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Efficacy of Instrument Assisted Soft-Tissue Mobilization in Patients with Heel Pain: An Experimental Study

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors have made equal contribution to the work.

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Original Research Article

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ABSTRACT

Aim: The purpose of this study was to evaluate and compare the effects of Instrument-Assisted Soft-Tissue Mobilisation (IASTM) and Therapeutic Ultrasound in patients with heel pain in terms of Numerical Pain Rating Scale and Foot and Ankle Ability Measure scale. This was undertaken as even though Ultrasound is regularly used, heel pain still remains resistant to treatment in some patients. Hence, the need to compare a relatively newer technique with it.
Study Design : Experimental study
Place and Duration: Department of Musculoskeletal Physiotherapy Sciences, Ravi Nair Physiotherapy College, Sawangi (Meghe) , Wardha , duration of 12 months.
Methods: Seventy people (n=70) with heel discomfort (lasting 6 weeks to 1 year) were chosen at random and placed into two groups, each getting eight therapy sessions. IASTM and Home Exercise Program was given to Group A, whereas Therapeutic Ultrasound and Home Exercise Program was given to Group Calf muscle stretches and Plantar fascia stretches were incorporated in the Home Exercise Programme. Outcome measures were recorded both at the beginning of treatment and after final treatment. The patients were assessed for Numerical Pain Rating Scale

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with first step in morning and at the beginning of first session and after end of last session and for Foot and Ankle Ability Measure scale at the beginning of first session and after end of last session. A follow up period of 90 days (after last session) was taken, the measurements of Numerical Pain Rating Scale and Foot and Ankle Ability Measure scale were taken again to see the long-term effects.

Results: Group A which received IASTM + Home exercises showed great improvements than Ultrasound and Home exercise group, from baseline to week 4 after the pain intensity and foot function were assessed using Numerical Pain Rating Scale and Foot and Ankle Ability Measure scale. Statistically significant differences were found in both the groups. i.e. P=0.0001. But 7 people in Ultrasound group complained of pain and functional ability at follow-up session.

Conclusion: In this study, it can be concluded that combining both the IASTM and Home Exercise Program have got beneficial effects in decreasing the pain intensity thus improving the foot and ankle function in patients with heel pain.

Keywords: Instrument assisted soft tissue mobilization; Heel pain; Therapeutic Ultrasound; Numerical pain rating scale; foot and ankle ability measure.

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1. INTRODUCTION

The 'heel' is the prominent rear part of the foot. It is based on the calcaneus (heel bone) protruding behind the lower leg bones' articulation. To distribute the compressive stresses imposed on the heel during locomotion (especially during stance phase) the foot's sole has a covering of connective subcutaneous tissues which are up-to 2 cm thick and lying under the heel [1].

Heel discomfort is one of the most common ailments. Heel pad syndrome (a deep, bruise-like pain in the core of the heel), neuromas, achilles' tendinopathy (a frequent disease that causes posterior heel pain), and plantar warts are a few significant reasons of heel pain.

Retrocalcaneal bursitis causes heel discomfort because of repetitive pressure from ill-fitting footwear or the deformity itself. Erythema and swelling above the bursa, as well as discomfort to direct palpation, are symptoms of retrocalcaneal bursitis [2-3].

Plantar fasciitis, plantar fasciosis (called fasciosis instead of fasciitis because there is evidence that this ailment is caused by non-inflammatory degenerative changes in the plantar fascia rather than inflammation), can all cause plantar heel discomfort. It is appropriate to refer to it as plantar fasciosis or heel spur syndrome also known as calcaneal spur which occurs due to a bony outgrowth that is present in the heel bone. It's the most common condition that brings patients to a foot/ankle specialist [4-5].

A heel spur is a side effect and is not related to the cause of the symptoms [6].

Plantar heel pain affects about 10% of people at some point during their lives .It is detected in people who lead sedentary lifestyle, as well as athletes, active people and military personnel [7].

The treatment for Plantar fasciitis has various conservative methods. Some of the treatments available are :- Joint manipulations and STM (Soft Tissue Manipulation) , technique of taping , muscle strengthening and insole [8].

Various other treatment modalities like ultrasound are used in treating the patients with heel pain. One of the most frequent therapy procedures used by physical therapists across the globe is Therapeutic Ultrasound. It improves metabolic processes by increasing tissue temperature. It softens the tissue, improves blood circulation, and promotes tissue chemical activity. It also enhances cell membrane permeability [9].

This study was undertaken as even though Ultrasound is regularly used , heel pain still remains resistant to treatment in some patients. Hence , the need to compare a relatively newer technique with it.

Two forms of manual treatment are used to treat

plantar heel discomfort: joint mobilization and soft tissue mobilization (deep tissue massage or myofascial release (MFR)). MFR is a soft tissue mobilization technique that includes stretching the myofascial complex using a low-load, long-duration stretch force with the objective of restoring optimal length, decreasing pain, and enhancing function [5].

Various therapies have been shown to help patients with plantar fasciitis improve their soft-tissue mobility, like muscle trigger point release therapy, Instrument Assisted Soft-tissue Mobilization (IASTM), and aggressive manual soft-tissue mobilization (AMSTM) [10].

A myofascial trigger point is a hyperirritable spot, usually within a taut band of skeletal muscle, which is painful on compression and can give rise to characteristic referred pain, motor dysfunction, and autonomic phenomena [11].

Instrument Aided Soft-Tissue Mobilization (IASTM) is a technique which involves applying longitudinal pressure to muscle fibers with the use of equipment. It is used in treating tendinopathies with positive outcomes, such as pain relief and increased range of motion (ROM) as well as a speedier return to normal function [12].

IASTM is a therapeutic and non-invasive method that is often administered by stroking the hard edge of the instrument on the skin surface, usually assisted by gel/lubricant, with the aim of influencing the underlying structures, like connective tissues, muscles and nerves. The increased proprioception through IASTM, allows for detection of altered tissue properties [13].

Various instruments of different type of material, the size, and the form have been invented. Each device is designed to assist the therapist in improving soft tissue mobility in such areas. Edge mobility tool (Manufactured by Galena International stainless steel 4X 4-inch Instrument Assisted Myofascial Release Tool and tool weight is 200 g) of these tools. It is structured of stainless steel and contains a variety of sharp and dull edges that help with body shaping and deep and superficial tissue therapy [14].

2. METHODS

An experimental study was conducted in the Department of Musculoskeletal Sciences, Ravi Nair Physiotherapy College, Sawangi (Meghe), Wardha, in the years 2020 and 2021. (DU).

Sample size was calculated by using the following formula :

$$n_1 = \frac{(\sigma^2_1 + \sigma^2_1 / k)\,(z_{1-\alpha/2} + z_{1-\beta})^2}{\Delta^2}$$

$$n_2 = \frac{(k * \sigma^2_1 + \sigma^2_2)\,(z_{1-\alpha/2} + z_{1-\beta})^2}{\Delta^2}$$

Subjects were chosen at random and divided into two groups using the chit technique. IASTM and Home Exercise Program was given to Group A (n=35), whereas Therapeutic Ultrasound and Home Exercise Program was given to Group B (n=35).

2.1 Inclusion Criteria

- Both male and female participants must be between the ages of 18 and 60 years old and have been suffering from heel discomfort for at least 6 weeks and up to a year.
- Having heel discomfort on the first step out of bed in the morning [15].

2.2 Exclusion Criteria

- Unwilling to participate.
- Subjects with any surgical procedure of leg/ankle/foot
- Subjects with cancer history, severe vascular disease, rheumatoid arthritis (RA) and osteoporosis.
- If NPRS score is less than 3 for both the continuous and persistent pain.
- Any trauma to ankle joint
- Hypersensitive skin [15].

2.3 Treatment

Group A: IASTM (Edge mobility tool) and Home Exercise Program.

To warm up the tissues, patient did a 5-minutes of low-resistance cycling workout with minimal

resistance(Prior to IASTM).

Using the Edge mobility tool (Image 1), each participant received 2 minutes of IASTM. The Edge Mobility Tool was used to mobilize the tissues on the triceps surae and plantar area of the foot by exerting constant pressure down the leg and foot after applying lubricant/gel to the back calf and plantar region of the foot to assist decrease friction on the skin. The device was moved parallel to fibers in alternating proximal and distal directions [16]. (Image 2 and 3)

A Home Exercise Program was also given to the participants. As part of the program, they were told to dothe following exercises twice a day.:

1) Stretching the calf muscles (3 repetitions for 30 seconds hold, each) (Image 4)

- The participants were asked to perform standing static calf stretch with the knee of the affected heel fully extended. The stretch was held for 30 seconds and for 3 repetitions.

2) Plantar fascia stretching (3 repetitions for 30 seconds hold , each) (Image 5)

- The plantar fascia is stretched by performing dorsiflexion of toes with one hand of the patient, while the other hand of patient palpates the plantar fascia to make sure that it is taut [15].

Group B: Therapeutic Ultrasound (Manufactured by Electroson 709) and Home Exercise Program To warm up the tissues, patient did a 5-minute low-resistance cycling workout, priorly.

Then, Ultrasound was applied over the heel and calf region. The frequency was set at 1 MHz, with a constant current of 1.8 w/cm^2 intensity, and the transducer movement was maintained to a minimum. The time restriction was set at 8 minutes [17–19].

The Group B participants were also provided a Home Exercise Program as given to participants in Group

A. They were also required to complete the program twice a day. The participants in both the group were not on any medication Both groups had 8 therapy sessions.

Group A (IASTM and Home Exercise Program) had two sessions each week for four weeks, for a total of eight sessions. Group B (Ultrasound and Home Exercise Program) received two sessions each week for four weeks, for a total of eight sessions. Foot and Ankle Ability Measure scale and Numerical Pain Rating Scale were scored before therapy (1st session) and after final treatment (8tth session).

After 90 days, of last session, a follow-up appointment was scheduled, where again Foot and Ankle Ability Measure scale and Numerical Pain Rating Scale scores were taken.

3. RESULTS

3.1 FAAM scale (Foot and Ankle Ability Measure Scale)

Improved functional level was the primary outcome. It was assessed by FAAM scale. It is a 21-items sub-scale that is used to assess an individual's ADLs (activities of daily living), or activities of daily life. Person dependability is 0.87, while item reliability is 0.99 [20-21]. Permission was obtained to use this scale.

3.2 NPRS (Numerical Pain Rating Scale)

The secondary outcome of heel pain was assessed using the Numerical Pain Rating Scale (NPRS). The participant was asked to rate his or her pain on an 11-point scale. The numbers 0 and 10 represented "no pain" and "worst possible pain," respectively [22].

3.3 Data Analysis

Data was collected in excel sheet and results were obtained. The Chi square test, Student's paired and unpaired t test, and Student's paired and unpaired t test were used in the statistical study. SPSS 24.0 and GraphPad Prism 7.0 were used in the study, with p0.05 being regarded the level of significance.

The demographic data given in Table.1 shows distribution according to age and gender. The IASTM group had the mean age of value of 33.17±8.43 and the Ultrasound group had the means age value of 36.60±11.59 . The Chi-square test revealed that there was no statistically significant difference in the ages of the patients in both groups. ($p=0.30$, $\chi 2$ value = 3.59).

Image 1. Edge mobility Tool

Image 2. IASTM to Calf region

Image 3. IASTM to heel region

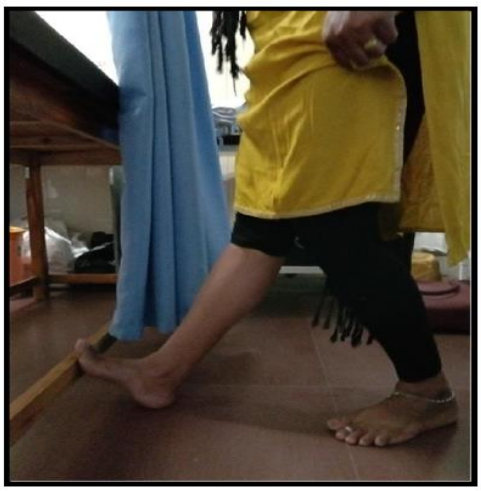


Image 4. Calf stretches

Image 5. Plantar fascia stretches

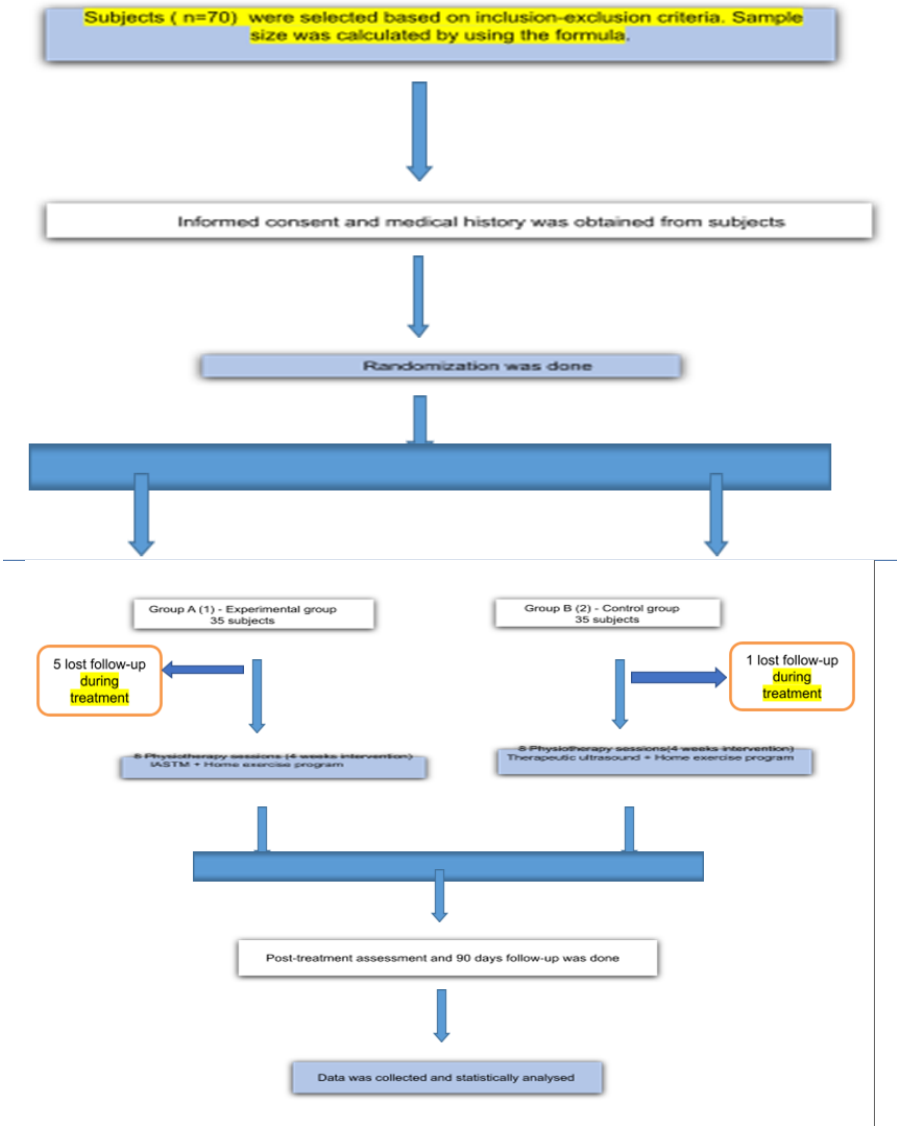


Fig. 1. Methodology flow chart

Table 1. Demographic data of both groups

	Group A (IASTM) Mean ± SD	**Group B (Ultrasound)** Mean ± SD	**χ2-value**
Age (years)	33.17±8.43	36.60±11.59	3.59 *p*=0.30, NS
	Group A (IASTM) Percentage wise distribution	**Group B (Ultrasound)** Percentage wise distribution	**χ2-value**
Male	42.86 %	57.14	1.42
Female	57.14 %	42.86%	*p*=0.23, NS

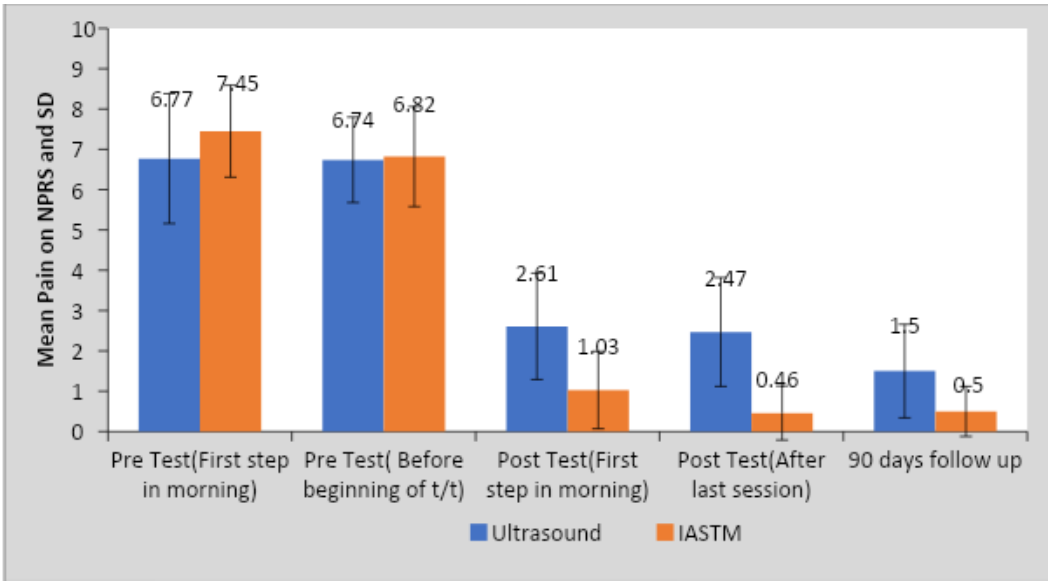
There were 42.86% males and 57.14% females in the IASTM group and 57.14% males and 42.86% females in Ultrasound group.

The gender distribution of the patients in two groups did not show a statistically significant difference when the Chi-square test was used. (χ2-value = 1.42, p=0.23)

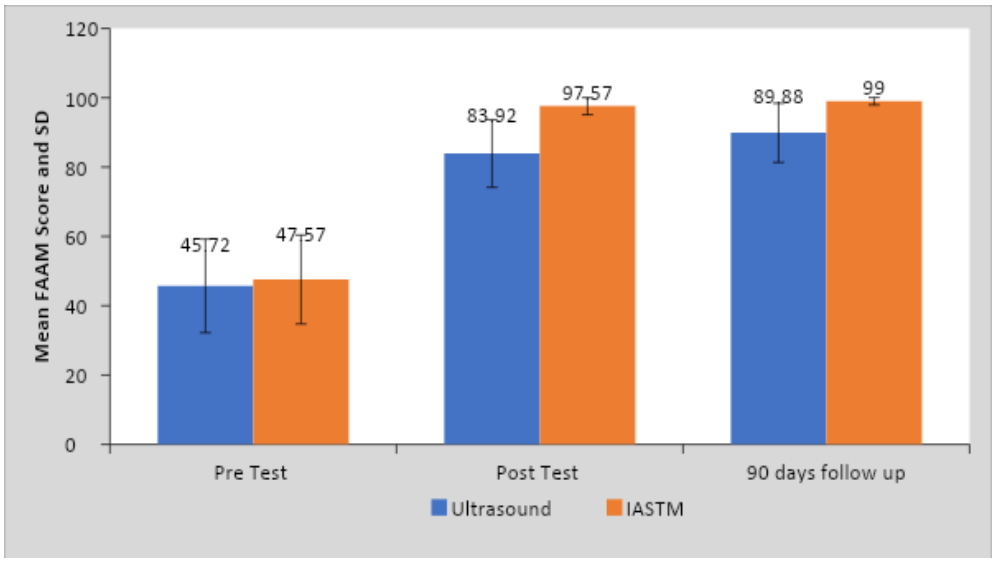
Graph 1 represent the comparison pain on NPRS in patients of both the groups i.e., IASTM group and Therapeutic Ultrasound group. The

pre-treatment, post-treatment, and 90-day follow-up scores were all kept a record of. The graph states that there was reduction in pain on NPRS in both the groups at post-treatment and 90 days follow-up. But, in IASTM group, more reduction in pain was seen as compared to the Therapeutic Ultrasound group.

Graph 2 describes the comparison of FAAM score in Ultrasound and IASTM group. The scores in post-test and 90 days follow-up showed improvement than the pre-test in both the groups i.e., Ultrasound and IASTM. But the scores in the IASTM group were much more improved than the Ultrasound group.



Graph 1. Comparison of pain on NPRS in Ultrasound and IASTM Group at pre-treatment and post-treatment



Graph 2. Comparison of FAAM Score in Ultrasound and IASTM Group at pre- treatment and post treatment

4. DISCUSSION

The purpose of this study was to examine how IASTM (Edge Mobility Tool) in combination with a home exercise program and Ultrasound in combination with a home exercise program helped with heel pain and functional abilities. Foot and Ankle Ability Measure scale and

Numerical Pain Rating Scale were the primary and secondary outcome measures.

The result of this research showed that the IASTM (using the edge mobility) tool and Therapeutic Ultrasound showed improvements in Foot and Ankle Ability Measure scale and Numerical Pain Rating Scale scores. But the IASTM group showed better improvement than Ultrasound group, both in short and long-term effects. A few participants in the Ultrasound group returned with symptoms of minor heel discomfort.

During the treatment , 3 people in IASTM group lost the post-treatment program , while 1 lost the 90 days follow-up program . In the therapeutic Ultrasound group 1 person lost the post-treatment program.

The Edge mobility tool was used in the IASTM group, then other STM (Soft tissue mobilization) tools, to improve pain and functional ability, as very less studies are being conducted on edge mobility tool.

The effects on reduction in heel pain in this study can be compared with the study carried out by Ashwini Bulbuli et al, in which they stated that M2T blade is used on tightened fascia. Repetitive fast strokes were given over the tight fascia which helped in softening of fascia, till the adhesions were broken. After repetitive strokes, there was release in fascia around ankle. The length of the fascia was restored, resulting in pain relief [23].

Also, according to the study carried out by Haytham M El-Hafez, the improvement occurred in the group which received IASTM maybe due to its (IASTM's) ability in inducing micro-trauma. So, it might have resulted in the inflammatory process (regional). There is also increase in the fibroblast release. So ,there is increase in collagen synthesis and regeneration of tissues due to migration of fibroblast, which helps in speeding up the process of healing. Additionally, there is also rise in temperature of tissue along with the blood flow which occur due to the friction movement between tool and tissues. As a result, tissue oxygenation and local waste metabolite elimination have improved [24].

The IASTM or stretching helps to improve quadriceps activation by reducing hamstring inhibition. Most importantly, the current research has clinical significance, as the IASTM treatment may be beneficial for those who have muscular shortening and hypomobility [25].

Furthermore, an additional reason for the improvement in ROM might be linked to the mechanical pressure that was applied naturally during the IASTM intervention. As a result of the mechanical tension placed on the fascia, the ROM of the ankle joint increases. Mechanical pressure activates mechanoreceptors, which alter the information sent to the central nervous system, resulting in a change in tissue tension [26].

The Ultrasound group also showed improvement in the pain reduction and functional ability. Enwemeka study the impact of 1 MHz therapeutic ultrasound on tendon healing strength and discovered that both tensile strength and energy absorption capacity increased significantly, indicating that therapeutic ultrasound improved the healing process. According to Linda Maxwell's study, while ultrasound may enhance collagen synthesis in vivo, sonication in vitro appears to provide positive results when utilized early in the healing process, but unfavorable results when used for extended periods of time. As a result, the timing of therapy might be crucial [27].

A study carried out by Ulusoy, showed the effective treatment of ultrasound (1 MHz) in treatment of plantar fasciitis. However, no-where it is clearly mentioned about the physiological effects of ultrasound on the healing process or reduction in pain [28].

In our study also, the ultrasound group people reported reduction in pain and improvement in functional ability, but 9 people came back again with the complaints of pain in the same region of heel. Thus, lacking the evidence regarding treatment of ultrasound. We can see the comparison of pain on NPRS in both the groups (IASTM group and Ultrasound group). The mean values in both the groups show statistically significant difference in both the post-test and 90 days follow-up sessions, showing that reduction in pain intensity compared to pre-test. But the IASTM group proved to be more effective in pain reduction than the ultrasound group. No adverse events like bruising , skin discoloration were observed in the IASTM group.

At the end of the therapy sessions, functional gains on FAAM benefited both the groups. The individuals also showed functional gains after 90

days following the final therapy sessions. However, in both the post-test and the 90-day follow-up session, the IASTM group outperformed the Ultrasound group. Thus, giving evidence regarding the FAAM scale.

The intention of this study focused on the use of the IASTM (Edge mobility tool) in the heel pain reduction and in improving the FAAM score. The findings suggested about the efficacy of the IASTM on heel pain. The results of this study are relevant to the practitioners, who are seeking to improve the pain and functional ability, as they demonstrate effects. The IASTM technique produced greater effects than the Ultrasound. Indicating that choosing the IASTM tool (edge mobility) than the Ultrasound. Also, the edge mobility tool is cost-effective. Though, ultrasound also proved to be effective, but exact physiological effects on pain is not given sufficiently in the articles.

This study also had some limitations. Effects of IASTM on pain and functional ability can be studied below the age group 18 and age group above 60. So, more level of evidence can be obtained for its use. Also, the selected subjects had unilateral heel pain, so study on bilateral heel pain can also be done in future.

5. CONCLUSION

In this study, it can be concluded that combining both the IASTM and Home Exercise Program have got beneficial effects in decreasing the pain intensity thus improving the function of foot and ankle in individuals with heel discomfort . Both therapy groups improved their pain intensity and ability to move their feet and ankles. But the subjects in Group 1 (IASTM) showed more improvement in the measurements taken in the follow-up after 90 days of final treatment, while the subjects in the Group 2 (Ultrasound) complained/came back with mild pain and reduction in some functional ability again during the follow-up period.

When treatment regimens for both the groups were taken into consideration for significance, they showed effectiveness in reducing the pain intensity and improvement in foot and ankle ability. But the group treated with IASTM and home exercise program proved to be more effective than the Therapeutic ultrasound and home exercise program.

CONSENT

Patients involved in the study provided informed consent.

ETHICAL APPROVAL

The authors have obtained all the necessary ethical approval from the IEC (Institutional Ethics Committee). IEC no. 2020-21/8970.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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