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Effect of Manual Therapy and Conventional Physiotherapy on pain, movement, and function following Acute and Sub-acute Lateral Ankle sprain: A Randomized Clinical Trial

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Abstract

Background: Lateral Ankle Sprain (LAS) is the most common musculoskeletal injury among highly active and non-active populations. Physiotherapy plays a significant role in reducing pain and improving range of motion (ROM) and functional outcomes in people with LAS. **Aims and Objectives:** The study's main objective is to compare the effects of manual therapy (Mulligan's MWM) and conventional physiotherapy (PRICE and therapeutic exercises) and conventional physiotherapy alone on pain, ankle ROM, and function in subjects with LAS. Study Design: A randomized clinical trial was used, and 40 patients diagnosed with acute and sub-acute grade I or II LAS were randomly allotted to two experimental groups. Setting: The patients who met the selection criteria were recruited from the Team Physio Clinic, Pudukkottai, Tamilnadu, from January 2020 to June 2021. **Materials and Methods:** The experimental group I (n=20) received Mulligan's MWM and conventional physiotherapy, whereas those assigned to the experimental group II (n=20) received conventional physiotherapy alone. The treatment duration for both groups was four weeks. Outcome measures such as pain intensity, ankle dorsiflexion ROM, and foot and ankle disability index (FADI) were used. **Statistics:** The Shapiro-Wilk test was applied to examine whether the data had a normal distribution. A paired 't-test' was used to compare the pre-and post-intervention mean scores within a group. Further, an unpaired 't-test' was used to compare the mean scores of both experimental groups at pre-and post-intervention stages. The data analysis was carried out using SPSS at a 5% level of significance. **Results:** Both experimental groups significantly reduced pain and improved ankle dorsiflexion ROM and function following the treatment duration. There is a significant difference between the two experimental groups in reducing pain and improving ankle dorsiflexion ROM and function at the post-intervention stage. **Conclusion:** MWM with conventional physiotherapy is significantly more effective than conventional physiotherapy alone in reducing pain and improving ankle dorsiflexion ROM and function in acute and subacute grade I or II LAS.

Keywords: Lateral ankle sprains, Manual therapy, Mulligan's mobilization with movement (MWM), PRICE, Therapeutic exercises.

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INTRODUCTION

Ankle sprains are a common musculoskeletal injury in highly active and non-active populations [1]. The most prevalent musculoskeletal injury is lateral ankle sprains (LAS), which account for 10% to 30% of all athletic injuries [2]. LAS can have significant ramifications for injured athletes regarding treatment cost and time lost from the sport. The incidence rate for such an injury is 0.93/1000 athlete-exposures [3]. This condition is even though only around 50% of patients seek therapy [4]. Due to lost productivity and work time, ankle sprains place a high economic cost on society [5]. Ankle sprains are most common in sports including sprinting, cutting, and jumping, such as basketball, volleyball, football, and soccer [6-8]. The lateral, medial and high ankle regions are all affected by ankle sprains, with the lateral or inversion ankle sprain being the most prevalent [3]. Noncontact, player contact, or surface contact are the most typical mechanisms of injury that cause inversion ankle sprains [8]. In plantarflexion and inversion ankle movements, the destructive forces tear one or more of the lateral ligaments of the ankle [9].

In the first two weeks after a sprain, mechanical instability in the ankle usually causes functional disability and pain [10-14]. Despite the severity of mechanical instability, functional disability and pain remain for more than two weeks in several instances [13]. If the mechanical instability of the ankle is not treated correctly and promptly, the ankle sprain can recur [10, 12, 14].

To lower LAS incidence in athletes, researchers must first identify the risk factors for the injury. Several extrinsic and intrinsic factors for LAS vulnerability have been suggested in studies. Lack of warm-up [15, 16], direct contact with an opponent [17, 18], shoes [16], and playing on artificial turf are the main extrinsic risk factors [19, 20]. Age [3], altered gait kinematics and postural stability [21], previous ankle sprains [22], decreased ankle range of motion (ROM) [23, 24], decreased strength and proprioception [25], limb dominance [26, 27], and body mass index (BMI) [28, 29] are the potential intrinsic risk factors. Because of the high occurrence of this injury in athletes and its side effects on their health and athletic life, it would be beneficial to identify those at risk of LAS. The history and clinical examination are used to diagnose an ankle sprain [30]. In suspected cases, radiographs may be required to rule out a fracture [31]. The risk of this damage can be reduced by identifying the affected people and implementing relevant measures. Furthermore, due to a lack of understanding of the causes of injuries, the effectiveness of injury prevention programs may be limited [32]. Despite several studies on intrinsic risk factors, few investigations into morphological etiological causes of lateral ankle sprains in athletes have been conducted, and the results are mixed [32]. The principles of protection, rest, ice, compression, and elevation are used in the initial therapy of an ankle sprain (PRICE). An ankle brace can be used for protection, with gradual restoration of activity as tolerated. Depending on the degree of the injury and any related ankle instability, physiotherapy may be recommended [33]. To relieve pain and increase joint ROM, exercise therapy focused on neuromuscular and proprioceptive exercises and joint mobilization is used [3, 30, 34].

Muscle stretching is an effective treatment for reduced ROM caused by immobilization because it elongates shortened musculotendinous tissues rather than restores periarticular tissue extensibility. On the other hand, joint mobilization is a goal-oriented treatment because of its intra-articular movements and focus of tensile pressures on the shortened tissues around the joints, such as ligaments and the joint capsule [35]. It is improved using both the Maitland and Mulligan mobilization procedures [36, 37]. According to review research [34], in all phases of ankle sprain, Maitland mobilization reduces pain and improves the range of ankle dorsiflexion. On the other hand, active joint mobilization, also known as mobilization with movement (MWM) is a relatively new technique used by various physiotherapists. The therapist provides a painless mobilizing force to the affected joint while the patient performs an active movement in the direction of pain and movement restriction. The goal is to make painful impaired movement pain-free so the patient can be involved in a progressive return to normal functional activities [38]. The authors [39] conducted a systematic review and found moderate-quality evidence favoring MWM for chronic recurring ankle sprains. The most widely examined MWM technique in that review was a posterior talar glide MWM [39]. Another MWM widely used in treating acute ankle sprains is the inferior tibiofibular joint. While the patient performs active ankle plantar flexion with inversion, a sustained mobilization force is given to the lateral malleolus in a posterior, superior, and lateral orientation. In addition, the rigid athletic tape can be applied to the skin to stimulate and prolong the effects of MWM [38]. To our knowledge, the use of MWM at the inferior tibiofibular joint in acute and subacute ankle sprains has only supportive evidence from a case series [40, 41]. High-quality randomized control trials are required to validate these positive research findings. Furthermore, comparing MWM to sham procedures will help researchers comprehend its efficacy beyond the placebo effect [42, 43]. In line with the above statements, this study hypothesized that the addition of manual therapy (MWM) would reduce pain and improve ankle mobility and function in the short term compared to conventional physiotherapy (PRICE and therapeutic exercises). To the best of the researchers' knowledge, no study comparing the effects of these two treatments for a sprained ankle has yet been done. Thus, the purpose of the present study was to compare the effects of MWM along with conventional physiotherapy (PRICE with therapeutic exercises) and conventional physiotherapy on pain, ankle ROM, and function in subjects with lateral ankle sprains in the Indian context.

MATERIALS AND METHODS

Study design

A randomized clinical trial to compare the effects of MWM along with conventional physiotherapy and conventional physiotherapy alone on pain, ankle ROM, and function in subjects with lateral ankle sprains.

Participants

This study included participants with acute and sub-acute grade I or II lateral/inversion ankle sprains presenting to Team Physio Clinic, Pudukkottai, Tamilnadu during January 2020 to June 2021 were recruited into this trial. An orthopaedic surgeon diagnosed a lateral/inversion ankle sprain based on the patient's history and clinical examination. Acute ankle sprains last four days after injury, while sub-acute ankle sprains last five to fourteen days [44]. Both groups of individual subjects had their injured ankles treated by the same physiotherapist who had five years of clinical expertise in manual therapy. Another physiotherapist assessed the outcome measurements such as pain scale, range of ankle dorsiflexion, and disability scale of the ankle before the first therapeutic session and then after the last session.

Inclusion Criteria

Subjects were 18 to 50 years old, had a unilateral lateral/inversion ankle sprain for the first time, and received ankle immobilization treatment for 2-4 weeks, depending on the injury before the intervention. Grade I and II mechanical instability were differentiated by physical examination performed through the anterior drawer and talar tilt tests on the injured limb.

Exclusion Criteria

Grade III ankle sprain, systemic diseases such as rheumatoid arthritis, diabetics, sensory disorders from neurological diseases, ankle fracture, subluxation, dislocation, recent surgery in either of the two lower limbs, recently received intra-articular steroid injection, and pain exacerbation during the intervention.

Initially, each group in this preliminary study consisted of twenty subjects. The subjects were assigned to one of two groups at random by choosing sealed envelopes containing numbers ranging from 1 to 40, with even numbers indicating manual therapy (Mulligan's MWM) plus conventional physiotherapy (PRICE and Therapeutic exercises) in group I and odd numbers indicating conventional physiotherapy only in group II. The therapeutic and evaluation methods were explained to both groups in simple language, and the participants then reviewed and signed the consent form.

Interventions

Both groups had eight treatment sessions over for four weeks. All patients received standard orthopaedic care, which included a compression bandage around the injured ankle and foot that extended above the ankle and immobilization in a posterior ankle brace for no more than two weeks, as recommended by the orthopaedic surgeon. They were also instructed to elevate their affected leg on pillows while sleeping and apply ice to the skin of the affected ankle for 20 minutes

at least three times a day after removing the brace and bandage. Subjects were taught to continue walking as soon as possible, using a walking aid if necessary.

Manual therapy – Mobilization with movement (MWM)

Mulligan's MWM for inversion ankle sprain [45], was given to the experimental group in addition to PRICE and therapeutic exercises. With the patient is in the supine position, the distal fibula was given a pain-free posterior, superior, and lateral force while the tibia was stabilized in supine. To promote comfort, this force was administered through a soft cloth pad. The subjects were instructed to perform active ankle plantar flexion and inversion to the maximal pain-free range while this force was maintained. While performing the technique, passive over-pressure was applied during plantarflexion and inversion only when the patient could attain a full pain-free range of motion with a maximum of 3 sets of 9 repetitions. In addition to the MWM, two layers of rigid tape were applied to the skin above the distal fibula, spiraling proximally up the leg. The therapist subtly altered the contact point, direction, and quantity of force to produce pain-free active ankle plantarflexion and inversion. No more MWM or tape application was given to these patients in that session if pain-free ROM could not be attained after a maximum of three trials of MWM with adjustment as stated. On the other hand, the subjects received the assigned therapy at successive visits, and the response was recorded. If there was any redness around the tape, all subjects were told to remove it immediately. Otherwise, the tape was removed 48 hours after it was first applied. An increase in pain intensity of more than 2 points on an 11-point NPRS that did not return to baseline within 5 minutes during the application of any intervention and any widespread allergic skin reaction to the tape, were recorded as adverse events [46].

PRICE and Therapeutic Exercises

After an initial examination (including history-taking, physical examination, and radiographic evaluations), acute management for ankle sprains includes anti-edema measures (protection, rest, ice, compression, elevation (PRICE)), anti-inflammatory medication, and weight-bearing support through a brace [30]. The therapist gave conventional PRICE regimen guidelines and suggested just undertaking pain-free movements for four weeks with exercises.

The designed exercise program began at the end of the first therapy session in both groups. This program was designed to improve ankle joint mobility and muscular strength and proprioception, and balance [46]. Exercises were planned to improve ankle mobility in a non-weight-bearing position during the first week and then gradually proceeded to weight-bearing as tolerated. They were instructed to stop exercising if their pain increased by more than 2 points on an 11-point NPRS scale and to resume only if their pain returned to normal within 5 minutes. The exercise parameters were tweaked as needed, but the type of exercise remained the same. Non-weight bearing exercises included ankle and subtalar ROM with three sets of 15 repetitions conducted in an extended sitting. Calf muscle stretches were held for 30 seconds and then repeated five times. Three sets of 15 repetitions of ankle strengthening exercises were performed against a resistance band. Using higher-grade resistance bands, the resistance was increased. As soon as the patient could stand comfortably without using an assistive device, he or she was moved to weight-bearing exercise. Forward lunges, bilateral squatting, and progression to unilateral squatting, all with support if needed. The single-leg heel rise was developed from a bilateral heel raise to a single-leg heel lift against bodyweight resistance. All weight-bearing exercises were done three times for a total of 15 repetitions. When weight-bearing was comfortable, balance training began. Balance training began with support standing in a bilateral stance on a stable surface before progressing to a unilateral stance on an unstable surface. The subjects were instructed to hold the position for a maximum of 2 minutes and then repeat the process five times. Recommendations were made for the patient to do similar activities twice a day at home. During each session, all activities were supervised, although compliance with the home exercise program was only obtained verbally [46].

Outcome measures

Numerical pain rating scale (NPRS)

The primary outcome measure was the worst pain intensity reported on an NPRS for pain in the previous 24 hours. Any functional activity or movement of the injured ankle could cause this. It is a single 11-point numeric scale, with 0 indicating "no pain" and 10 indicating "worst suffering imaginable." The NPRS's minimal clinically relevant difference (MCID) was set at 1.7 points [47].

ROM measurement

The lunge test was used to determine the maximum functional ankle dorsiflexion ROM in a weight-bearing position. Without elevating the heel, the participant was asked to lunge their knee towards a wall while standing, knee in line with the second toe. A bubble inclinometer was put beneath the tibial tuberosity to measure the dorsiflexion angle. The angle of ankle dorsiflexion during the lunge test was shown to have excellent intra-rater reliability. The final range was determined by taking the average of three readings [48].

Foot and Ankle Disability Index

The Sports module of the Foot and Ankle Disability Index (FADI) was developed to assess functional limitations caused by foot and ankle injuries. The FADI consists of 26-item activities of daily life subscale and an 8-item sports subscale. A lower score indicates a higher disability. The total potential score is 136 (FADI 104 points, & Sports 32 points). In participants with ankle sprains, the reliability of the FADI score was rated as excellent [49].

Statistical analysis

The Shapiro-Wilk test was used to determine whether the data had a normal distribution. An unpaired ‘t-test’ was applied to compare the mean scores of both experimental groups at pre- (0 weeks) and post-intervention (end of 4th week) stages. A paired ‘t-test’ was used to compare the pre-and post-intervention mean scores within a group. SPSS was used to analyze the data at a significance level of 0.05.

RESULTS

Table 1: Mean and standard deviation of all the outcome measures at pre-intervention and post-intervention stage

Variables	Experimental Group 1		Experimental Group II	
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
Pain Scale	6.20	1.85	6.35	3.30
Ankle Dorsiflexion	25.10	40.0	25.65	30.65
FADI (Foot and Ankle Disability index)	64.70	85.20	64.25	79.60

Table 2: Analysis of Pain, Ankle ROM, and Foot and ankle disability of subjects in both experimental groups during Pre-intervention Stage

Outcome Measures	Groups	Mean	SD	*t-value*
Pain intensity	Experiential Group-1	6.20	0.89	0.56**
	Experiential Group-II	6.35	0.81	
Ankle Dorsiflexion	Experiential Group-1	25.10	1.29	1.24**
	Experiential Group-II	25.65	1.50	
FADI (Foot and Ankle Disability index)	Experiential Group-1	64.70	0.87	1.29**
	Experiential Group-II	64.25	1.29	

***Non-significant at 0.05 levels (p>0.05)*

The pre-intervention mean scores of three outcome measures were subjected to the unpaired 't-test' and the obtained 't' value is less than the table 't' value at 0.05 level [Table 2]. Hence it is inferred that the mean scores of all the outcome measures were identical at the Pre-intervention stage before being subjected to the selected therapeutic interventions (p>0.05).

Table 3: Analysis of Pain, Ankle ROM, and Foot and ankle disability of subjects in MWM and Conventional physiotherapy group (pre-versus post-intervention)

Outcome Measures	Groups	Pre-intervention Stage		Post-intervention Stage		*t-value*
		Mean	SD	Mean	SD	
Pain intensity	Experiential Group-1	6.20	0.89	1.85	0.67	17.86*
	Experiential Group-II	6.35	0.81	3.30	0.80	13.33*
Ankle Dorsiflexion	Experiential Group-1	25.10	1.29	40.0	1.12	42.01*
	Experiential Group-II	25.65	1.50	30.65	1.09	12.58*
FADI (Foot and Ankle Disability index)	Experiential Group-1	64.70	0.87	85.20	1.20	91.68*
	Experiential Group-II	64.25	1.29	79.60	1.05	37.83*

**Significant at 0.05 levels (p<0.05)*

Further exploration was made to ascertain whether any significant difference was observed in the outcome measures between the two-time intervals (i.e., pre-treatment phase and at the end of 4th week) in both experimental groups. It is found that both groups showed a significant reduction in the pain intensity and self-rated foot ankle disability and better improvement in ankle dorsiflexion ROM between the pre-intervention and post-intervention stages (p<0.05) (Table 3).

Table 4: Analysis of Pain, Ankle ROM, and Foot and ankle disability of subjects between MWM and Conventional physiotherapy group (Post-intervention stage only)

Outcome Measures	Groups	Mean	SD	t-value
Pain intensity	Experiential Group-1	1.85	0.67	6.21 *
	Experiential Group-II	3.30	0.80	
Ankle Dorsiflexion	Experiential Group-1	40.0	1.12	26.71*
	Experiential Group-II	30.65	1.09	
FADI (Foot and Ankle Disability index)	Experiential Group-1	85.20	1.20	15.76*
	Experiential Group-II	79.60	1.05	

**Significant at 0.05 levels (p<0.05)*

From Table 4 and Figure 1, it is inferred that the experimental group I exposed MWM with conventional physiotherapy showed a significant reduction in pain intensity (mean difference 1.45) and improvement in ankle dorsiflexion ROM (mean difference 9.35), and self-reported foot

ankle disability (mean difference 5.60) than the experimental group-II exposed to conventional physiotherapy ($p<0.05$).

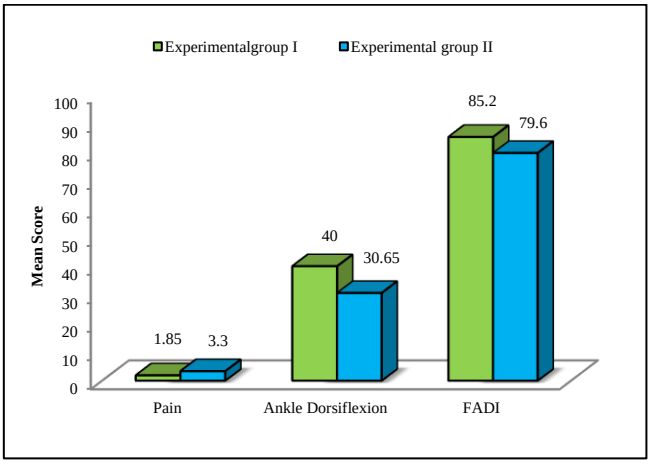

Figure 1: Unpaired 't' test comparing the post-intervention mean score between two experimental groups

DISCUSSION

This study aimed to compare the effects of MWM along with conventional physiotherapy and conventional physiotherapy alone on pain, ankle ROM, and function in subjects with lateral ankle sprains.

While reviewing the results, the experimental group I received the MWM along with conventional physiotherapy for the treatment duration of 4 weeks. Following the treatment duration, this group showed a significant reduction of pain and improvement of ankle dorsiflexion and function in subjects with lateral ankle sprains. In line with this finding, Gogate *et al.* (2021) stated that the application of MWM and exercise therapy tends to boost clinical and speedy improvement than exercise alone [50]. Nguyen *et al.* (2021) concluded that most (84%) of patients with dorsiflexion ROM deficit after subacute lateral ankle sprain had responded well to the mulligan MWM protocol [51]. A faulty fibula position might lead to abnormal pain and movement after an ankle sprain. The MWM applied to the fibula, and its biomechanical effect might be responsible for improving ROM and hypoalgesic effects, causing pain relief [50]. The mechanical hypoalgesia from MWM proposed a potential role of central mechanisms related to the non-opioid mediated descending pain inhibitory system activation, variation in muscle activation, and behavioral mechanisms [38]. Besides, exercise therapy concentrating on neuromuscular and proprioceptive exercise and joint mobilization decreases pain and improves ROM in treating ankle sprain [3, 30, 34].

On the other hand, experimental group II received only conventional physiotherapy for the treatment duration of 4 weeks. Following the treatment duration, this group showed a significant reduction of pain and improvement of ankle dorsiflexion and function in subjects with the lateral ankle sprain. In accord with this result, Mohd Salim *et al.* (2018) observed that the standard physiotherapy program for one week decreased pain and increased ankle eversion to inversion ratio in grade I ankle sprain cases. The standard physiotherapy program comprised protection, optimal loading, ice, compression, elevation (POLICE), stretching, and balancing exercises [52]. Further, neuromuscular training and balance exercises effectively manage muscle strength deficits [53, 54]. Strengthening exercises for weakened muscles are vital for a speedy recovery, and such exercises prevent the recurrence of an ankle sprain [55]. A static-stretching exercise showed a strong effect in improving ankle dorsiflexion following acute ankle sprains. Generally, stretching exercise is applied to regain full ROM by aiming the calf muscles' flexibility. It might enhance flexibility prior to pain perception and permit the viscoelastic properties of muscle and tendon junctions to overcome the stretch reflex or raise the stretch tolerance [56].

In a comparison of both groups, it is inferred that there is a significant difference between the effect of MWM along with conventional physiotherapy and conventional physiotherapy alone on pain, ankle ROM, and function in subjects with lateral ankle sprains. After the four weeks of treatment, MWM with conventional physiotherapy is found to be more effective than conventional physiotherapy alone in reducing pain and improving ankle function and dorsiflexion. This observed difference might be due to the biomechanical and hypoalgesic effects of MWM in combination with exercises that alleviate pain and improve ankle function and dorsiflexion in the lateral ankle sprain. Gogate *et al.* (2021) found that MWM and conventional care showed better and long-term improvement in pain, functional dorsiflexion ROM, balance, and disability in people with an acute and subacute lateral ankle sprain [50]. Norouzi *et al.* (2021) concluded that Mulligan's MWM was more effective than Maitland mobilization in reducing pain and improving ROM in patients with lateral ankle sprain due to reflex arc afferents and efferents interaction and active and passive mobilizing tensile forces [57].

CONCLUSION

The present study adds value to the literature that applying the manual therapy (MWM) combined with conventional physiotherapy reduces pain, improves ankle dorsiflexion and functional ability in patients with grade I or II lateral ankle sprains. Specifically, after four weeks of treatment interventions, both groups significantly reduced pain and improved ankle function and dorsiflexion. It is further concluded that the group treated with MWM with conventional physiotherapy is significantly more effective than conventional physiotherapy alone in reducing pain and improving ankle function and dorsiflexion ROM in subjects with acute and subacute grade I or II lateral ankle sprains.

Further directions of this study

- Long-term follow-up is required to study whether any sustained or carry-over effect occurs after the treatment.
- The study should be conducted as a large-scale randomized clinical trial by including a large group of samples and an extended follow-up period.

Conflicts of Interest

The authors declare no conflict of interest

Authors' Contribution

Conceptualization, Dr. D. Prabhakaradoss; Methodology: Dr. Shahul Hameed Pakkir Mohamed, M. S. Sreejesh; Formal Analysis, Dr. Arun Vijay Subbarayalu; Data Collection: Dr. D. Prabhakaradoss, M. S. Sreejesh; Writing – Original Draft Preparation, Dr. Arun Vijay Subbarayalu; Dr. Shahul Hameed Pakkir Mohamed; Writing – Review & Editing, Dr. Sivasankar Prabaharan; Dr. D. Prabhakaradoss.

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Nothing to Report.

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