissue (fascia) that connects your heel bone to the base of your toes. The fascia is centrally, known as aponeurosis and is thin along the sides. The fascia consists of three parts, medial, lateral and the central part, respectively.
Objective: The present study was done to find the effectiveness of combination of intrinsic and extrinsic muscle strengthening for plantar fasciitis.
Methodology: A sample size of 30 subjects were selected by random sampling method and divided into three groups containing 10 in each group. Subject in group A were treated with intrinsic muscle strengthening, subject in group B were treated with extrinsic group of strengthening only. Group C was treated with combination of intrinsic and extrinsic muscle strengthening.
Results: Myofascial release technique help to break the break adhesion and soft tissue contractures. the vicious cycle of tightness and weakness by broke by including strengthening of extrinsic and intrinsic muscle along with release of posterior muscle while ultimately increased ankle dorsiflexion.
Conclusion: Thus the study conclude that the simultaneous stretching and strengthening of both the muscle groups is superior to strengthening of single muscle group alone.
Keywords: Plantar fascia, Intrinsic muscle, Extrinsic muscle, Myofascial-release (MFR).

1. INTRODUCTION

The plantar fascia is a band of tissue (fascia) that connects your heel bone to the base of your toes. The fascia is thick centrally, known as aponeurosis and is thin along the sides. The fascia consists of three parts, medial, lateral and the central part, respectively. The aponeurosis is triangular in shape. The central portion, is attached to the medial tubercle of the calcaneal , proximal to the attachment of the Flexor Digitorum Brevis and it divides into five processes, near the head of the metatarsal bones, one for each of the toes. Each of these processes further divides opposite to the MTP articulation into two strata, superficial and deep. Wind-lasss mechanism is something which make foot to adapt according to surface or force, dissipate force and stress during gait .in plantar fasciitis the windlass mechanism might not function properly and lead to compensatory

mechanism which hamper the biomechanical chain. during weight bearing when the first metatarsophalangeal joint (MTPJ) moves into extension:

1. The medial longitudinal arch (MLA) height increases.
2. The calcaneus inverts.
3. The leg (tibia and fibula) externally rotates.
4. A tight band appears (the plantar aponeurosis) [4]

It maintain the normal biomechanics of the foot by absorbing the shock from the upper body weight while weight transfer activity during gait [3]. as per the estimation fascia can carry upto14% of the total load of the foot. Any damage to fascia can lead to imbalance of whole biomechanics of foot and may also lead to related abnormalities to proximal joint structure.

Muscles that have the ability to influence height of the medial longitudinal arch include tibialis anterior, tibialis posterior, peroneals and gastrocnemius [4] there is link between plantar fascia, achilles tendon, gastrocnemius muscle. Increased tensile force at achilles tension lead to development of plantar fasciitis by directly or indirectly increasing force on the plantar structure of the foot. gastrocnemius is the chief muscle of the calf.it is two headed muscle present at the back of the foot. gastrocnemius is primarily involved in running, jumping and other "fast" movements of leg [5]. triceps surae-comprised of three heads, two are superficial consisting of medial and lateral head of gastrocnemius. soleus is a deep muscle and small percentage of plantaris. Main function of the muscle is plantar flexion of the foot and its supination along with flexion of the knee. gastrocnemius restrains forward tibial translation of knee [6] during plantarflexion medial head acts with more power than lateral head of gastrocnemius.

Plantar fasciitis is a inflammatory condition causing severe pain and disabling in nature. Pathogenesis of plantar fasciitis involve micro tears within fascia due to physical-mechanical overload and degeneration of plantar aponeurosis. Pain is very severe during the first weight-bearing steps in the morning and after prolonged period of rest. Morning pain is mostly due to the sudden tension on the shortened fascia which get stretched on first step in the morning. Obesity, prolonged standing, flat feet, soleus-gastrocnemius complex dysfunction, ankle instability, shoe type, increased physical activity are leading cause of plantar fasciitis.[7] pain is located on the medial plantar aspect of the foot. Pain is reproduced on the passive dorsiflexion of foot, windlass test [3].

Gastrocnemius tightness has been long associated with plantar fasciitis. As we already know the relation of plantar fascia, achilles tendon and gastrocnemius. Achilles tendon is one of the most powerful and strong tendon of the ankle. At its insertion tensile force is transmitted by the active force of contraction by gastrocnemius and soleus muscle and passively by the increased dorsiflexion of the foot or tightness of triceps surea muscle.[8]

There is negative impact on health-related quality of life among individual with plantar fasciitis [12] Physical therapy is concerned with identifying and maximising quality of life and movement potential within the spheres of promotion, prevention, treatment/intervention, rehabilitation and rehabilitation [11]. Physiotherapy administered in a timely fashion can reduce pain, symptoms and

return to baseline status. Conservative physiotherapy is initiated first to manage the mild or no pain.

Therefore the purpose of this study was to evaluate the individual and combined action of foot muscles in maintaining normal alignment of foot and restoring biomechanism of the foot. This was done by dividing the individual with plantar fasciitis into 3 class and note the outcome at the end day of the protocol in each class.

We hypothesised that both intrinsic and extrinsic muscle group play an equally important role in maintaining a normal longitudinal foot arch to prevent plant fasciitis.

2. METHODOLOGY

This is a study of effectiveness of intrinsic and extrensic muscle strengthening exercises with MFR of plantar fascia in individual with plantar fasciitis. This study was conducted in Krishna Vishwa Vidyapeeth 'Deemed to be' University, Karad. 30 Subjects were chosen by simple random sampling method according to the inclusion criteria and exclusion criteria.

Pre-test examination was taken through following test: visual analogue scale, Windlass test. Permission was taken from the authorities in the area where the study was conducted. The procedure and purpose of the study was explained to the participants. Consent form was filled by those who are willing to participate in the study. Subjects were divided into Group A , Group B and Group C each group containing 10 subjects. Subjects who are in Group A were given treatment which includes main focus on the strengthening of intrinsic muscle and myofascial release of plantar fascia with stretch.

Only extrinsic muscle group was taken into consideration for Group B with strengthening of extrinsic muscle group with myofascial release and stretching regime Group C included both strengthening of intrinsic and extrinsic muscle group.

Group A [n= 10]

1. Intrinsic Muscle activation- individual were asked to plant there foot on the floor and pull metatarsal towards heel without curling toes.
2. Intrinsic muscle strengthening-
   - TOE CURLS
   - TOE SPLAY
   - FIRST MTP EXTENSION
   - TOE PICK UP

   5- 10 repetition twice a day
3. Myofascial release - active release was taught using tennis ball.

Passive release was done by therapist. Patient position was prone, ankle in dorsiflexion duration was 15 min transverse strokes across affected area (from origin to insertion)

4. Stretching of plantar fascia - stretch was taught in non-weight bearing position i.e., sitting one leg crossed over contralateral knee. Patient was to hold heel with one hand and push in downward direction while passively extending toes with another hand Intensity of the stretch was kept to the point where patient complains of slight discomfort and taut plantar fascia on palpation.

10 sec hold with 5 sets thrice a day.

Group B[n=10]

1. Extrinsic muscle strengthening-
   - Heel raise: progression: Double leg heel raise
     Single leg heel raise
     Single leg heel raise deficit
   - SQUATS: body weight squat with intrinsic muscle in activation.
   - Posterior tibialis strengthening
     5 rep -Twice a day
2. Myofascial release technique- this technique is used in tightness and soft tissue restriction. therapist used both hands in a cross-hand pattern, knuckles of wrist over the gastrocnemius muscle. Ischemic compression on trigger points for 30- 60 sec.
3. Stretching of gastrosoleus- passive stretching of GS was done by therapist, patient in supine-lying. active stretches in standing and supine lying were taught to the patients. Stretching was done immediately followed by myofascial release.

Group C [n= 10]

1. Intrinsic Muscle activation
2. Myofascial release technique- this technique is used in tightness and soft tissue restriction. therapist used both hands in a cross-hand pattern, knuckles of wrist over the gastrocnemius muscle. Ischemic compression on trigger points for 30- 60 sec.
3. Stretching of plantar fascia and gastrosoleus – passive stretching of GS was done by therapist, patient in supine-lying. active stretches in standing and supine lying were taught to the patients. Stretching was done immediately followed by myofascial release.
4. Strengthening of foot muscles –
   - TOE CURLS
   - FIRST MTP EXTENSION
   - TOE PICK UP
   - Heel raise: progression: Double leg heel raise

Single leg heel raise

Single leg heel raise deficit

   - SQUATS: body weight squat with intrinsic muscle in activation.
   - Posterior tibialis strengthening

5 rep -Twice a day

Inclusion Criteria

- Male or female
- Pain along medial plantar aspect of foot.
- Pain on first morning steps.
- Age group 20 and above.
- Individual with obesity class 1 and above.
- Individual involved in any athletic activity for more than 1 year.

Exclusion Criteria

- Heel pain due to calcaneal fracture
- Individual diagnosed with RA
- Patient with neurological symptoms (tarsal tunnel syndrome, medial calcaneal branch of the posterior tibial nerve entrapment).
- Patient underwent previous surgery for plantar fasciitis.

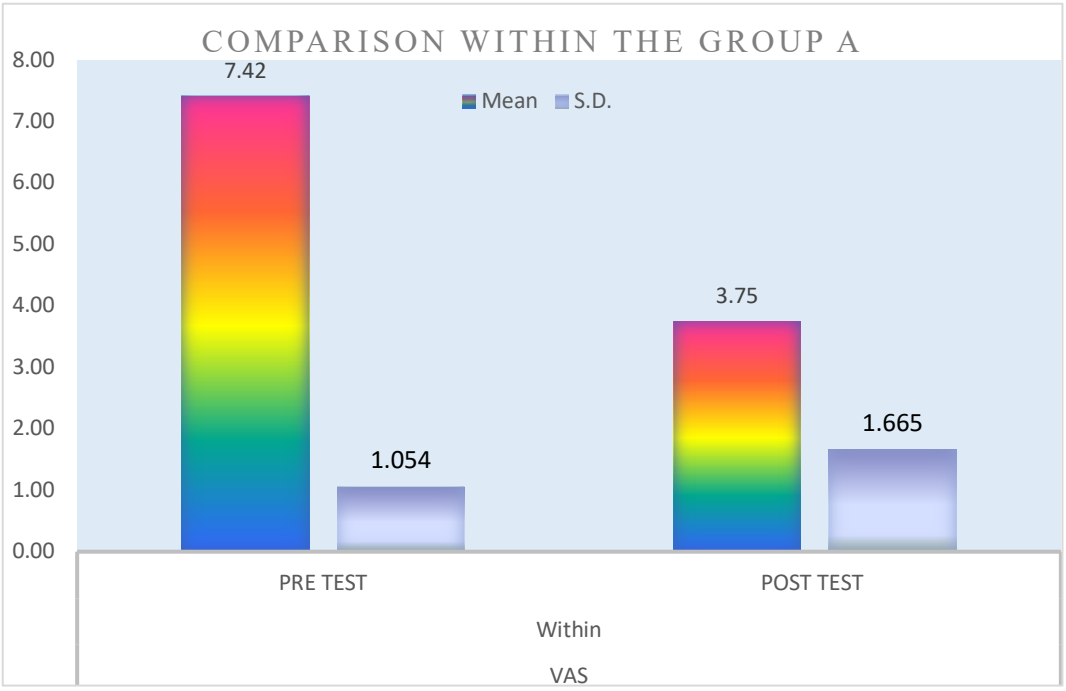
Outcome Measures

- Visual analogue scale
- Windlass test

Data Presenatation

Table 1: Mean, S.D, p vale in post intervention within Group A using VAS where t value is 7.131 and p value 0.001 which is statistically significant

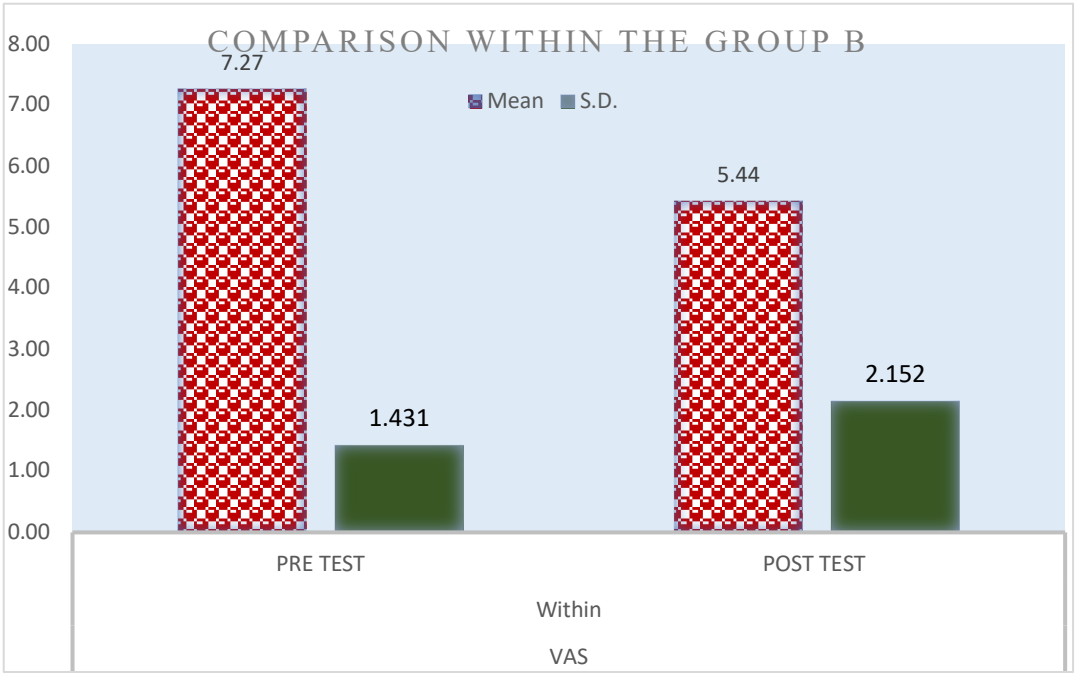
Group A	VAS	
	Within	
.	PRE TEST	POST TEST
Mean	7.42	3.75
S.D.	1.054	1.665
Number	10	10
Maximum	9.1	6.1
Minimum	5.9	1.5
Range	3.2	4.6
Mean Difference	3.67	
T Paired Test	7.131	
P value	<0.001	
Table Value at 0.05	2.26	
Result	Significant	



Graph 1: Comparison of mean of pre-test and post-test VAS score within Group A.

Table 2: Mean, S.D, p vale in post intervention within Group B using VAS where t value is 2.624 and p value 0.028 which is statistically significant

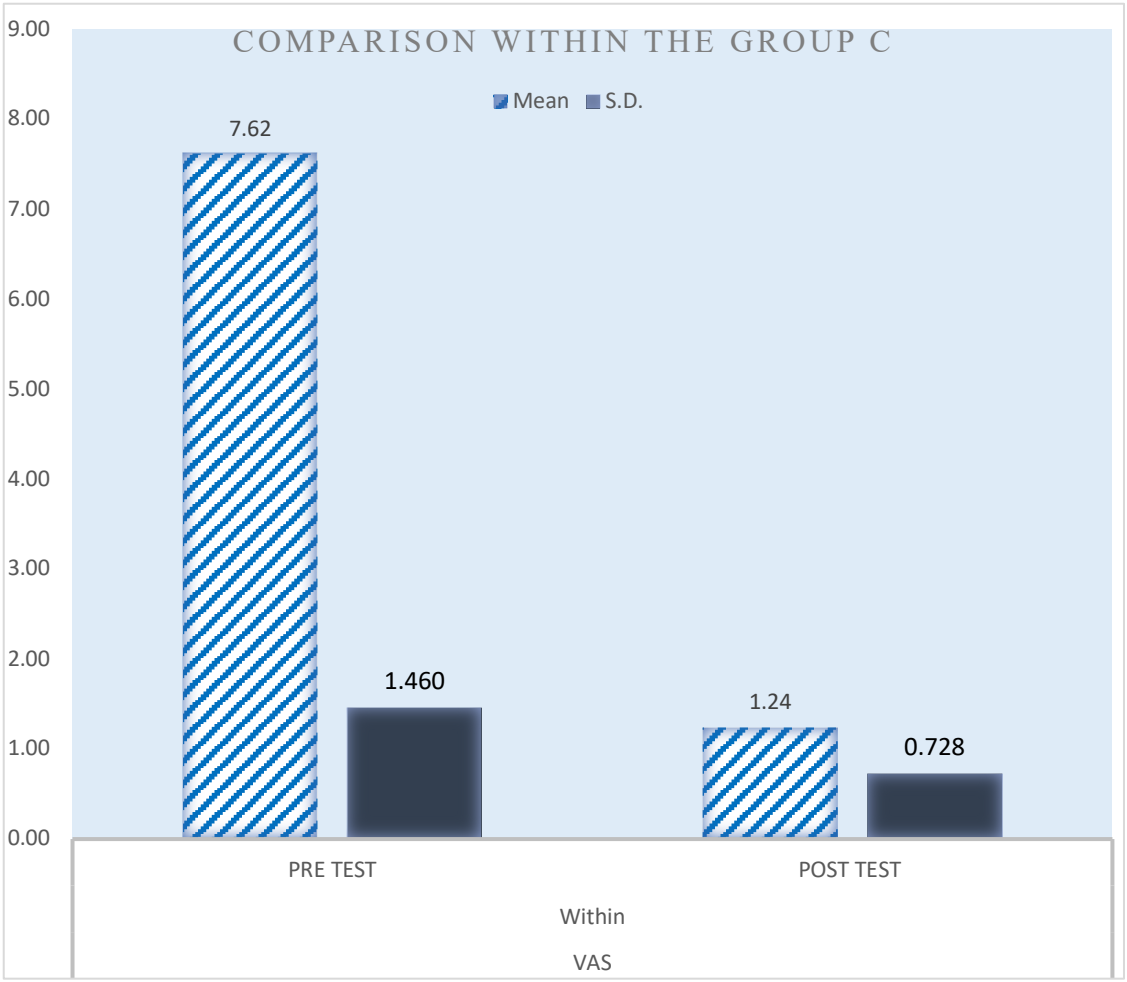
Group B	VAS	
	Within	
.	PRE TEST	POST TEST
Mean	7.27	5.44
S.D.	1.431	2.152
Number	10	10
Maximum	9.4	8
Minimum	5	0.9
Range	4.4	7.1
Mean Difference	1.83	
T Paired Test	2.624	
P value	0.028	
Table Value at 0.05	2.26	
Result	Significant	



Graph 2: Comparison of mean of pre-test and post-test VAS score within Group B.

Table 3: Mean, S.D, p vale in post intervention within Group C using VAS where t value is 14.921 and p value 0.001 which is statistically significant

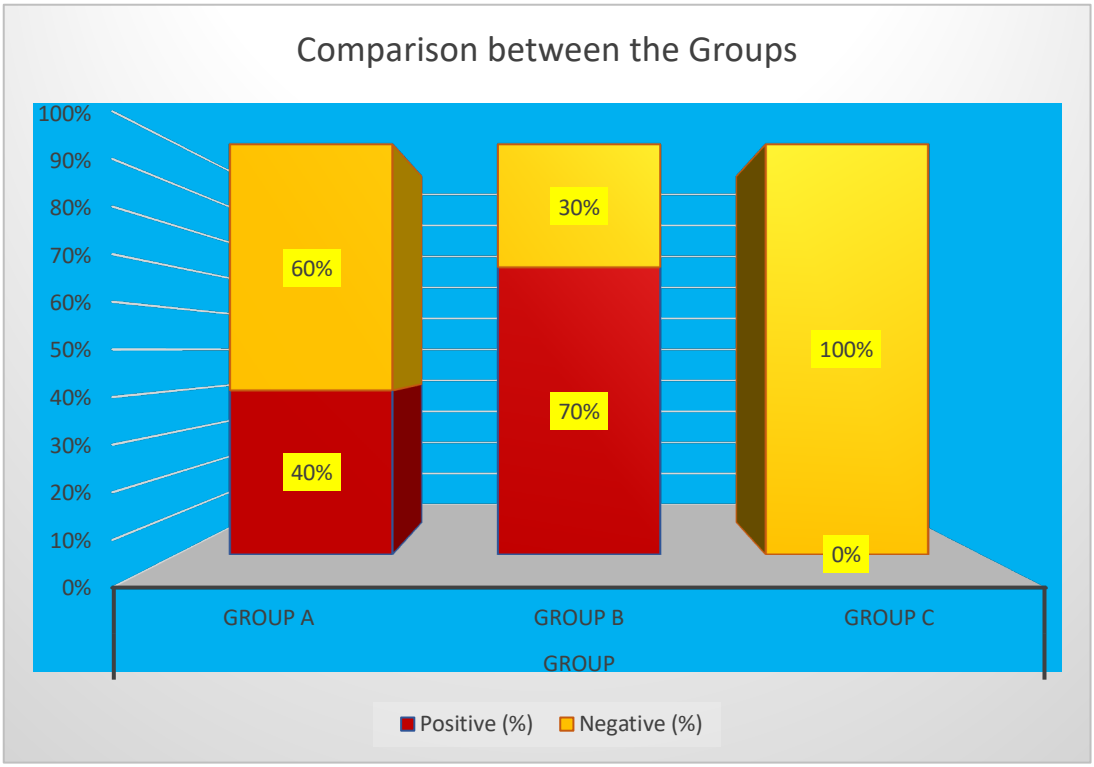
Group C	VAS	
	Within	
.	PRE TEST	POST TEST
Mean	7.62	1.24
S.D.	1.460	0.728
Number	10	10
Maximum	9.1	2.3
Minimum	4.5	0
Range	4.6	2.3
Mean Difference	6.38	
T Paired Test	14.921	
P value	<0.001	
Table Value at 0.05	2.26	
Result	Significant	



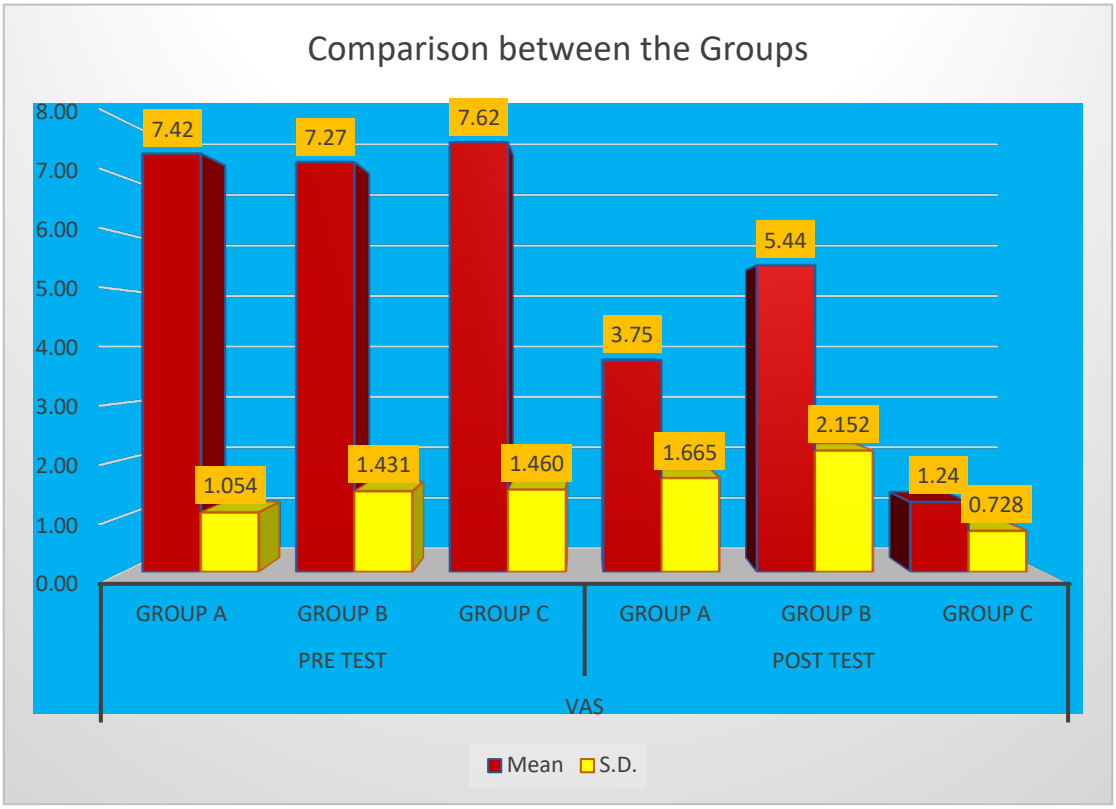
Graph 3: Comparison of mean of pre test and post test VAS score within Group C

Table 4: Comparison of pre and post windlass test between the groups

Windlass test	Pre test			Post test		
	Group A	Group B	Group C	Group A	Group B	Group C
Positive (%)	100%	100%	100%	40%	70%	0%
Negative (%)	0%	0%	0%	60%	30%	100%
Positive (f)	10	10	10	4	7	0
Negative (f)	0	0	0	6	3	10



Graph 4: Comparison of windlass test between group A, B and C



Graph 5: Comparison of VAS between groups

3. RESULT

On the findings significant difference between group were seen. Each group showed significant positive result. There was a significant difference in group C on post test windlass test. 100% recovery was seen in group C. VAS scale on pre test the maximum pain threshold was 9.1cm for post test 2.3 cm for first morning steps. stretching of gastrocnemius in group C showed significant results. Myofascial release technique help to break the break adhesion and soft tissue contractures. An additional benefit gained in group C was the vicious cycle of tightness and weakness by broke by including strengthening of extrinsic and intrinsic muscle along with release of posterior muscle while ultimately increased ankle dorsiflexion.

4. DISCUSSION

Plantar fasciitis being one of the most common musculoskeletal problem faced about many individual including athletics and common individuals. plantar fasciitis has been reported to affect activities of daily in an individual. 80% of all heel pain are diagnosed with plantar fasciitis. Patients usually complain of pain at the anteromedial prominence of the calcaneum. The pain is exacerbated by passive dorsiflexion of the toes. Symptoms may have been present for weeks or months at the time of presentation.

The current study focuses on the contribution of extrinsic and intrinsic muscles of foot on the load distribution to prevent plantar fascia pain. As per the research, the present study is the first study to examine the effect of individual muscle group and combination of muscle group on plantar fascial pain. The study's primary goal was to determine what caused the discomfort and how to treat it. Study constituted population of 30 individual diagnosed with plantar fasciitis. After 12 weeks of protocol group C demonstrated significant difference in pain threshold level than group A and B with post treatment analysis. Concerning within group comparison, all the three interventions resulted in significant reduction in pain at first step in the morning. While there were significant increase in range of motion of ankle dorsiflexion. much improved to being completely improved symptoms than those in other groups. On the findings significant difference between group were seen. Each group showed significant positive result. There was a significant difference in group C on post-test windlass test. 100% recovery was seen in group C. VAS scale on pre-test the maximum pain threshold was 9.1cm for post-test 2.3 cm for first morning steps. stretching of gastrocnemius in group C showed significant results. Myofascial release technique help to break the break adhesion and soft tissue contractures.

An additional benefit gained in group C was the vicious cycle of tightness and weakness by broke by including strengthening of extrinsic and intrinsic muscle along with release of posterior muscle while ultimately increased ankle dorsiflexion. Posterior tibialis muscle strengthening exercise helped in maintaining the foot bone alignment by pulling up the muscle and holding the position. Other group did show significant results but during windlass test did not show much negative results as compared to group c on post-test because they focused only on one component. In group A even after the IFM strengthening, pain threshold on post VAS was max (6.1) and min (2.1). this is because even after the strengthening of IFM the load was not distributed evenly and the all forces where transmitted to calcaneus. Not only intrinsic but extrinsic muscles strengthening is of great importance to evenly distribute weight and maintain load across the joints and fascia.

IFM activity increases in response to greater postural demands and in the presence of foot pathologies. IFM stabilize foot by stiffening the LA while EFM are primary responsible for ankle joint motion and balance control. Altered IFM activities may proceed with ankle foot pathologies, which altimataly affects the EFM control and muscle pathology.

Muscle group may compensate for each other, resulting in decreased activation in one group during increased activation in another group.

5. CONCLUSION

The present study suggests that participants in group C described their symptoms as being much improved to being completely improved than those in group A and group B. Thus the study conclude that the simultaneous stretching and strengthening of both the muscle groups is superior to strengthening of single muscle group alone.

6. LIMITATION

The limitations of this study include the following; firstly small population. Large population was required to make it more reliable. confounding factors may have occurred during the study because patients' behaviors such as changes in activity or lifestyle, shoes, or weight were not noted. Range of motion for dorsiflexion was not assessed to check the muscle tension in posterior muscles.

Consent: All the participants were thoroughly explained about the need and purpose of the study and an informed consent was obtained.

Ethical Approval: The study was approved by the Institutional Ethics Committee of the KIMSDU Karad.

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