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Effectiveness of muscle energy technique with mulligan mobilization versus sensory targeted ankle rehabilitation (STAR) in athlete with lateral ankle sprain

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Abstract
Objective: To find out the effectiveness of mulligan mobilization with muscle energy technique and sensory targeted ankle rehabilitation strategies with lateral ankle sprain.
Methods: Male subjects (18-26 year) were divided into two groups based on the random sampling method and selection criteria (n=50) (group A and group B). Group A included 25 athletes who received mulligan mobilization with muscle energy technique for three days per week for two weeks. Group B included 25 athletes who received sensory targeted ankle rehabilitation for two days per week for 2 weeks. The outcome measures used in this study included the numerical pain rating scale for assessing the pain, weight bearing lunge test, goniometer for ankle dorsiflexion range of motion. Prior to the treatment period, and then 3rd weeks into the intervention, both group A and groups B underwent testing.
Results: The study's findings demonstrated that mulligan mobilization with muscle energy technique, are significantly more effective than sensory targeted ankle rehabilitation in their influence on the process of ankle sprain rehabilitation on a chosen criteria variable.
Conclusion: From the findings of the study, It has been concluded that 2 week of mulligan mobilization and muscle energy technique is more effective in improving the range of motion and decreasing pain on sub-acute lateral ankle sprains. The facilitation to enhance male athletes' ankle ROM which improves the range and sport performance and make them recover fast from injuries. Hence it is recommended to implement mulligan mobilization and muscle energy techniques in the early rehabilitation phase which decreases joint stiffness and muscle wasting and produces a quick rehabilitation period.

Keywords: Mobilization, muscle energy technique, range of motion, pain, weight bearing lunge test, goniometry

Introduction

The ankle sprains comprised 16% of all sports injuries. The ankle is the most frequently injured joint in athletes and more than half of the injuries at the ankle are sprains. That ankle injuries constitute up to 25% of all time-loss injuries in running and jumping sports. (Eiff MP *et al*., 1994) [4] An ankle sprain is a damage to the groups of tissue (*ligament and tendons*) that encompass and interface the bones of the leg to the foot. (Prosenjit *et al*., 2018). Lateral ankle sprains are one of the most common injuries in athletes. The rate of injury is as high as 70%. The most commonly involved ligament is the anterior talofibular ligament (ATFL), followed by the calcaneofibular (CFL) and posterior talofibular ligament (PTFL). The common mechanism of injury is inversion with excessive ankle supination in forced plantarflexion when the ankle joint is in its most unstable position. There are three grades of ankle sprains: Grade I, mild with an incomplete tear of ATFL; Grade II, moderate with a complete tear of ATFL with or without an incomplete tear of CFL; and Grade III, severe with complete tear of ATFL and CFL. (Rachana *et al*.,2019)

Immediate inflammatory processes produce acute anterolateral pain and oedema, with avoidance of movement and weight bearing (Wolfe *et al*., 2001). Subsequent losses of joint range, particularly dorsiflexion, and muscle strength result in significant gait dysfunction. Recent data highlights the presence of a dorsiflexion deficit not only in the acute stage, but also in the subacute stage (Yang &Vicenzino *et al*., 2002). Early mobilization cites advantages of early return to function, less muscle atrophy, and better mobility. Early mobilization has been shown to get patients back to sports and daily activities faster than immobilization.

Manual therapy techniques (*hands-on techniques like mobilization/manipulation, muscle energy technique, massage)* are beneficial in restoring or improving ankles range of motion, stride speed and step length, distribution of forces through the foot, and pain.

STAR (Sensory *Targeted Ankle Rehabilitation*) sensory inputs through manual therapy techniques such as ankle joint mobilizations, plantar massage, and triceps surae stretching to effectively rehabilitate CAI, but our understanding of the unique contributions is associated. STARS directed to three unique sources of sensory input (m*usculotendinous receptors, ankle joint receptors, and plantar receptors*) will result in specific and unique improvements in clinician-oriented measures of sensorimotor system function and patient-oriented measures of clinical disablement.

The STAR shows the effects of ankle joint mobilizations, plantar massage, and triceps surae stretching on patient-, clinician-, and laboratory- based outcome measures that are representative of sensorimotor function and disability in those with lateral ankle sprain. (Mckeon *et al*., 2016) [1]

Muscle Energy Technique (MET) is claimed to be useful for increasing the length of a contracted or shortened muscle and thus increasing the range of motion of a joint. It also helps improve fluid drainage from peripheral parts of the body and limbs. MET is based on the hypothesis that if a joint is not playing out of its full scope of movement, then its function will be limited and it will have more risk of

suffering from strains and injuries. The main two variations which are done in muscle energy technique are post isometric relaxation (PIR) and reciprocal inhibition (RI). (Chai tow L.,1994)

Mulligan mobilization, the concept of mobilizations with movement (MWMS) is given by Brian Mulligan. According to Brian Mulligan, mobilizations with movement (MWM) will be applicable for the limbs. Two variations of MWM include weight bearing and non-weight bearing MWM. However, weight bearing variation of MWM replicates aspects of functional activities of ankle dorsiflexion. (Collins *et al*., 2004) [17]

The objective of any rehabilitation protocol is the fast and safe return to the preinjury activity level. By investigating how strength training may improve both range of motion and strength at the same time, clinicians may allow patients to decrease treatment time and return to participation more rapidly.

Statement of the Problem

The purpose of the study is to compare the effectiveness of muscle energy technique and sensory targeted ankle rehabilitation in athletes with lateral ankle sprain. For that there is a need to conduct a study, which mainly compares the muscle energy technique and sensory targeted ankle rehabilitation to determine which group shows better improvement in ankle dorsiflexion ankle of motion.

Objectives of the Study

1. To evaluate the effectiveness of the muscle energy technique with mulligan mobilization in athletes with lateral ankle sprain.
2. To evaluate the effectiveness of the effectiveness of sensory targeted ankle rehabilitation in athletes with lateral ankle sprain.
3. To compare the effectiveness of the muscle energy technique with mulligan mobilization Versus sensory targeted ankle rehabilitation in athletes with lateral ankle sprain.

Hypothesis

Based on the objectives of the study, the following hypotheses were formulated

$H_1$1: Significant changes will be seen on NPRS, WBLT and goniometry to two weeks of muscle energy technique with mulligan mobilization in athletes with lateral ankle sprain.

$H_0$1: Significant changes will not be seen on NPRS, WBLT and goniometry to two weeks of muscle energy technique with mulligan mobilization in athletes with lateral ankle sprain.

$H_1$2: Significant changes will be seen on NPRS, WBLT and goniometry to two weeks of sensory targeted ankle rehabilitation in athletes with lateral ankle sprain.

$H_0$2: Significant changes will not be seen on NPRS, WBLT and goniometry to two weeks of sensory targeted ankle rehabilitation in athletes with lateral ankle sprain.

$H_1$3: Significant changes will be seen on NPRS, WBLT and goniometry between muscle energy technique with mulligan mobilization and sensory targeted ankle rehabilitation in athletes with lateral ankle sprain.

$H_0$2: Significant changes will not be seen on NPRS, WBLT and goniometry between muscle energy technique with mulligan mobilization and sensory targeted ankle rehabilitation in athletes with lateral ankle sprain.

Methodology

Selection of Subjects

In this study, volunteers fifty (50) athletes were participating in Athletes were selected at random as subjects, using randomized control trial sampling method.

Inclusion criteria	Exclusion criteria
Age: 18 – 25 years	History of fractures and implant on ankle joint
Recent ankle sprains	Arch defects
Recurrent ankle sprains	Plantar tendinitis
Dominant side injured athlete	Retrocalcaneal bursitis
Gender: male	Hypermobility in ankle
	Underwent any other therapy
	Open wound

The selected independent and dependent variables of this study are as follows.

Independent variables

The independent variables used in this study were mulligan mobilization with muscle energy technique and sensory targeted ankle rehabilitation.

Dependent variables

The following dependent variables were chosen for this study.

- Weight bearing lunge test
- Goniometry
- Numerical pain rating scale

Procedure

In this study routine manual therapy was performed by both the group A and group B thrice a week (i.e., on monday, wednesday, friday) for two weeks. While the group A subjects engaged in mulligan mobilization and muscle energy technique and group B subjects were engaged in sensory targeted ankle rehabilitation.

Mulligan Mobilization and Muscle Energy Techniq Procedure

The Athlete is kneeling with one foot on a treatment table. Treatment belt is looped around the patients distal lower leg, at a right angle to the lower leg, and around the therapists hips. The talus is fixed by the web space of both hands to prevent anterior movement of talus. Therapist glides the tibia anteriorly with the treatment belt. Athlete lunges forward to gain dorsiflexion range.

Muscle energy technique

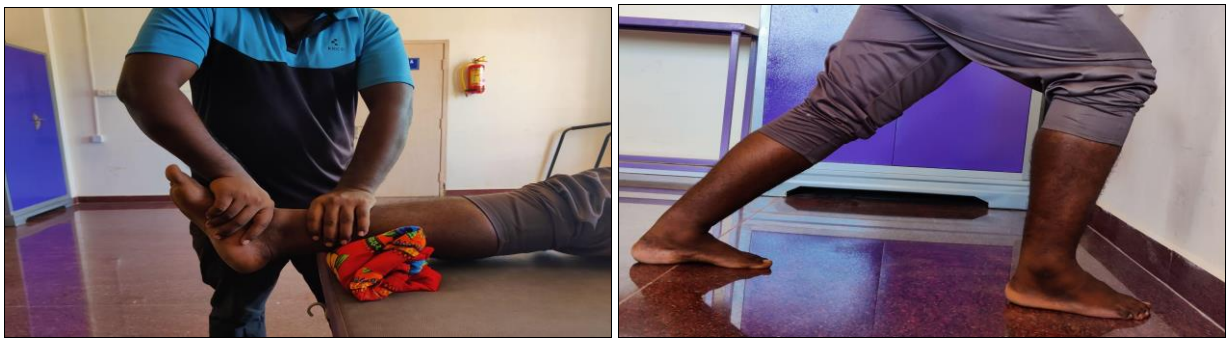
The Athlete was prone lying with his knee bent lightly. 20% of the available strength was applied by the athlete against unyielding resistance towards plantarflexion. The therapist ensured the foot does not actually move and only a static muscle contraction was applied and held for 10 seconds. This was followed by 2-3 seconds of relaxation, and then the foot was passively stretched to dorsiflexion up to the palpated barrier and/or tolerance to stretch.

Group A: Treatment Protocol

Sensory Targeted Ankle Rehabilitation (STAR)
Procedure
Talocrural joint mobilization
Athlete lies supine with the ankle just over the edge of the treatment table. The distal lower leg is supported and the knee slightly bent on a rolled towel. One hand holds the calcaneus, while the web space of the other hand contacts the ventral talus. Both hands contribute to the anteroposterior glide of the talus. While maintaining the anteroposterior glide, the patient can perform active dorsiflexion or the therapist can invite passive dorsiflexion of the ankle.

Plantar massage
Effleurage of the foot continues with the petrissage technique. Hold the back of the foot with one hand. And hold the full fist on the other hand against the bottom of the foot. use the fist to knead the bottom of the foot, using moderate pressure. repeat this motion, working down the ball of the foot to the heel.

Calf stretch
The athlete should place the foot at a distance from the wall, with the athlete leaning forward, keeping the knee in extension, which leads to stretching of the triceps surae muscles.



Group B: Treatment Protocol

Analysis of data and interpretation of results
The pre and post-test data collected within group A and B on numerical pain rating scale, weight bearing lunge test and goniometry was analyzed using paired t-tests which evaluate the significant, mean and standard difference within the groups from pre to post test was tabulated below.

Computation of Independent T Value on Selected Variables Between Pre and Post Test of NPRS

NPRS	Testing Conditions	Pain Intensity		T Value	P Value	% Of Improvement
		Mean	Standard Deviation			
A	Pre Test	6.6800	0.988	28.805	0.000	66%
	Post Test	2.2800	0.792			
B	Pre Test	6.5200	1.085	21.117	0.000	49%
	Post Test	3.3600	1.036			

*significance at 0.05 level

Computation of Independent T Value on Selected Variables Between Pre and Post Test of WBLT

Groups	Testing conditions	Range of motion		t value	p value	% of improvement
		mean	Standard deviation			
A	Pre test	7.132	1.475	-39.066	0.00	83%
	Post test	13.064	1.305			
B	Pre test	7.116	1.576	-41.588	0.00	65%
	Post test	11.76	1.321			

*significance at 0.05 level

Computation of Independent T Value on Selected Variables Between Pre and Post Test of Goniometry

Group	Testing conditions	Range of motion		t value	p value	% of improvement
		mean	Standard deviation			
A	Pre test	8.52	1.982	-36.518	0.00	80%
	Post test	15.28	1.969			
B	Pre test	8.56	1.609	-31.659	0.00	65%
	Post test	14.080	1.91			

*****significance at 0.05 level

Discussion on Findings

In this study comparison of the pre and posttest pre mean values of the NPRS for group A is 6.680 and 2.28 for group B is 6.52 and 3.360. The Weight bearing lunge test (WBLT) mean value of A is 7.132 and 13.064 for group B is 7.116 and 11.76. And the goniometry mean value of group A is 8.52 and 15.28 for group B is 8.56 and 14.08. The obtained 't' value on NPRS, WBLT and goniometry of group A was28.805($p < 0.05$), -39.066 ($p < 0.05$) and -36.518($p < 0.05$) respectively. And for group B was 21.177($p < 0.05$), -41.588 ($p < 0.05$) and -31.659(0.05) which is statistically significant improvement in both groups, which demonstrate that both techniques are effective in improving ankle range of motion. In this study almost all athletes showed reduction in pain intensity after 2 weeks of mulligan mobilization and MET program compared with the STAR technique group. During the first session of mulligan mobilization and MET itself most of the participants noticed half of the intensity of Pain and discomfort was reduced while the range of motion was improved.

The result of the study highly correlated with the study done by Mckeon *et al*., (2016) [1], who found that STAR treatment offers unique contributions to the rehabilitation outcomes of those with CAI. Joint mobilization resulted in the most meaningful improvements in weight bearing dorsiflexion, whereas plantar massage had the most meaningful effect on single-limb balance. Stretching the triceps surae offers benefits as well, but these benefits may be maximized potentially in combination with the other STAR therapy.

Hoch *et al*., (2012) [26] This indicates that a Maitland Grade III anterior-to-posterior joint mobilization treatment has mechanical and functional benefits for addressing impairments in sensorimotor function and arthrokinematic restrictions commonly experienced by individuals with CAI. Prosenjit *et al*., (2018) Efficacy of muscle energy technique and contract relax with mulligan's mobilization with movement technique in subacute ankle sprain defines, Amin *et al*., (2015) suggested that active release and MET both have equal effect in increasing hamstring flexibility than Mulligan technique in normal male adults, So, increase in dorsiflexion range of motion can also be due to the effect of MET. It indicates that MET was successful in increasing the flexibility of the tight gastro-soleus complex and thus the dorsiflexion range of motion increased.

Kumari Nisha *et al*., (2014) [14] suggested that distal tibiofibular joint mobilization with movement in conjunction with conventional treatment is more effective than Exercises - Range of motion exercises i.e. achilles stretching in non-weight bearing and weight bearing positions, Alphabet exercises. Muscle strengthening exercises (*isometric and concentric*) using contralateral foot for dorsiflexors, plantar flexors, investors and evertors. Toe curls and marble pickups. Toe raises, heel walk and toe walk conventional treatment alone improve ankle dorsiflexion range in post-acute lateral ankle sprain.

Nisha Yadav *et al*., (2016) [5] Trigger Point Pressure Release and Post Isometric Relaxation (MET) both improved ankle dorsiflexion. However, post isometric relaxation was more effective in increasing ankle dorsiflexion range in case of soleus trigger points.

In this study, mulligan mobilization and muscle energy techniques increased the joint range of motion and decreased pain intensity on lateral ankle sprain injury. It was evident that positive results were found in the athletic population. In this study strength and balance were not included, thus further study should include strengthening and balance training interventions and include more specific sports subjects to get sufficient perspective results.

Discussion on hypothesis

Earlier in chapter 1 of the study, the investigators formulated 6 hypotheses in which the first three hypotheses stated that, there would be a significant influence of muscle energy technique with mulligan mobilization and sensory targeted ankle rehabilitation on numerical pain rating scale, weight bearing lunge test and goniometry. The findings of the study reveal that there is an existence of statistically significant effects of mulligan mobilization with MET and sensory targeted ankle rehabilitation on selected criterion variables.

The fourth hypothesis is that there would be a statistically significant difference in mulligan mobilization with muscle energy technique and sensory target ankle rehabilitation on numerical pain rating scale among asymmetric athletes with lateral ankle sprain. The result of the analysis of variance accepts the alternate hypothesis that there is statistically significant difference between mulligan mobilization with muscle energy technique and sensory targeted ankle rehabilitation on athletes with lateral ankle sprain.

The fifth hypothesis is that there would be a statistically significant difference in mulligan mobilization with muscle energy technique and sensory target ankle rehabilitation on weight bearing lunge test among asymmetric athletes with lateral ankle sprain. The result of the analysis of variance accepts the alternate hypothesis that there is statistically significant difference between mulligan mobilization with muscle energy technique and sensory targeted ankle rehabilitation on athletes with lateral ankle sprain.

The sixth hypothesis is that there would be a statistically significant difference in mulligan mobilization with muscle energy technique and sensory target ankle rehabilitation on goniometry among asymmetric athletes with lateral ankle sprain. The result of the analysis of variance accepts the alternate hypothesis that there is statistically significant difference between mulligan mobilization with muscle energy technique and sensory targeted ankle rehabilitation on athletes with lateral ankle sprain. The null hypothesis has

rejected completely there will be a significant improvement over the study of mulligan mobilization with muscle energy technique and sensory targeted ankle rehabilitation on lateral ankle sprain with no difference between the criterion variables.

Conclusion

The study of mulligan mobilization with muscle energy technique and sensory targeted ankle rehabilitation are found to be more effective. Comparatively, mulligan mobilization with muscle energy technique is more effective than STAR technique. It has been concluded that 2 week of mulligan mobilization and muscle energy technique is more effective in improving the range of motion and decreasing pain on sub-acute lateral ankle sprains. The facilitation to enhance male athletes' ankle ROM which improves the range and sport performance and make them recover fast from injuries. Hence it is recommended to implement mulligan mobilization and muscle energy technique in the early rehabilitation phase which consists of joint stiffness and muscle wasting

Limitations

- Hence the study has been conducted on a small sample size.
- Information regarding the routine session has not been recorded in this study.
- The treatment procedure is not considered for the non dominant leg.
- The study participants were not confined to data related to particular sports or games. Since it can influence the ankle range of an individual due to differences in mechanism involved, training methods, practice sessions etc.

Recommaedations

- Further study includes the large sample size.
- Further study can extend to non-dominant legs.
- Further studies should go for regular examination and duration of recurrence of the injury and return to sport.
- Further studies should examine the strength, balance and gait pattern after rehabilitation.

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