Research Article
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Efficacy of muscle energy technique and contract relax with mulligan's mobilization with movement technique in subacute ankle sprain

Abstract

Background: Patients with subacute ankle sprain demonstrate pain with movement, significantly reduced range of motion of ankle joint and change in dynamic gait parameters.

Objective: To determine the difference between the effectiveness of muscle energy technique (MET) and contract relax with mulligan's mobilization with movement (MWM) technique in the treatment of subacute stage of lateral ankle sprain.

Methods: Forty patients (mean age=22.80±2.55 years, male: female 60%: 40%) were randomly allocated into two groups. Group A was treated with MET and mulligan's MWM technique, group B received contract relax and mulligan's MWM technique for 4 weeks (3 days per week).

Results: Analysis with paired t test revealed significant reduction ($p<0.05$) in pain and significant improvement in range of motion of ankle joint and some gait variables within the group for both groups. However independent t test for comparing the pre, post and improvement from pre to post data between group A and group B showed no statistical significant difference ($p>0.05$).

Conclusion: This study concluded that both MET and contract relax with mulligan's MWM are equally effective techniques to reduce pain, increase ankle ROM, and dynamic gait variables in subacute stage of lateral ankle sprain.

Keywords: ankle sprain, tibiofibular MWM, contract relax, MET

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Introduction

The ankle is a standout amongst the most well-known body part that got harmed at game events,[1] while ankle sprain is the most widely recognized ankle injury,[1,2] 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. During any sudden twist or turning of the ankle in awkward way these ligaments holding the ankle bones and joints together can get stretch or tear resulting in ankle sprain. The most ordinarily included area is the lateral ankle complex, which comprises the anterior talofibular, calcaneofibular, and posterior talofibular ligament.[3] Although not for all time incapacitating, but these injuries are exorbitant[4] and it can considerably affect the athlete's capacity to prepare and participate in games. Besides the reoccurrence rate of ankle injuries has been accounted for to be as high as 80% among athletes.[5] In a study done on players of Punjab to find out the prevalence of ankle sprain, reported to be 8.29% at the time of study, 42.93% during the last 12 months and 71.70% for lifetime prevalence of ankle sprain. Reoccurrence rate of ankle sprain among those players with current ankle sprain was also high i.e. 82.35%.[6] Initial treatment for an ankle sprain is considered as the RICE (Rest, Ice, Compression, Elevation) approach. Physiotherapists prefer early mobilization for returning to work early, less muscle decay, and better versatility. It has been confirmed that early mobilization allows patients to get back to work and day by day exercises speedier than immobilization.[7] Likewise, muscle quality, range of motion, power, and endurance should be accomplished to the reinjury levels so that complete, asymptomatic functional activities can be performed to the reinjury level and further. Muscle Energy Technique (MET) is claimed to be useful for increasing the length of a contracted or shortened muscle[8] and thus increase the range of motion of a joint. It also helps improving fluid drainage from peripheral part of the body and limbs.[9] 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). Comparison between the effectiveness of PIR and RI on hamstring flexibility has found that both of these techniques are effective in improving the hamstring flexibility while PIR is more effective between these two.[10] Contract relax is a specific form of Proprioceptive Neuromuscular Facilitation (PNF) stretching technique where intramuscular tension in the muscle is developed using isotonic contraction in order to facilitate the relaxation phase of the muscle and afterwards stretching of the muscle is done. Facilitation of the relaxation phase of muscle increase circulation within the muscle and it also increase the tissue extensibility. In the contract relax stretching the force that the patient applies during the contraction can vary from submaximal to maximum muscle force. Contract relax stretching can effectively increase the joint range of motion and it also has influence on force velocity relationship of the muscle. 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 varations of MWM include weight bearing and non-weight bearing MWM. However, weight bearing variation of MWM replicate aspects of functional activities[11] but both varations

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are generally used. As many studies has been done to find out the efficacy of MET, contract relax and mulligan's MWM in term of improving pain, ROM, flexibility etc, but in the patient of subacute ankle sprain there is a lack of comparison between effectiveness of MET and contract relax with mulligan's MWM technique. So, this study is helpful to compare the results of MET & contract relax with mulligan's MWM technique in the treatment of patient with subacute ankle sprain.

Materials & methods

Pre-diagnosed case of subacute ankle sprain was taken. These patients were asked to give written consent, after which the patients were screened as per the inclusion and exclusion criteria. Inclusion criteria included ages of 16 to 30 years old, both male and female, subacute stage of lateral ankle sprain and first episode of ankle sprain. Patients were excluded if they had tumor, fracture, rheumatoid arthritis, osteoporosis, prolonged history of steroid use or prior to surgery of the distal tibia, fibula, ankle joint or rear foot region and subjects who had a co-existing neurological condition like stroke, spinal cord injury, etc. Forty patients were randomly allocated into two groups. Pre-intervention measure of pain, gait variables and ankle joint range of motion was recorded. Then group A was treated with MET and mulligan's MWM technique, group B received contract relax and mulligan's MWM technique. After four weeks of treatment post intervention data was recorded. Patients were taken from outpatient department, Uni-Hospital (Department of Physiotherapy, Lovely Professional University, India). Patients were taken using convenient sampling and then randomly allocated into two groups. MET for gastrocnemius and soleus muscle was done. Patient was in prone lying with the ankle out of the bed. 20% of the available strength was applied by the patient 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 second of relaxation, and then the foot was passively stretched to dorsiflexion up to the palpated barrier and/or tolerance to stretch. This was continued until no further gains were achieved.[12] 2 sets of 5 repetitions a day. It was given for 3 days a week for 4 weeks. Contract relax for gastrocnemius and soleus muscle was done. Patient was in prone lying with ankle out of the bed. Gastrocnemius and soleus muscle was placed in a maximally stretched position by doing dorsiflexion passively. Then the patient plantar flexed the ankle against moving resistance isotonically and then relaxed. After the relaxation the foot was stretched to dorsiflexion up to the new available range. It was given for 2 sets of 5 repetitions a day, 3 days a week for 4 weeks. Mulligan's MWM was performed for distal tibiofibular joint. Patient position was supine with ankle out of the bed. Therapist's thenar eminence of one hand was positioned over the distal part of lateral malleolus, while the other hand was used to provide support to the leg. A sustained glide was given obliquely and posteriorly to the fibula. While sustaining the glide, patient was asked to do plantar flexion and inversion of the ankle. Therapist also used overpressure to further displace the joint. Patient's reaction was monitored during the whole procedure. If pain was felt by the patient, then the direction of glide was changed until it becomes pain free. After the completion of the technique, tape was used to hold the joint in corrected position.[13] It was given for 2 set of 10 repetitions a day,[14] 3 days a week for 4 weeks. Tape application: A rigid tape was used. First the tape was attached 2 inches proximal to the lateral malleolus, then while maintaining the glide tape was angled in the same direction as the MWM. The tape was brought behind the distal tibiofibular joint, ending proximally to the beginning of the tape without the ends over-lapping.[15] Pain was measured using NPRS.[16] Range of motion of ankle joint was measured using universal goniometer.[17] Dynamic gait analysis of the patient was done using win track force platform.[18] Post intervention data was recorded after 4 weeks of intervention. All statistical analyses were performed using SPSS ver. 20 for Windows 10.1. The paired samples t-test was performed to verify change within the group and independent samples t-test was performed to compare the effect between the two intervention groups. The significance level was set at 0.05.

Results

A total of 40 patients with pre-diagnosed ankle sprain (16 females and 24 males) were included in this study. SD= Standard deviation. (Table 1) shows that mean ± SD age for group A and B was 22.60±2.80 and 23.00±2.34 years respectively. (Table 1) shows the mean age of the participants in group A and group B. (Figure 1) shows that male and female for group A was 70% and 30% respectively and for group B it was equally distributed. There was no significant differences in mean and SD of age between group A & group B (Table 2). SD=Standard deviation; Gr.=Group; A=Group A; B=Group B; Significant. Paired t test shows significant reduction ($p<0.05$) in pain for both intervention group. Significant increase in dorsiflexion, plantarflexion, inversion and eversion range was evident for both group. There was significant improvement ($p<0.05$) in some gait parameters such as step duration, double stance duration, step length, sole area for both treatment group. However, swing duration, stride duration, and gait cycle length also significantly improved ($p<0.05$) for group A. Maximum foot pressure did not improve significantly ($p>0.05$) for any intervention group (Table 3). Data are presented as mean ± standard deviation. PRE I=Pre-intervention; Post I= Post-intervention; IFPP= Improvement from Pre-test to Post-test. No significant difference was evident for any parameters in the independent t test where comparison was done between the pre-intervention, post-intervention and improvement between pre to post intervention readings of NPRS, ankle joint range of motions and dynamic gait variables between the groups (Table 4).

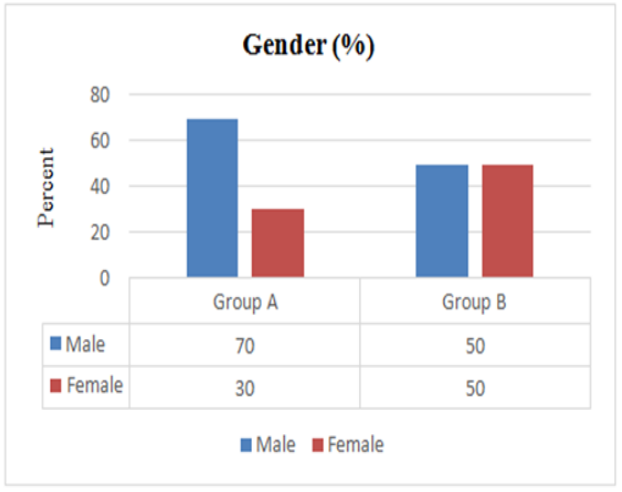

Figure 1 Gender distribution among Group A and Group B.

Table 1 Mean age of the participants of Group A and Group B

Characteristic	Group	Mean	SD
Age (Years)	A	22.60	2.80
	B	23.00	2.34

Table 2 Comparison of mean and SD of age between Group A & Group B

Characteristic	Group A	Group B	Mean difference	p value	t
Age (Mean±SD)	22.60 ± 2.80	23.00 ± 2.34	0.400	0.627	0.490

Table 3 Results of paired t test to compare the changes in NPRS, ankle joint range of motions and dynamic gait variables within the groups

Parameters	Gr.	Pre intervention(Mean±SD)	Post intervention (Mean±SD)	Improvement from pre-test to post-test (Mean±SD)	p value	t
NPRS	A	4.85±.81	.25±.44	4.60±.75	.001*	27.286
	B	4.40±.88	.20±.41	4.20±.89	.001*	21
Dorsiflexion	A	9±4.47	16±3.08	7±3.40	.001*	9.2
	B	11.75±4.38	17±3.77	5.25±2.55	.001*	9.2
Plantarflexion	A	40.25±5.73	45.50±4.26	5.25±4.13	.001*	5.688
	B	42.25±5.73	47.25±4.44	5±3.63	.001*	6.164
Inversion (degree)	A	14.25±5.20	22.00±4.97	7.75±4.97	.001*	7.815
	B	14.50±5.00	22.75±4.72	8.25±5.20	.001*	7.095
Eversion (degree)	A	12±3.77	15.25±3.02	3.25±2.94	.001*	4.951
	B	13.25±4.06	15.75±3.73	2.50±3.04	.002*	3.684
Step duration (ms)	A	595±137.02	684.50±111.43	89.50±108.12	.002*	3.702
	B	581±149.38	675.50 ±124.96	94.50±170.80	.023*	2.474
Double stance (ms)	A	207.50 ±97.65	282.50±102.34	75.00±91.68	.002*	3.658
	B	209±81.94	268±84.64	59±105.78	.022*	2.494
Swing duration (ms)	A	1363±194.02	1502.50±227.27	139.50±153.95	.001*	4.052
	B	1344.50±237.56	1453±195.13	108.50±281.90	0.101	1.721
Stride duration (ms)	A	2003.50±247.71	2167±337.63	163.50±257.77	.011*	2.837
	B	1968.50±374.41	2114±303.62	145.50±467.96	0.18	1.391
Step length (mm)	A	408.20 80.16	465.80±75.52	57.60±102.19	.021*	2.521
	B	424.10±76.863	478.10±86.59	54.00±93.99	.019*	2.569
Gait cycle length (mm)	A	881±109.58	955.55±114.81	74.55±110.48	.007*	3.018
	B	898.70±101.19	926.65±100.18	27.95±98.29	0.219	1.272
Sole area (cm^2)	A	58.75±14.131	65.05±11.283	6.30±6.191	.001*	4.551
	B	55.70±16.342	62.60±15.906	6.90±4.973	.001*	6.206
Foot pressure (g/cm^2)	A	3260.15±932.75	3288.10±992.84	27.95±1151.88	0.915	0.109
	B	3493.30±866.07	3531.75±997.18	38.45±899.29	0.85	0.191

Table 4 Results of independent t test to compare the value of NPRS, ankle joint range of motions and dynamic gait variables between the groups

Parameters	T	Group A	Group B	p value	t
	Pre I.	4.85±.81	4.40±.88	0.102	1.677
NPRS	Post I.	.25±.44	.20±.41	0.714	0.37
	IFPP	4.60±.75	4.20±.89	0.134	1.529
	Pre I.	9± 4.47	11.75±4.38	0.057	1.966
Dorsiflexion (degree)	Post I.	16±3.08	17±3.77	0.364	0.911
	IFPP	7±3.40	5.25±2.55	0.074	1.84
	Pre I.	40.25±5.73	42.25±5.73	0.277	1.104
Plantarflexion (degree)	Post I.	45.50±4.26	47.25±4.44	0.211	1.272
	IFPP	5.25±4.13	5±3.63	0.84	0.203
	Pre I.	14.25±5.20	14.50±5.00	0.884	0.146
Inversion (degree)	Post I.	22.00±4.97	22.75±4.72	0.628	0.489
	IFPP	7.75±4.97	8.25±5.20	0.745	0.327
	Pre I.	12±3.77	13.25±4.06	0.32	1.009
Eversion (degree)	Post I.	15.25±3.02	15.75±3.73	0.644	0.466
	IFPP	3.25±2.94	2.50±3.04	0.432	0.794
	Pre I.	595±137.02	581±149.38	0.759	0.309
Step duration (ms)	Post I.	684.50±111.43	675.50±124.96	0.811	0.24
	IFPP	89.50±108.12	94.50±170.80	0.913	0.111
	Pre I.	207.50±97.65	209±81.94	0.958	0.053
Double stance (ms)	Post I.	282.50±102.34	268±84.64	0.628	0.488
	IFPP	75.0091.68	59±105.78	0.612	0.511
	Pre I.	1363±194.02	1344.50±237.56	0.789	0.27
Swing duration (ms)	Post I.	1502.50±227.27	1453±195.13	0.464	0.739
	IFPP	139.50±153.95	108.50±281.90	0.669	0.432
	Pre I.	2003.50±247.71	1968.50±374.41	0.605	0.522
Stride duration (ms)	Post I.	2167±337.63	2114±303.62	0.729	0.349
	IFPP	163.50±257.77	145.50±467.96	0.881	0.151
	Pre I.	408.20±80.16	424.10±76.863	0.526	0.64
Step length (mm)	Post I.	465.80±75.52	478.10±86.59	0.635	0.479
	IFPP	57.60±102.19	54.00±93.99	0.908	0.116
	Pre I.	881±109.58	898.70±101.19	0.599	0.531
Gait cycle length (mm)	Post I.	955.55±114.81	926.65±100.18	0.402	0.848
	IFPP	74.55±110.48	27.95±98.29	0.167	1.409
	Pre I.	58.75±14.131	55.70±16.342	0.532	0.631
Sole area (cm^2)	Post I.	65.05±11.283	62.60±15.906	0.578	0.562
	IFPP	6.30±6.191	6.90±4.973	0.737	0.338
	Pre I.	3260.15±932.75	3493.30±866.07	0.418	0.819
Foot pressure (g/cm^2)	Post I.	3288.10±992.84	3531.75±997.18	0.444	0.774
	IFPP	27.95±1151.88	38.45±899.29	0.975	0.032

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Discussion

The present study found that the pre post comparison of pain level on NPRS within group was statistically significant ($p<0.05$) for both treatment groups and there was significant reduction of pain in both groups, demonstrating as a pain free joint range of motion and pain free weight bearing. Although there was a significant within-group change over time, no significant differences ($p>0.05$) were evident between the two treatment groups on pre, post and improvement between pre post data. This reduction in pain might be due to the mulligan's concept of MWM which have been applied to address positional faults for restoration of normal arthrokinematic and osteokinematic motion. Mulligan hypothesized that a positional fault has been identified and corrected when MWM abolishes pain, restores function, and provides a long-lasting therapeutic effect.[13] Previous study suggested that several reasons may be responsible for the reduction in dorsiflexion range of motion after an ankle sprain. Deneger C. et al reported that there can be reduced flexibility of gastrocnemius and soleus muscle, unilateral laxity of subtalar and talocrural joint, reduced posterior glide of talus on the mortis, restriction on tibiofibular, subtalar or midtarsal joints or any combination of all these above as a result of ankle sprain.[19] Reduced overall range of motion of ankle joint may also be due to the pain, swelling or the muscle spam as an after effect the sprain. This study demonstrated an increase in active ankle range of motion in term of dorsiflexion, plantarflexion, inversion and eversion for both intervention. There is significant improvement ($p<0.05$) in range of motion in pre post comparison for both intervention. Whereas in the between group comparison for the improvement in range of motion wasn't statistically significant ($p>0.05$). This study reflects the same findings associated with recent studies. Heather Mau et al reported that using only modified mobilization with movement and taping technique the patient was discharged with equal range of motion bilaterally,[15] Anthony D. Kay et al concluded that significant increases in dorsiflexion ROM and reductions in whole muscle tendon stiffness occurred following contract relax stretching,[20] Kumari Nisha et al. suggested that distal tibiofibular joint mobilization with movement in conjunction with conventional treatment is more effective than conventional treatment alone in improving ankle dorsiflexion range in post-acute lateral ankle sprain,[21] Amin DI suggested that active release and MET both have equal effect in increasing hamstring flexibility than Mulligan technique in normal male adults,[22] 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. The present study also found that there was significant improvement ($p<0.05$) in some gait parameter such as step duration, double stance duration, step length, sole area for both treatment group. There was significant improvement ($p<0.05$) in swing duration, stride duration, and in gait cycle length for group A. However maximum foot pressure did not improve significantly ($p>0.05$) for any intervention groups. Improvement in gait parameter may occurred due to several factors. As a patient with ankle sprain walk in antalgic gait to avoid pain so the stance phase of the gait reduces and step length became small. After the treatment as the pain reduced simultaneously the stance phase increased for both group and same for the sole area. This may also be due to the functional recovery and correction of positional fault. This study had several limitations. First of all, the study had a small sample size. There was no control group and thereby it fails to bring the placebo effect of the intervention used and this study was done in lateral ankle sprain patients only. In the future, research studies can be conducted to compare between the effect of MET and contract relax in acute or chronic stage of ankle sprain with or without the combination of any other technique.

Conclusion

This study concluded that both MET and contract relax with mulligan's MWM are equally effective techniques to reduce pain, increase ROM and gait variables in subacute stage of lateral ankle sprain.

Clinical implication

For better functional improvement in gait, range of motion and for the reduction in pain either MET or contract relax can be used with mulligan's MWM in patients with subacute ankle sprain.

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None

Conflict of interest

The author declares no conflict of interest.

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