Comparative Effect of Multimodal Physiotherapy Approach on Pain and Functional Disability in Tailors with Plantar Fasciitis

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***Abstract*—**
Background:
Plantar fasciitis is one of the most prevalent musculoskeletal disorders affecting the foot, which mainly manifests as severe heel pain, all tailors used foot-operated sewing machines due to which plantar fasciitis is very common.

Objectives:
The aim of the study was to compare the effectiveness of conventional multimodal physiotherapy and advanced multimodal physiotherapy approaches in reducing pain and improving functional disability among female tailors with plantar fasciitis over a period of four weeks.

Materials and Methods:
A quasi-experimental design with two parallel groups was conducted among 76 female tailors aged 40–55 years diagnosed with plantar fasciitis. Participants were divided into 2 groups with 38 participants in each group. Group A **received the conventional multimodal physiotherapy approach, including ultrasound therapy, PRT and strengthening exercises. Group B received the advance multimodal physiotherapy approach, including ultrasound therapy, tissue flossing and PNF. Outcome measures included Numeric Pain Rating Scale (NPRS), Foot Function Index (FFI), Weight Bearing Lunge Test (WBLT), and ankle Range of Motion (ROM), windlass test. Assessments were recorded at Day 0 and Day 16.**

Results:
Paired t-test and independent t-test results showed statistically significant improvement within both groups ($p < 0.001$). However, greater improvement was observed in the advanced multimodal physiotherapy approach group.

Conclusion:
Both conventional and advanced multimodal physiotherapy approaches were effective in managing plantar fasciitis. However, the advanced multimodal approach incorporating ultrasonic therapy, tissue flossing and PNF technique was significantly more effective in reducing pain, improving functional ability in female tailors.

***Index Terms*—Plantar fasciitis, PRT, tissue flossing, PNF**

I. INTRODUCTION

One of the most prevalent musculoskeletal disorders affecting the foot is plantar fasciitis, which mainly manifests as severe heel pain.[1] The plantar fascia, a broad band of tissue that supports the foot's arch, may become more tense when the foot is unable to dorsiflex.[2] all tailors used foot-operated sewing machines which brought on by repeated injuries or stress or pressure on tendons, bones, joints, or muscles as a result of ongoing employment.[3]

Therapeutic ultrasound- One popular deep heating technique for treating plantar fasciitis pain is therapeutic ultrasound. By generating hot zones within the tissue, high-energy ultrasound stimulates the tissue repair cascade and encourages the production of collagen.[4]

Positional Release Technique (PRT)- PRT is an indirect approach with respect to tissue resistance that includes the use of positioning of the body, utilization of tender points to find the problem and monitoring the therapeutic intervention. As a result, there is a notable

improvement in functional range of motion and a reduction in pain.[5]

Tissue Flossing- also referred to as compression band therapy or blood flow restriction therapy. this procedure produces a localized ischemia environment that causes an increase in blood flow when the band is released.[6] it may decrease muscle stiffness, and increase muscular stretch tolerance for joint range of motion and tissue stiffness.[7] As a compression tool, floss band applies pressure to the skin, potentially activating large diameter Ab-fibres to reduce pain.[8]

Proprioceptive Neuromuscular Facilitation (PNF)- PNF techniques are known to be widely used methods in rehabilitation, specifically in managing an increased range of motion and strength.[9] The main goal of therapy is to restore normal motor control which in turn will enable the patient to rehabilitate to the maximum possible level of functioning.[10]

Strengthening Exercises-It is crucial to focus on the intrinsic muscles of the sole and their regulating role in foot function.[11] The foot muscles may be strengthened to stabilize the arch's shape through the use of towel curls, foot doming, and toe spread exercises.[12] For plantar fasciitis, stretching the Achilles tendon and/or Plantar Fascia is said to be a typically safe and successful treatment.[13,14]

II. METHODOLOGY

Materials and Methods

Study Design

A quasi-experimental study design with two parallel groups was used.

Study setting

The study was conducted in the department of physiotherapy in Khalsa college, Amritsar. Participants were recruited from women working in tailoring unit (Ritu Infants Care) and (Bharat Agency) using sewing machine pedals for at least 4-6 hours per day.

Participants

This included pedal sewing machine tailor women those who working from last 2-3 years were targeted population. female tailors aged 40–55 years diagnosed with plantar fasciitis were included in the study.

Sample Size

sample size was found to be 76 participants which were divided into two groups

Group A – 38 participants (Conventional multimodal physiotherapy approach)

Group B – 38 participants (Advance multimodal physiotherapy approach)

Selection criteria

Inclusion criteria

- Female tailors (sewing machine operators) aged 40-55years.
- Regular occupational use of foot-operated sewing machine pedal for 4-6 hours per day.
- Diagnosed of plantar fasciitis with:

Windlass test had to be positive

WBLT had to be positive

Plantar heel pain localized to the medial calcaneal region

Pain worse on 1st step in morning or after prolonged sitting

Tenderness at plantar fascia insertion (medial calcaneal tubercle)

- Symptoms lasting for 3 months or more

Exclusion criteria

- History of any foot or ankle surgery or fracture in affected limb.
- Systemic inflammatory or autoimmune disease (e.g., rheumatoid arthritis)
- Any peripheral neuropathy (e.g., diabetic neuropathy), peripheral vascular disease (DVT)
- Current use of anticoagulant therapy (e.g., warfarin) or bleeding disorders (due to increased risk of hematoma with flossing).
- Any skin lesions, corticosteroid injections into plantar fascia or heel within past 3 months.
- Any foot deformity (e.g.-Pes Cavus, hallux valgus and rigidus, claw toe, hammer toe)

Variables

Independent Variable:

- Positional Release Technique
- Ultrasound

- Tissue flossing
- Strengthening Exercises
- Proprioceptive Neuromuscular Facilitation

Dependent variable:
- Pain
- Pain, Disability, Activity Limitation
- Ankle Dorsiflexion
- Range Of Motion

Instruments and tools
- Flossing band
- Ultrasound machine
- Goniometer
- Measuring tape for WBLT

Outcome measures
- Numeric pain rating scale (NPRS) - for pain intensity
- Goniometer – for range of motion
- Windlass Test - for plantar fascia flexibility
- Weight Bearing Lunge Test (WBLT) – for ankle dorsiflexion range of motion
- Foot Function Index (FFI) – for assessing pain, disability, and activity limitation.

Procedure
- Permission was taken from the management of the respective workplace.
- Participants informed consent was taken.
- Screening of subjects using NPRS, Windlass Test, FFI, ankle rom, WBLT were performed.
- Participants were randomly assigned to either group

Group A received the conventional multimodal physiotherapy approach, including ultrasound therapy, PRT and strengthening exercises.

Group B received the advance multimodal physiotherapy approach, including ultrasound therapy, tissue flossing and PNF.
- The duration and frequency were for 4 weeks, with 4 sessions per week.

GROUP-A Conventional multimodal physiotherapy approach

Ultrasound Therapy - It was applied to the plantar fascia (medial calcaneal region) at an intensity of 1.5 W/cm² in continuous mode. 5 minutes, 2 sessions/week, for 4 weeks (Monday, Wednesday).

Positional release technique (PRT) - Target muscles: Gastrocnemius & Soleus (calf). The patient was placed in a comfortable position where the ankle moved towards plantarflexion until tenderness at the trigger point was minimized. The therapist applied gentle pressure at the trigger point. Hold for 90 seconds, 2 sessions/week (Tuesday, Thursday).

Strengthening Exercises - The exercise program included heel raises, towel curls, toe spread exercise, foot doming exercise, and plantar fascia stretch. 15–20 minutes (approx. 10 reps of each exercise). 4 sessions /week (All 4 days i.e. from Monday to Thursday).

GROUP B: Advance multimodal physiotherapy approach
Ultrasound Therapy - It was applied to the plantar fascia (medial calcaneal region) at an intensity of 1.5 W/cm² in continuous mode. 5 minutes, 2 sessions/week, for 4 weeks (Monday, Wednesday).

Tissue flossing - A warm-up was performed, including 1 minute of walking, 15 seconds of heel raises, and 15 seconds of ankle dorsiflexion.

The floss band was then applied around the ankle and foot, starting at the metatarsals and wrapped in a figure-of-eight pattern encircling the Achilles tendon and foot. The wrapping was repeated for three rotations while maintaining appropriate tension. The patient performed active ankle and foot movements during the application. Safety precautions were ensured to avoid numbness, excessive pain, or impaired circulation. The band was removed immediately after completing the movements. 3 Floss treatment for 2 minutes each, followed by 2 min rest between sets, 2 sessions/week (Tuesday, Thursday).

PNF– Slow Reversal- Alternating isotonic contractions were performed for the agonist and

antagonist muscle groups (ankle plantar flexors and dorsiflexors). The patient moved the ankle actively while the therapist had to provide resistance. 35 seconds per set

PNF-rhythmic stabilization- Manual resistance was applied by the therapist in alternating directions around the ankle joint to improve neuromuscular control and joint stability.
The patient maintained the position while resisting the perturbations. 90 seconds per set 3 sets/session 4 sessions /week (All 4 days i.e. from Monday to Thursday)

Statistical analysis
Descriptive statistics such as mean and standard deviation were used to summarize demographic characteristics and baseline values of the outcome measures.

For within-group comparison (pre-test and post-test values), the paired t-test was applied. For between-group comparison of post-test values, the independent t-test was used. The level of significance was set at $p < 0.05$.

III. RESULTS

Table I: Descriptive Analysis of Age Comparison Between Groups

Group	N	Mean Age	Std. Deviation	Std. Error Mean
Conventional Physiotherapy Approach	38	48.16	4.415	0.716
Advanced Physiotherapy Approach	38	47.37	4.233	0.687

Table-I: The mean age of participants in the conventional physiotherapy group was 48.16 years, while in the advanced physiotherapy group it was 47.37 years. Independent samples t-test showed no statistically significant difference ($p = 0.429$).

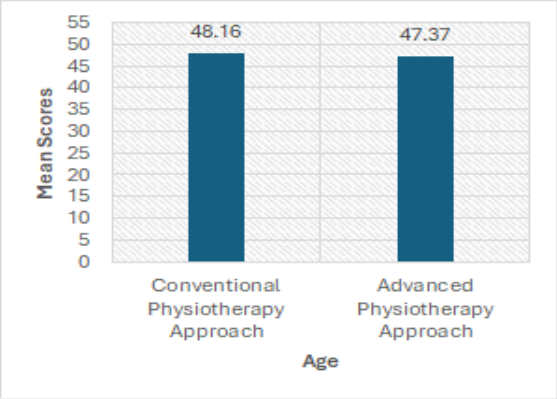

Fig. 1. Age comparison between groups.

Table II: Paired t-test for Group A (Conventional Physiotherapy Approach)

Outcome Measure	Comparison	Mean Difference	Std. Deviation	Std. Error Mean	t value	p value
NPRS	Day 0 - Day 16	3.2895	0.5651	0.0917	35.883	0.000
FFI	Day 0 - Day 16	38.8158	5.4962	0.8916	43.535	0.000
WBLT	Day 0 - Day 16	-3.6326	0.5067	0.0822	-44.193	0.000
Ankle Plantarflexion	Day 0 - Day 16	-8.6316	1.6672	0.2705	-31.915	0.000
Ankle Eversion	Day 0 - Day 16	-5.7632	0.9708	0.1575	-36.596	0.000
Ankle Inversion	Day 0 - Day 16	-7.8684	1.2119	0.1966	-40.023	0.000

Paired t-test analysis showed statistically significant improvements in pain intensity (NPRS), foot function (FFI), ankle dorsiflexion (WBLT), and ankle range of motion (ROM) within Group A following conventional physiotherapy ($p < 0.001$).

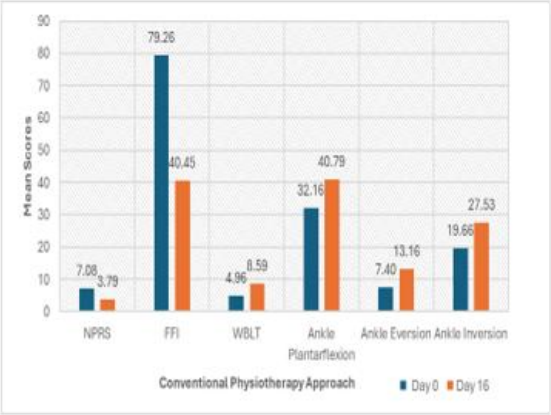

fig. 2. Pre–post comparison in Group A

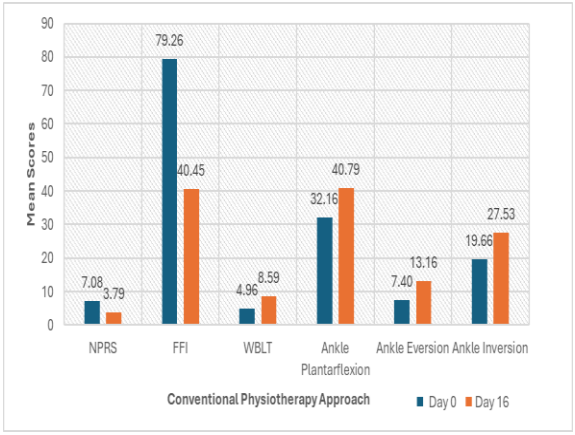

Fig. 3. Pre–post comparison in Group B.

Table III:Paired t-test for Group B (Advanced Physiotherapy Approach)

Outcome Measure	Comparison	Mean Difference	Std. Deviation	Std. Error Mean	t value	p value
NPRS	Day 0 - Day 16	5.2632	0.6851	0.1111	47.354	<0.001
FFI	Day 0 - Day 16	54.4737	6.7533	1.0955	49.723	<0.001
WBLT	Day 0 - Day 16	-5.0203	0.5609	0.0910	-55.169	<0.001
Ankle Plantarflexion	Day 0 - Day 16	-13.2632	3.0826	0.4913	-26.996	<0.001
Ankle Eversion	Day 0 - Day 16	-9.8684	1.3187	0.2139	-46.131	<0.001
Ankle Inversion	Day 0 - Day 16	-11.8947	1.6405	0.2661	-44.695	<0.001

Paired t-test results demonstrated highly significant improvements in NPRS, FFI, WBLT, and ankle ROM scores within Group B after the advanced physiotherapy intervention ($p < 0.001$).

Table IV:Independent t-test (Between Group Comparison)

Outcome	Time	Group A Mean ± SD	Group B Mean ± SD
NPRS	Day 0	7.079 ± 0.941	6.947 ± 0.957
NPRS	Day 16	3.789 ± 0.777	1.684 ± 0.471
FFI	Day 0	79.263 ± 7.047	71.447 ± 7.225
FFI	Day 16	40.447 ± 6.947	16.974 ± 5.196
WBLT	Day 0	4.955 ± 0.731	5.203 ± 0.757
WBLT	Day 16	8.588 ± 0.570	10.223 ± 0.661
Ankle Plantarflexion	Day 0	32.158 ± 3.658	33.605 ± 3.453
Ankle Plantarflexion	Day 16	40.789 ± 2.840	46.868 ± 1.436
Ankle Eversion	Day 0	7.395 ± 1.326	8.079 ± 1.343
Ankle Eversion	Day 16	13.158 ± 1.263	17.947 ± 1.184
Ankle Inversion	Day 0	19.658 ± 2.109	20.921 ± 2.364
Ankle Inversion	Day 16	27.526 ± 1.466	32.816 ± 1.353

Independent t-test results indicate that Group B achieved significantly greater improvement in pain reduction, functional recovery, and ankle dorsiflexion compared with Group A.

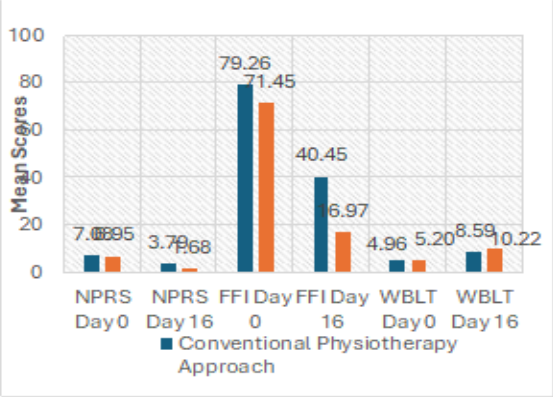

Fig. 4. (a) Between-group comparison of NPRS, FFI, WBLT

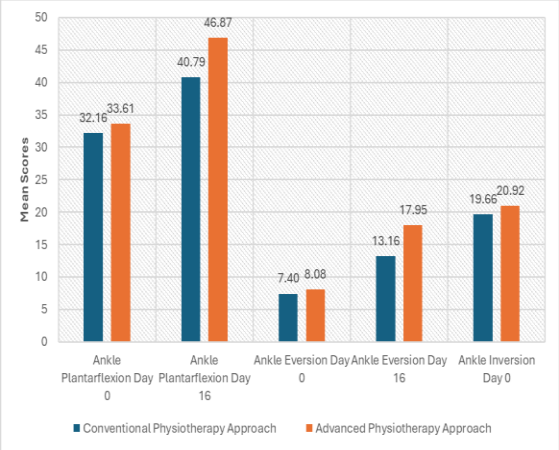

Fig. 4. (b) Between-group comparison of ankle plantarflexion, eversion, inversion.

Table-VWindlass Test (Chi-Square Analysis)

Day	Conventional Group	Advanced Group	Chi-square	Df	p value
Day 0	Positive	Positive	–	–	–
Day 16	Slight Positive	Negative	76.000	1	<0.001

Chi-square test demonstrated statistically significant differences in Windlass test outcomes between groups, with a greater number of participants in the advanced physiotherapy group achieving a negative Windlass test.

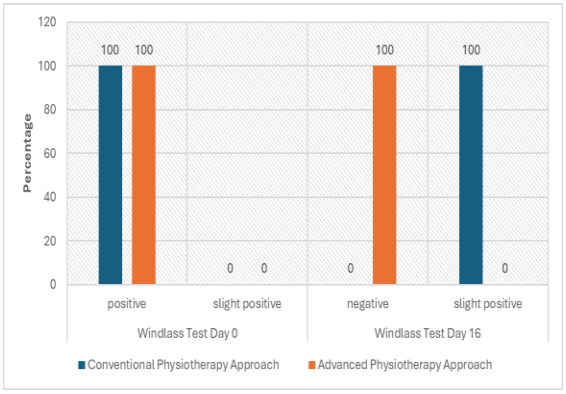

Fig. 5. Windlass test outcome comparison.

IV. DISCUSSION

The present study evaluated the effectiveness of Group A conventional and Group B advanced multimodal physiotherapy approaches in reducing pain and improving functional ability and ankle mobility in female tailors with plantar fasciitis. Following the 4-week intervention, both groups showed notable improvements in pain (NPRS), functional disability (FFI), ankle dorsiflexion (WBLT), range of motion (ROM), and windlass test, suggesting that multimodal physiotherapy is useful in treating plantar fasciitis.
However, the Group B (advanced multimodal approach) showed significantly greater improvements compared to the Group A (conventional multimodal approach).

Group B (Advanced multimodal approach) included therapeutic ultrasound, tissue flossing and PNF in which Ultrasound increases local blood flow, improves collagen extensibility, and promotes cellular activity, thereby facilitating pain reduction and improved tissue flexibility. Tim Watson reported that therapeutic ultrasound facilitates tissue healing and pain reduction via thermal and non-thermal mechanisms.[21]

tissue flossing technique's enhancement of tissue mobility and functional performance. Tissue flossing creates a localized ischemic environment, which, upon the release of the band, prompts a surge in blood flow. This surge is believed to aid in the removal of exercise byproducts and enhance the delivery of oxygen and

nutrients to the muscles, improving joint mobility, increased muscle strength, and accelerated recovery. Driller and Overmyer (2017) suggested floss band enhances blood circulation and fascial mobility, thereby improving joint movement.[17] Similarly, Ross and Kandasamy (2017) reported significant improvements in ankle dorsiflexion and functional performance.[18]

PNF is believed to improve neuromuscular control and muscle flexibility. As a result, the plantar fascia experiences less strain during functional activities due to increased joint range of motion and decreased muscle tightness. In the present study, the PNF likely contributed to improved ankle range of motion and functional performance. Sharman et al. (2006) also demonstrated that PNF stretching techniques produce greater improvements in flexibility compared to conventional stretching methods.[19] Nakamura et al. (2021) suggested that both neural and mechanical adaptations contribute to improved flexibility and joint mobility.[20]

The improvements in NPRS, FFI, and WBLT, range of motion, negative windlass test scores suggest that the intervention not only reduced pain but also enhanced functional mobility and joint flexibility, which are essential for improving the quality of life of individuals suffering from plantar fasciitis.

Group A (conventional multimodal group), the combined effects of therapeutic ultrasound, positional release technique, strengthening exercises may be responsible for the notable gains seen in the conventional group. Ultrasound facilitated pain reduction and improves tissue extensibility. Tim Watson reported that therapeutic ultrasound facilitates tissue healing and pain reduction via thermal and non-thermal mechanisms.[21]

whereas positional release technique may have improve muscle tension and tenderness. Jain NM et al. reported that Positional Release Technique (PRT) is effective in reducing gastrosoleus trigger point pain and improving muscle flexibility in recreational runners.[22] Improved foot stability and load distribution throughout the plantar fascia may have been facilitated by strengthening workouts. Boob M et al. reported that to maintain correct foot alignment, control the arch's position, and improve balance by activating the proprioceptors on the foot's sole, strengthening exercises were performed.[14]

However, magnitude of improvement in conventional group was comparatively less than that in advanced group. This may be due to limited influence of conventional techniques on soft tissue mobility and neuromuscular control.

V. CONCLUSION

The current study reveals that, both conventional and advanced multimodal physiotherapy techniques are beneficial in reducing pain and enhancing functional ability and ankle range of motion. The combined effects of tissue flossing, proprioceptive neuromuscular facilitation, and ultrasound therapy improved pain, soft tissue flexibility, neuromuscular control, and foot ranges, which is probably why the advanced multimodal method produced better results. For the clinical treatment of plantar fasciitis in occupational groups, the advanced method might therefore be deemed more successful.

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