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Original Article

EFFECT OF IMPAIREMENT-BASED KALTENBORN TECHNIQUE FOR PLANTAR FASCIITIS: A RANDOMIZED CONTROL TRIAL

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ABSTRACT

Relevance: Plantar fasciitis, the most common cause of heel pain, is due to repetitive strain injury to the medial arch and the heel, causing functional disabilities. Any biomechanical alteration in the lower extremity has its effect on plantar fascia. Kaltenborn mobilization techniques have been proved effective in improving the range of motion of the affected joints. There is a need to evaluate these techniques in plantar fasciitis by treating whole lower extremity.

Participants: 20 subjects with the mean age (23.80±2.71) with primary heel pain are recruited in the study.

Method: Subjects of randomized controlled trial were randomly allocated into two groups, Group A (n=10) received therapeutic ultrasound, stretching's and exercises and Group B (n=10) received therapeutic ultra sound, Kaltenborn mobilizations to the affected joints of lower extremity, stretching and exercises. The outcome measures are visual analogue scale (VAS), foot function index (FFI) and range of motion measured by Goniometer assessed on day 1 pre-treatment and day 12 post treatment.

Analysis: It was done using Mann Whitney U test and Wilcoxon matched pairs test using SPSS software.

Results: The intra-group mean differences in pre and post values for group-A are 1.80±2.39, 2.50±2.64, 3.40±1.84, and 19.75±8.16 for ankle dorsiflexion, plantarflexion, VAS and FFI respectively, and in group-B are 1.00±2.11, 10.50±8.32, 4.70±0.67and 28.07±8.26 for ankle dorsiflexion, plantarflexion, VAS and FFI respectively. The intra-group comparison had shown statistical significance with $p<0.05$ and whereas in between comparison group-B had shown better improvement than group-A.

Conclusion: Kaltenborn mobilizations along with therapeutic ultrasound, stretches and exercises have shown better improvement compared to the control group.

KEY WORDS: Kaltenborn mobilizations, plantar fasciitis, impairment-based.

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INTRODUCTION

Plantar fasciitis a common cause of heel pain is due to repetitive strain injury of the medial arch and heel [1]. Plantar heel pain occurs as a secondary problem due to repetitive strain of plantar fascia at its attachment to tuberosity of the calcaneus, is an extremely common podiatric problem which requires a great attention and care [2]. Plantar fascia holds two functions a static function it stabilizes the medial longitudinal arch; dynamically, it restores the arch and aids in reconfiguring the foot for efficient toe-off [1]. The patient complains of worse pain in the morning when he attempts to take the first few steps after getting out of bed, after prolonged sitting, or when he just begins to workout [1,3]. The causative factors for plantar fasciitis includes, overweight; walking, running or standing for a long period of time, old worn shoes with insufficient arch support [3]. Faulty mechanics like over pronation, discrepancy in leg length, excessive tibial torsion and excessive femoral anteversion are other causative factors [4]. Structural abnormalities in ankle and foot or at other joints forming the kinematic chain of the affected lower extremity can also be a causative factor for plantar fasciitis.

Diagnosis of plantar fasciitis is based on the complains and the patient's history, patient's with plantar fasciitis complains pain in the inferior heel on weight bearing which is described as either throbbing pain, searing or piercing pain especially when he takes first few steps in the morning and after prolonged periods of inactivity [5]. Faulty biomechanics is also a risk factor for developing plantar fasciitis. Studies have proved that excessive pronation of foot is a major cause for plantar fasciitis [5].

The plantar fascia is a dense fascia that runs nearly the entire length of the foot. It begins posteriorly on the medial tubercle of the calcaneus and continues anteriorly to attach by digitations to the plantar plates and then, via the plates to the proximal phalanx of each toe. Plantar fascia contributes to arch support, the support of arches has been compared to the function of a tie-rod on a truss where the truss and tie-rod forms a triangle; the two struts of the truss form the sides of the triangle and the tie-rod is the bottom. The talus and calcaneus forms the posterior strut, and the remaining tarsal and metatarsals form the anterior strut. The plantar fascia, as the tie-rod, holds together the anterior and posterior struts when the body weight is loaded on the triangle. This structural design is efficient for the weight-bearing foot because the struts (bones) are subjected to compressive forces, whereas the tie-rod (fascia) is subject to tension forces [6].

The treatment options for plantar fasciitis include electrophysical agents like ultrasound, stretching's and strengthenings [4,7], taping [8]; myofascial trigger point release technique [9]; counterstrain techniques [10]; manual therapy techniques [2,7,11].

Movement impairment of limited dorsiflexion is identified as an increasing risk causing plantar fasciitis [12]. Factors such as tight gastrosoleus, rotational deformities such as femoral anteversion and tibialvarus had their effects on plantar fascia. These biomechanical impairments in lower extremity joints may be factors for abnormal stresses on plantar fascia. Perhaps impairment-based therapy may aid in recovery as fascia will be relieved from the abnormal stress. Hence the aim of the study is to evaluate the effectiveness of impairment-based Kaltenborn mobilizations for plantar fasciitis.

MATERIAL AND METHODS

A total of 24 participants were screened for plantar fasciitis, out of which 4 were excluded as they did not meet the inclusion criteria.20 subjects with primary heel pain were recruited in the study as per the following inclusion criteria 1) both female and male 2) age between 18 to 40 years and 3) primary heel pain for about 3 to 4 weeks. Subjects were excluded if they had 1) tumor 2) recent fracture in lower extremity 3) rheumatoid arthritis 4) osteoporosis 5) prolonged history of steroid use, 6) severe vascular disease7) any prior surgery to distal tibia, fibula, ankle joint, or proximal to the base of the metatarsals . Demographic data was recorded and physical examination will be carried out prior to intervention. Participants were recruited and randomly allocated into control group (A) or experimental group (B) using envelope method.

The study was carried out in tertiary health care hospitals, Belgaum after the approval from Institutional Ethical Committee and informed consent was obtained from the subjects.

Outcome Measures: The outcome measurements were VAS for pain, ROM for ankle was calculated using a goniometer and FFI to assess function was taken on 1st day before intervention and 12th day after intervention.

Pain was measured using VAS by asking the patient to mark a point indicating the severity of his/her pain on a 0 to 10 cm horizontal scale, where 0 signified no pain and 10 signified the worst pain.

FFI is used to measure how much the foot pain has affected the functional ability, it is measured by using the sores ranging from 0 to 10 where 0 is the minimum and 10 is maximum it consist of 3 subscales pain subscale, disability subscale and activity limitation subscale. Maximum score is 230 points.

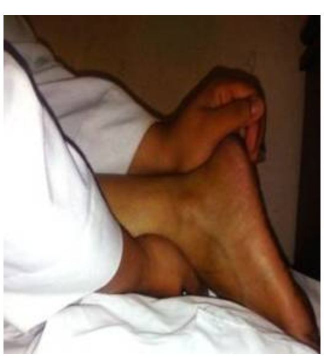
A universal goniometer is used to measure the ROM at ankle joint which is a more reliable method.

Procedure: The subjects were randomly allocated into two groups using envelope method. Group A received therapeutic ultrasound (3 MHz, 1.5 W/cm^2, 100 Hz frequency, 20% duty cycle for 5 minutes) stretchings (gastrocnemius and plantar fascia) and exercises (intrinsic muscle strengthening), 6 sessions were given on alternate days for 2 weeks. Group B received therapeutic ultrasound, stretching's (gastrocnemius and plantar fascia) and exercises (intrinsic muscle strengthening), Kaltenborn mobilizations to the joints in the lower extremity as required, 6 sessions were given on alternate days for 2 weeks.

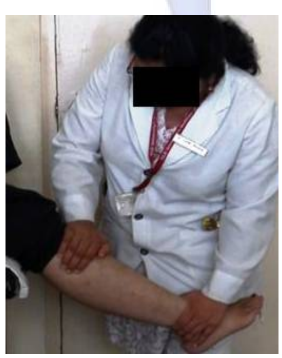
Photograph 1: Talocrural Posterior Glide.

Photograph 2: Talocrural Anterior. Glide.

Photograph 3: Subtalar Distal Tractio.



Photograph 4: Knee Posterior Glide.



Statistical Analysis: Statistical analysis was done using SPSS. Mean and standard deviation of age was calculated for age. Within group comparison for VAS, ROM and FFI was done by Wilcoxon matched pairs test and between group comparisons with Mann-Whitney U test. Level of significance was set at *p*<0.05.

RESULTS AND TABLES

20 subjects were randomly allocated into 2 groups using envelope method. The mean value of age of subjects in Group A was 23.80±3.61 and the mean value of age in Group B was 23.80±1.81 (Table 1)

Table 1: Mean and SD of age.

	Mean n SD
Group A	23.80±3.61
Group B	23.80±1.81

ROM: Mean ROM values increased from 40.00±6.67 to 42.50±5.40 for plantar flexion in group A and in group B ROM values increased from 38.50±9.44 to 49.00±3.16 for plantarflexion. Mean ROM values increased from 16.50±4.12 to 18.30±3.33 for dorsiflexion in group A and in group B ROM values increased from19.00±2.11 to 20.00±0.00 for dorsiflexion. The intra group comparison of ROM in Group A and Group B for plantarflexion had shown statistical significance with p-value 0.0431 and 0.0077. The intra group comparison of ROM in Group A and Group B for dorsiflexion had not shown statistical significance with p-value 0.0679and 0.9999 (Table-2). The intergroup comparison of ROM had shown statistical significance for plantar flexion with p-value 0.0082.The inter group comparison had shown no statistical significance dorsiflexion with p-value 0.4963 (Table-3).

Table 2: Intragroup comparison of ROM, VAS and FFI using Wilcoxon matched pairs test.

Variables	Groups	Pre	Post	Difference	p-value
ROM Dorsi flexion	Group A	16.50±4.12	18.30±3.33	1.80±2.39	0.0679
	Group B	19.00±2.11	20.00±0.00	1.00±2.11	0.9999
ROM Plantar flexion	Group A	40.00±6.67	42.50±5.40	2.50±2.64	0.0431*
	Group B	38.50±9.44	49.00±3.16	10.50±8.32	0.0077*
VAS	Group A	6.90±0.32	3.50±1.58	3.40±1.84	0.0069*
	Group B	7.00±0.94	2.30±0.48	4.70±0.67	0.00001*
FFI	Group A	42.12±9.66	22.38±9.30	19.75±8.16	0.0059*
	Group B	42.66±13.21	14.59±6.80	28.07±8.26	0.0051*

Table 3: Intergroup comparison of ROM, VAS and FFI using Mann Whitney U-Test.

Variables	Groups	z-value	p-value
ROM dorsiflexion	Group A vs. Group B	-0.6803	0.4963
ROM plantar flexion	Group A vs. Group B	-2.6458	0.0082*
VAS	Group A vs. Group B	-2.0032	0.0452*
FFI	Group A vs. Group B	-2.419	0.0156*

VAS: Mean VAS values reduced from 7.00±0.94 to 2.30±0.48 with a mean difference of 3.40±1.84 in group A and in group B VAS reduced from and in group B VAS reduced from 7.00±0.94 to 2.30±0.48 with a mean difference 4.70±0.67. The intra group comparison of VAS in Group A and Group B had shown statistical significance with p-value 0.0069 and 0.00001 (Table-2).The intergroup comparison had shown statistical significance with p-value 0.0452 (Table-3).

FFI: Mean FFI values reduced from 42.12±9.66 to 22.38±9.30 with a mean difference of 19.75±8.16 in group A and in group B it reduced from 42.66±13.21 to 14.59±6.80 with a mean difference of 28.07±8.26. The intra group comparison of FFI in Group A and Group B had shown statistical significance with p-value 0.0059 and 0.0051 (Table-2).The intergroup comparison had shown statistical significance with p-value 0.0156 (Table-3).

DISCUSSION

The present study was conducted to determine effects of impairment-based Kaltenborn mobilizations on pain and function in subjects with plantar fasciitis. The result of the study showed the mobilization group had significant improvement in VAS and FFI compared to the control group. The mobilization group also had shown better improvements in ROM compared to the control group, where plantar flexion had shown statistical significance but dorsiflexion was not statistically significant. The pre and post dorsiflexion scores showed no statistical significance as the difference is very less; there was a very less increase in dorsiflexion range from pre treatment to post treatment and most of the subjects had full range of dorsiflexion.

The results of this study were consistent with the results of the previous study done by Joshua et al, where both manual therapy group and the control group had shown significant improvement in pain and function but manual therapy group had shown better improvement compared to the control group [2].

Decreased dorsiflexion is considered as a causative factor for plantar fasciitis and when the range is improved by manual therapy technique subjects had reported decreased pain. This can be attributed to the fact that improved range at ankle joint decreased tension created in plantar fascia and leads to decreased pain [3]. A tight gastrosoleus decreases the dorsiflexion range of motion, stretching gastrosoleus increases the range. Decreased plantar flexion can be due to weak plantar flexors as they produce a decreased plantar flexor force at ankle [6].

Joshua et al and Young et al had proved the combined effect of manual therapy and physical therapeutic agents and stretching and exercises is more effective than treating with electrotherapeutic agents, stretching and exercises; the present study has similar results as compared to the above literature and had proved the efficacy of Kaltenborn mobilizations in plantar fasciitis.

Treating the whole kinematic chain yields better results compared to treating the affected area was observed in this study, literature supports treating whole kinematic chain treatment of lower extremity in conditions such as OA hip had shown improvement in pain and function [13].

Therapeutic ultrasound has analgesic and anti-inflammatory effects; the reduction of pain in subjects in both the groups could be due to the use of therapeutic ultrasound. Kaltenborn mobilizations also have its effects on pain reduction [14]. Pain reduction was observed in both the groups when assessed on VAS but Group B showed significant reduction in pain, this can be attributed to mobilizations. Grade III mobilizations were given to the participants, grade III mobilizations include traction and glide it stretches the tendon, ligament, capsule and improves physiologic accessory movement [15]. When traction is applied there is distraction of one articular surface on the other in perpendicular direction. Gliding causes translational glide of one surface parallel to the other; both the techniques improves joint range and decreases pain [16,17].

As the pain limits the functional abilities reduced pain in subject could be a factor for improving the functional performance. This could be stated as the pre and post scores assessed using FFI functional assessment scale had increased. As the mobilizations at each joint improved the function at that level proper weight distribution might have occurred and the abnormal stress on plantar fascia is decreased. Gastrocnemius stretching had decreased the tightness of the muscle relieving stress on fascia; this could be another reason for significant pain reduction in both the groups. The small sample size and recruitment of subjects from a single centre is a limitation of the study as the results could not be generalized.

Future Scope: A similar study with large sample size could be done. The long term effects need to be investigated. Similar study with other manual therapy techniques needs to be investigated.

CONCLUSION

The present study concludes that both the groups had shown improvement in pain and function but the mobilization group is more effective compared to the control group. Hence, it is proved that combined treatment approach of manual therapy with electro-physical agents and exercises would yield better results.

Conflicts of interest: None

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