Efficacy of Muscle Energy Technique and Contract Relax with Mulligan's Movement with Mobilization Technique in Subacute Ankle Sprain.

A Dissertation Submitted to

Department of Physiotherapy, LSPPS

Supervised By:

Dr. Manni Wadhwa (PT)

(M.P.T. Ortho)

Assistant Professor

Department of Physiotherapy

Lovely Professional University

Submitted By:

Prosenjit Baidya

Reg No: 11509129

MPT (Ortho) 2nd year

Phagwara, Punjab

May 2017

CERTIFICATE

This is to certify that the dissertation work entitled "**Efficacy of Muscle Energy Technique and Contract Relax with Mulligan's Movement with Mobilization Technique in Subacute Ankle Sprain**" was carried out by Mr. Prosenjit Baidya, Registration No: 11509129, Department of Physiotherapy, Lovely Professional University, towards partial fulfilment of the requirements of Masters in Physiotherapy (Orthopedics) degree programme.

Dr. Ajay Prashad Gautam
MPT (Cardio), Phd
Professor and Head of Department
Department of Physiotherapy,
Lovely Professional University,
Phagwara, Punjab

Date: 23rd May, 2017

Place: Lovely Professional University

CERTIFICATE

This is to certify that **Mr. Prosenjit Baidya, Registration No: 11509129** has selected the MPT dissertation titled "**Efficacy of Muscle Energy Technique and Contract Relax with Mulligan's Movement with Mobilization Technique in Subacute Ankle Sprain**" for dissertation presentation under my guidance and supervision.

Signature of Supervisor

Dr. Manni Wadhwa (PT)
(M.P.T. Ortho)
Assistant Professor
Department of Physiotherapy
Lovely Professional University
Punjab

Date: 23rd May, 2017

Place: Lovely Professional University

DECLARATION

I hereby declare that the dissertation titled, "**Efficacy of Muscle Energy Technique and Contract Relax with Mulligan's Movement with Mobilization Technique in Subacute Ankle Sprain**" submitted for the MPT Synopsis is entirely my original work.

Prosenjit Baidya

Reg. No: 11509129

Place: LPU, Jalandhar

Date: 23rd May, 2017

ACKNOWLEDGEMENT

I am using this opportunity to express my gratitude to the almighty and to everyone who have supported me throughout the journey of completing this project. I am thankful for their aspiring guidance, invaluably constructive criticism and friendly advice during the project work. I am sincerely grateful to them for sharing their truthful and illuminating views on a number of issues related to the project.

I express my heartfelt to **Mr. Ashok Mittal**, Honourable Chancellor, **Mrs. Rashmi Mittal**, worthy Pro Chancellor, **Dr. Ramesh Kanwar**, worthy Vice Chancellor and **Dr. Monica Gulati**, Senior Dean of LSPPS for providing all the facilities to carry out the project work.

I would like to express my deep and sincere gratitude to **Dr. Ajay**, Professor and Head of the Department of Physiotherapy, Lovely Professional University for giving me the opportunity to work on this project. I am grateful to him for his detailed and constructive comment and for his support throughout this work.

With extreme gratitude and in deftness, I wish to express my acknowledgement to **Dr. Manni Wadhwa,** (MPT Ortho), **Dr. Rati** (MPT Ortho), for helping me as a guide and for making the research possible. I could not imagine going through this work without both of your kind help and support.

I would like to thank **Dr. Ramesh Patra** (MPT Ortho), **Dr. Dheeraj Lamba** (MPT Ortho and Phd), **Dr. Amaar Suhail** (MPT Ortho**), Dr. Shashi** (MPT Ortho and PhD), **Dr. Richa Bedi** (MPT Sports), **Dr. Mahesh Sharma** (MPT Ortho) for their guidance and support.

Last but not the least, I would like to thank to all my friends for their consistent support and inspiration.

DEDICATION

I dedicate this research report
affectionately to the following:
My parents, Shachindra Nath Baidya and Runu Baidya
My sister, Susmita Baidya
My brother, Ovijit Baidya

CHAPTER 1

INTRODUCTION

1.1 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.

An ankle sprain ordinarily happenes during an inversion-type twist of the foot, trailed by pain and swelling. 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 which was 82.35%.[6]

Chronic ankle injuries usually associated with long-term alteration in the proprioceptive and neuromuscular function.[7] Athletes who have suffered from ankle sprain once, have greater chance of reinjuring the same ankle again,[8] which can progress to disability and can lead to chronic pain or instability in 20% to 50% of these cases.

Chronic ankle injuries can also occur because of the foremost common residual complication of ankle sprain which is termed as functional instability of ankle joint. In functional ankle instability the person gets the sensation of giving away at the injured ankle while performing ankle movements. In a recent study done to find out the prevalence rate of ankle instability following ankle sprain in young basketball players reported to be 57.74%.[9]

Following symptoms may be present in a sprained ankle: swelling, tenderness, bruising, pain, trouble to put weight on the injured ankle, skin discoloration, stiffness. In an ankle sprain, the severity of the tearing of ligament can vary from either slightly stretch or torn to completely torn of the ligaments. Depending on the extremity of the tear, ankle sprain is classified into three grade.

In grade I of ankle sprain there is minor extending or negligible rupturing of the ligament or tendon with gentle swelling, tenderness and stiffness. However, the ankle joint is steady and patient can still walk despite the slight pain. In grade II of ankle sprain the tear is wide ranging but continuity of the ligament is not disrupted and there is moderate pain, swelling, and bruising. Although the ankle joint feels stable but tenderness is present over the injured areas, and walking is also very painful.

In Grade III of ankle sprain there is absolute disruption of the ankle ligament or tendon with serious bruising and swelling at the ankle. There is a sensation of wobbly and the ankle joint is unstable. Walking is usually not possible due to severe pain and there is a feeling of giving away at ankle, however the initial pain may subside quickly.[10]

After ankle sprain injury, clinical examination frequently uncovers lost of the capacity to mightily evert the ankle, diminished proprioception and neuromuscular control, reduced movement, and ligamentous laxity.[11]

Initial treatments for an ankle sprain is considered as the RICE (Rest, Ice, Compression, Elevation) approach. Patient might need to use the crutches during walking until walking without support is painful. After the occurrence of ankle sprain initial phase of treatment for the first 48 to 72 hours involves using ice pack for 10 to 20 minutes, repeated with a time interval of 1-2 hour during the day to reduce the swelling. Ice or contrast baths can be tried after 48 hours. Although there is less scientific evidence suggesting that contrast bath or ice helps, but they are frequently used.

Using of crepe bandage or elastic compression wrap can be helpful for the reduction of swelling and should be worn during the initial 24 to 36 hours after sprain. An ankle support for allowing protection can likewise be utilized if weight bearing is needed using injured ankle. Using of compression bandage can be helpful but it does not provide protection, rather it helps by reminding to be careful while using the injured ankle during walking. The injured ankle is advised to kept in elevated position. Raising the sprained ankle above the heart level for 2 to 3 hours a day is suggested which diminishes swelling and bruising.

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.[12]

With proper treatment, function of the ankle complex is reestablished and the athlete is ordinarily ready to come back to unlimited physical activity. Whereas inadequate treatment after sprain may leave the ankle more prone to repeated injury,[13] re injury is yet normal after finishing an organized protocol of rehabilitative exercises.

The goals which are important for the treatment protocol of ankle sprain includes diminishing pain, swelling and initial provocative reaction and protection of the joint so that overly aggressive rehabilitation does not create a secondary inflammatory response to the joint. 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.

Stretching exercise is a specific form of exercise in which a particular muscle or muscle group or ligament is purposively extended from its initial length in order to improve the muscle's felt elasticity and to gain a comfortable muscle tone.[14] The result of stretching on a muscle is a feeling of improved muscle control, flexibility, and increased scope of movement. Stretching exercises are also used to reduce cramps.

Stretching is usually used to expand the scope of movement around the joint and estimated to enhance athletic execution. There are few reviews which suggests that intense and delayed stretching may diminish execution, prolonged stretching might reduce performance through decreasing the power and force.[15]

The nerve endings are having proprioceptor which can hand off data about the musculoskeletal framework to the central nervous system. These proprioceptors are additionally called mechanoreceptors and these are the source of proprioception. They can identify any type of change or displacement in length, force, tension, inside the body.

These proprioceptors are situated in all the nerve endings of the joints, tendons and muscles. The proprioceptors which are responsible for detecting change during stretching of muscle are situated in the tendons and in the fibers of the muscle.

Two type of fiber are present in muscle. These are intrafusal muscle fiber and extrafusal muscle fiber. Extrafusal fibers contain myofibrils and which is also known muscle fibers. Intrafusal fibers situated parallel to the extrafusal fibers and these are also known as muscle spindles. When the extrafusal fibers of a muscle lengthen, intrafusal fibers (muscle spindles) also lengthen. There are two different form of fibers that are present in muscle spindle which

are sensitive to recognize the alteration and the rate of alteration of length of muscle.

At the time when muscles contract it create pressure on the ligaments where the golgi ligament organ is available. The golgi ligament organ is sensitive to the recognize change in pressure and the rate of progress of the tension.[16] Resistance activities can be started when there is no pain through the accessible scope of movement, with full weight bearing.

Rehabilitation programs more often begin with low-level strengthening for example, submaximal isometric activities and advance in a pain free form to isotonic and isokinetic strengthening. Emphasis is put on strengthening the muscles that serve to create dynamic strength to the injured joint. Commonly, a combination of both open and close kinematic chain exercise are utilized as a part of the rehabilitation procedure.

Open-chain practices incorporate the utilization of free weights and resistance tubing. Closed chain activities are those exercises which are more practically based where the distal extremities limit is settled on a steady surface and the patient takes part in an action that requires the co-activation of opposing muscles to balance out the extremity.[17] Proprioceptive and balance exercises are useful in teaching the body to control the position of a deficient or an injured joint.

Exercise in a wobble board or in an unsteady surface is a very familiar example of proprioception exercise which is advised for the rehabilitation of a sprained ankle. Proprioception or balance exercise trainings are very important and can effectively strengthen an unstable ankle by increasing the muscular and postural control of the joint and thus reduce risk of recurrent injury.

After any stress to the ligament around a joint result in firing of specific receptors in the joints and through the reflex arc, producing contraction of muscles overlying the joint.[18] Studies suggest that there is decreased dorsiflexion in the ankle following lateral ankle sprain due to restriction in the talocrural joint.[19]

Muscle energy technique (MET) is a manual procedure where controlled, voluntary contractions of a target muscle group is done and following the relaxation phase the muscle is stretched to its new available range.

It is widely advocated by authors in the field of osteopathy that is now used in many different manual therapy professions. MET is claimed to be useful for increasing the length of a contracted or shortened muscle and thus increase the range of motion of a joint. It also helps

improving fluid drainage from peripheral part of the body and limbs.[20] 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.

This particular technique involves the use of a patient's voluntary contraction. While the therapist provides a sustain resistance the patient will contract their muscle using isometric or isotonic contraction. After the contraction during the relaxation phase the joint is taken to new available range. The main two variations which are done in muscle energy technique are post isometric relaxation (PIR) and reciprocal inhibition (RI).

In PIR the shortened muscle first performs isometric contraction then following relaxation phase as the tone of the agonist muscle reduces the joint is taken to its new available range. In RI the reciprocal inhibition property of muscle is used where inhibition of agonist muscle is achieved by doing isometric contraction of the antagonist muscle.

Agrawal SS (2016) did a study to compare the effectiveness between PRI and RI on hamstring flexibility and found that both of these technique is effective in improving the hamstring flexibility while PRI is more effective between these two.[21] The concept of mobilizations with movement (MWMS) is given by Brian Mulligan. According to Brian Mulligan, movement with mobilization (MWM) will be applicable for the limbs and sustained natural apophyseal glides will be applicable (SNAGS) for the spine.

Contract relax is a specific form of 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.

Movement with mobilization technique reported to provide rapid restoration of pain free range motion in patients. Two variation of MWM include weight bearing and non-weight bearing MWM. However, weight bearing variation of MWM replicate aspects of functional activities[22] but both variation is generally used.

During the application of "MWMS" as an evaluation, the therapist search for PILL response to use the same as a treatment, which confirms that the technique need be pain free, it should have immediate result and increase in range should be long lasting. If no PILL response is observed, then the technique should not be advocated. The MWM treatment approach for ankle aimed at enhancing dorsiflexion of the ankle joint which includes a relative anteroposterior glide of the tibia on talus with active dorsiflexion movements, preferentially in weight bearing.

The MWM for distal tibiofibular joint is done by applying glide to the fibula posteriorly and obliquely on the tibia. The direction of glide is maintained along the line of the anterior talofibular ligament which is a sustained anterior-posterior dorso-proximal glide. While maintain the glide, the patient is asked to perform a plantar flexion and inversion movement.

Braces and tape may also be used as a measures to prevent and provide support after ankle sprain. It is evident from previous study that the use of braces can reduces the risk of ankle sprain,[23] and it is argued that tape also has a similar preventive effect because of the same working mechanism similar to braces.

However, both of these measures are having some negative side effects too[23]. For example, if a brace is not properly fitted then it can cause irritation to the person, it can also reduce the performance. During playing tape can also get loosen, so it needs to be applied by a qualified personal.

1.2 NEED OF THE STUDY

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 will help to compare the results of MET & contract relax with mulligan's MWM technique in the treatment of patient with subacute ankle sprain.

1.3 SIGNIFICANCE OF THE STUDY

Treatment of a sprained ankle varies according to the grade and stage of the injury. Depending on the stage of injury stretching, strengthening, proprioception exercises, muscle energy technique, contract relax technique, mulligans MWM & taping techniques are used.

The present study will provide new insight regarding the better functional improvement, changes in gait parameter in patients with subacute stage ankle sprain and will save both clinicians and patients time and resources by its effectiveness. This study will add growing knowledge regarding the efficacy of MET and contract relax with mulligan's MWM in the treatment of subacute stage of ankle sprain.

1.4 AIMS AND OBJECTIVES

- To figure out the efficacy of MET with mulligan's MWM in the treatment of subacute ankle sprain.
- To figure out the efficacy of contract relax with mulligan's MWM technique in the treatment of subacute ankle sprain.
- To compare the efficacy of MET and contract relax with mulligan's MWM technique in the treatment of subacute ankle sprain.

1.5 HYPOTHESIS

- **Null Hypothesis:** There is no significant difference between efficacy of MET and contract relax with mulligan's MWM in the treatment of subacute ankle sprain.
- **Alternate Hypothesis:** There is significant difference between efficacy of MET and contract relax with mulligan's MWM technique in the treatment of subacute ankle sprain.

1.6 OPERATIONAL DEFFINITION

Ankle Sprain: An injury that happens as a result of twisting or rolling of ankle causing tear or sprain of the ligaments that connect the leg to the foot

Stretching Exercise: These are the exercises which are done to increase elasticity and achieve comfortable tone, reduce cramps of the muscles or tendons and to increase ROM of the joints.[24]

Proprioception Exercise: These are the exercises that are used to teach and improve the control or position sense of a joint that is reduced or altered. Proprioception exercise can be easily done by using of a balance board or by balancing or walking in unstable surfaces.

Strengthening Exercise: These are the specific exercises used to improve muscle strength

Muscle Energy Technique: Muscle Energy Technique is a procedure in which a person voluntarily contracts a muscle or muscle group either by isometric or isotonic contraction in a controlled direction, at a varying intensity and power. After the contraction during the relaxation phase the muscle is stretched up to the new available range increasing the ROM of the joint.

Mulligans mobilization: The concept of Mulligan's mobilizations with movement (MWM) is a technique that involve combination of accessory joint mobilization together with physiological motion.[25]

Contract-Relax: The contract-relax PNF technique involves the increase in tension in a muscle or muscle group by isotonic contraction with sub maximum to maximum force in order to facilitate and then relax the muscle and therefore stretch the muscle.

CHAPTER 2

REVIEW OF LITERATURE

- **Agrawal SS (2016)**[21] conducted study on comparison between post isometric relaxation and reciprocal inhibition manoeuvres on hamstring flexibility in young healthy adults, where MET in the form of post isometric relaxation to one group and MET in the form of reciprocal inhibition is given to the second group, 3 times in a week for 3 weeks and concluded that PIR and RI were both found to be effective in improving hamstring flexibility but, PIR is more effective therapeutic maneuver.

- **Ghram A et al (2016)**[26] conducted study on the contract-relax proprioceptive neuromuscular facilitation (PNF) stretching can affect the dynamic balance in healthy men, where the study population participated in two treatment session, one session using CR PNF stretching and second session was without stretching. Both session was performed in a randomized order. In conclusion he concluded that CR PNF stretching can be useful in improving the dynamic balance in subjects.

- **Amin DI (2016)**[27] conducted study on comparison of different therapeutic techniques on hamstring flexibility in normal adults, where one group received active release technique, second group muscle energy technique, third group Mulligan's technique and fourth group didn't get any intervention. On conclusion he suggested that both active release and muscle energy techniques have similar impact in enhancing hamstring flexibility than Mulligan technique in normal male adults.

- **Anthony D. Kay et al (2015)**[28] conducted study on effects of contract relax, static stretching, and isometric contractions on muscle tendon mechanics and concluded that statistically significant improvement was evident in dorsiflexion ROM and stiffness was reduced for whole muscle tendon for all the groups. However, contract relax was more effective than the other two interventions.

- **Narayan A et al (2014)**[29] conducted study on efficacy of muscle energy technique on functional ability of shoulder in adhesive capsulitis, where MET (3 repetitions per set, 1 session per day and thrice a week for 5 weeks) with conventional therapy is given to one group compared to only conventional therapy in the second group and concluded that muscle energy technique is very much effective on improving functional ability of shoulder in adhesive capsulitis.

- **Reddy BC et al (2014)**[30] conducted study on a randomized controlled trial to compare the effect of muscle energy technique with conventional therapy in stage ii adhesive capsulitis,

where conventional therapy was given in first group and conventional therapy along with MET was given on second group. Dosage for MET was 3 set of 5 repetitions per day, for 15 days. He concluded that both intervention group were equally effective in the treatment of adhesive capsulitis.

- **Heather Mau et al (2014)**[31] conducted study on a modified mobilization with movement to treat a lateral ankle sprain and concluded that application of 5 sessions of modified MWM together with taping technique was useful to regain equal range of motion for both ankles and patients were able to perform physical examination without any pain or symptoms.

- **Kumari Nisha et al (2014)**[32] conducted study on efficacy of weight bearing distal tibiofibular joint mobilization with movement (MWM) in improving pain, dorsiflexion range and function in patients with post-acute lateral ankle sprain, where one group received MWM for distal tibiofibular joint together with traditional management whereas the second group received only traditional treatment. Treatment was given for 3 sessions over 1 week. On conclusion researcher concluded that both intervention was effective in reducing pain and improving function whereas MWM with traditional treatment group showed significantly more effectiveness.

- **Punam Ghadi et al (2013)**[33] conducted study on the efficacy of the mulligan's movement with mobilization and taping technique as an adjunct to the conventional therapy for lateral ankle sprain, where experimental group was treated with mulligans MWM and taping together with conventional therapy and control group was treated with RICE protocol or UST and home exercise programme for 6 days. In conclusion the researcher concluded that faster functional recovery was evident in the experimental group treated with mulligans MWM & taping with conventional therapy.

- **Morcelli MH et al (2013)**[34] conducted study on comparison of static, ballistic and contract-relax stretching in hamstring muscle, where all the volunteer received each stretching technique in a randomized order. Each technique was given in single session with seven days interval. On conclusion researcher concluded that ballistic and contract relax stretching was equally effective and performed better than static stretching on flexibility gain.

- **Zakaria AR et al (2012)**[35] conducted study on efficacy of PNF stretching techniques on hamstring tightness in young male adult population, where one group was treated with self-stretch and the second group was treated with PNF stretch. Dosage was 4 repetitions per session, 5 times per week for 6 weeks. On conclusion research concluded that both stretch technique proved effective, however therapist given PNF was more clinically significant.

- **Shenouda MM (2012)**[36] conducted study on efficacy of stretching exercises versus postisometric relaxation technique on pain, functional disability and range of motion in patients with cervical spondylosis, where MET is given for cervical flexor, extensor, side flexor, rotator, trapezius in one group and passive static stretching is given for the second group for 12 sessions (3sessions/week) over four week's period. On conclusion he suggested that post-isometric relaxation technique is effective as well as passive stretching exercises in relieving neck pain and disability and improving neck range of motion in patients with cervical spondylosis.

- **Daniel Camara Azevedo et al (2011)**[37] conducted study on uninvolved versus target muscle contraction during contract relax proprioceptive neuromuscular facilitation stretching. In this study one group received traditional hamstring CR stretching, second group received modified contract relax where hamstring CR stretching was done using contraction of an uninvolved muscle distal from the target muscle and the control group did not receive any stretching. In conclusion researcher concluded that increase in range of motion was equal for both CR group whether or not the target muscle was contracted.

- **Moore SD et al (2011)**[38] conducted study on the immediate effects of muscle energy technique on posterior shoulder tightness, where one group was treated with MET for GH joint horizontal abductor and second group was treated with MET for the GHJ external rotator. In conclusion researcher concluded that single session of MET for GHJ abductor can provide immediate increase in horizontal adduction and internal rotation.

- **Misaki Fujii et al (2010)**[39] conducted study on does distal tibiofibular joint mobilization decrease limitation of ankle dorsiflexion and concluded that distal tibiofibular joint mobilization can significantly improve dorsiflexion ROM. So it can be used for the treatment of limitation of ankle dorsiflexion.

- **Madeleine Smith et al (2008)**[40] conducted study on a comparison of two muscle energy techniques for increasing flexibility of the hamstring muscle group, where first group was treated with MET with 30 sec post isometric stretch phase and second group with 3 sec post isometric stretch phase. In conclusion researcher concluded that changing the duration of the stretch component does not have a significant effect on the effectiveness of MET for short-term increases in muscle extensibility.

- **Andrea Reid et al (2007)**[41] conducted study on efficacy of mobilization with movement for patients with limited dorsiflexion after ankle sprain where both intervention group received two treatment protocol (sham mobilization and true mobilization) in reverse order for two sets of 10 repetitions. In conclusion researcher concluded that a talocurual MWM can immediately increase ankle dorsiflexion following treatment. Future research evaluating the effectiveness of multiple treatments on functional outcomes is warranted.

- **Shadmehr A et al (2007)**[42] conducted study on the effect of muscle energy techniques on flexibility of the short hamstring muscles, where one group was treated with MET with 50% of maximal voluntary isometric contraction and 10 second hold and the second group was control group and concluded that muscle energy techniques of following variation produced an increase of hamstring flexibility.

- **J B Feland et al (2004)**[43] conducted study on effect of submaximal contraction intensity in contract relax proprioceptive neuromuscular facilitation stretching, where three different variations (using 20%, 60%, 100% of maximum voluntary isometric contraction) of CRPNF was used on three different intervention group, once daily for five days. On conclusion researcher concluded that CRPNF stretching using submaximal contraction was equal beneficial as maximum contractions in improving flexibility and submaximal contraction may also reduce the risk of injury related to PNF stretching.

- **Natalie Collins et al (2004)**[22] conducted study on the initial effects of a mulligan's mobilization with movement technique on dorsiflexion and pain in subacute ankle sprains, where each participant received the three treatment condition such as MWM, placebo and no treatment control in a randomised way for 3 days. In conclusion researcher concluded that MWM for ankle dorsiflexion has a mechanical effect not hypoalgesic effect in ankle sprain.

- **Ballantyne F. et al (2003)**[44] conducted study on the effect of muscle energy technique on hamstring extensibility: the mechanism of altered flexibility, where a single application of MET is given to hamstring muscle and concluded that muscle energy technique produced an immediate increase in passive knee extension.

- **KL Lenehan et al (2003)**[45] conducted study on the effect of muscle energy technique on gross trunk range of motion, where the experimental group was treated with single application of thoracic MET and the second group was control group. In conclusion researcher concluded that MET is effective in improving the limitation of trunk range of motion.

- **Marie Carmen Valenza et al**[46] conducted study on acute effects of contract-relax stretching vs. TENS in young subjects with anterior knee pain, where one group was treated with CR stretch, second group with TENS and third group was control group. On conclusion researcher concluded that reduction in pain and improvement in range of motion was evident in both treatment group shortly after treatment.

- **M Handel et al (1997)**[47] conducted study on effects of contract relax stretching training on muscle performance in athletes and concluded that CR stretching training may favourably influence the force velocity relationship of the trained muscle as well as shape of the torque curve during movements at a given velocity.

- **P W McCarthy et al (1997)**[48] conducted study on effects of contract relax stretching procedures on active range of motion of the cervical spine in the transverse plane, where one group was treated with contract relax stretching and the second group was control group. In conclusion researcher concluded that CR stretching for 1 week can significantly improve active cervical ROM in transverse plane.

CHAPETR 3

MATERIALS AND METHOD

3.1 STUDY DESIGN: Randomized Control Trial

3.2 STUDY SETTING: Outpatient Department (Department of Physiotherapy, Uni-Hospital, Lovely Professional University, Punjab), SPS Hospital Ludhiana, Fortis Hospital Ludhiana and Outpatient Department (Department of Physiotherapy, Phagwara)

3.3 POPULATION AND SAMPLING: 40 patients with subacute lateral ankle sprain was taken by convenient sampling and randomly divided in two groups.

3.4 SELECTION CRITERIA:

3.4.1 Inclusion Criteria:

1. Ages of 16 to 30 years.
2. Both male and female.
3. Pre- diagnosed cases of subacute stage of lateral ankle sprain.
4. Painful ankle movement.
5. First episode of ankle sprain.
6. Patients who can read and understand language.

3.4.2 Exclusion Criteria:

1. Fracture.
2. Prior surgery to the distal tibia, fibula, ankle joint, or rearfoot region.
3. Contraindications to exercise, (eg, tumor, fracture, rheumatoid arthritis, osteoporosis, prolonged history of steroid use, or severe vascular disease).
4. Insufficient English language skills to complete all questionnaires; or inability to comply with the treatment and follow up schedule.
5. Subjects who have a co-existing neurological condition like stroke, spinal cord injury, etc

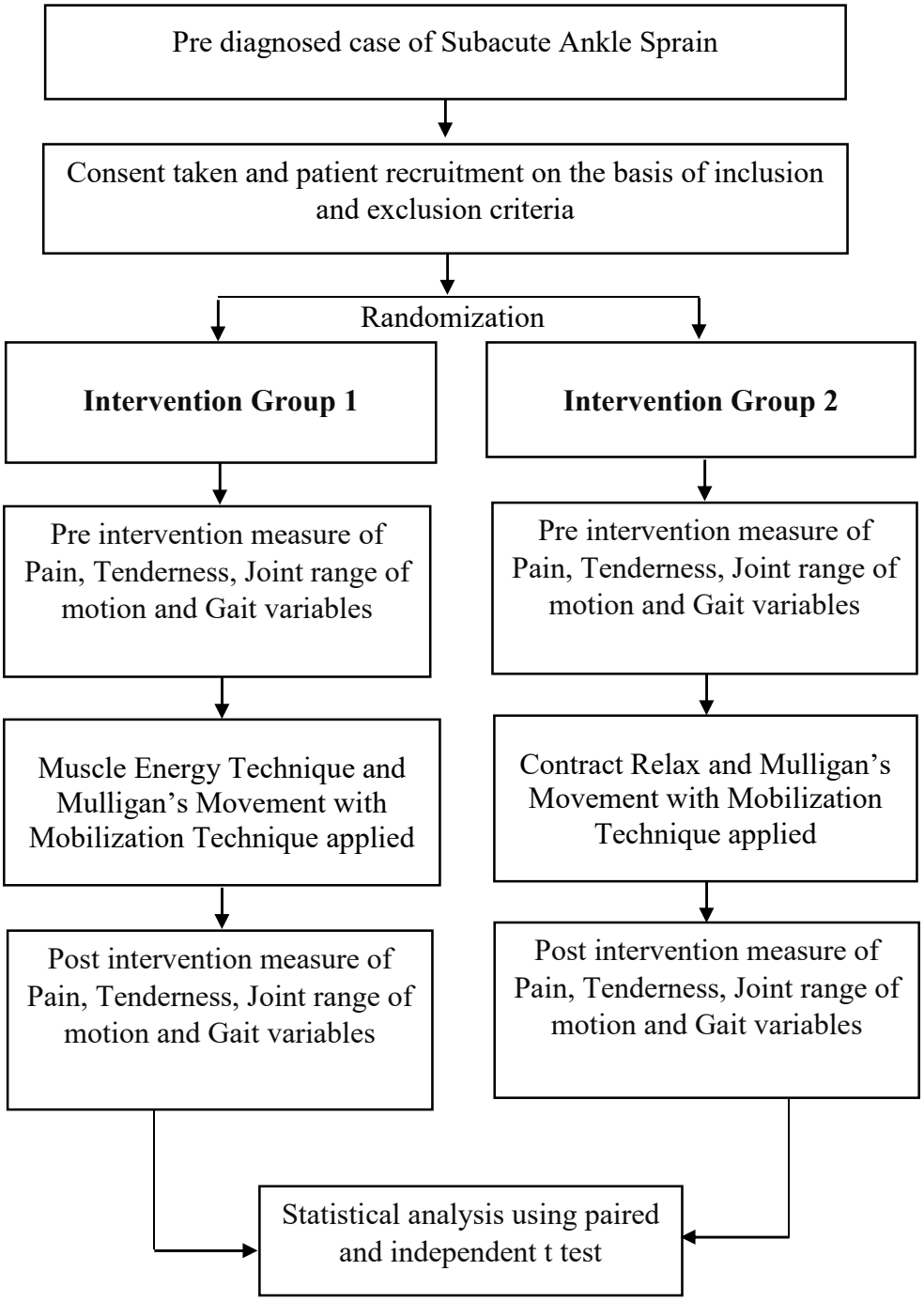
3.5 PARAMETERS

- Pain
- Tenderness
- Range of Motion
- Gait

3.6INSTRUMENTS AND TOOLS

- NPRS[49]
- Algometer[50]
- Universal Goniometer [51]
- Win Track[52]

3.7 PROCEDURE



Pre diagnosed cases 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. Selected patients were randomly divided into two groups. After this the patient was given the questionnaire and briefed about the way of answering it. Pain was measured using NPRS. Tenderness was recorded using Algometer. Then range of motion of ankle joint was measured and documented using universal Goniometer. Gait analysis of the patient was done using Win track. After that initial treatment was given to the patient according to the RICE [53] protocol and exercise was given according to intervention group.

Intervention Group 1: Muscle Energy Technique & Mulligan's MWM Technique
Intervention Group 2: Contract Relax & Mulligan's MWM Technique

Muscle Energy Technique: 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 s of relaxation, and then the foot was passively stretched to dorsiflexion up to the palpated barrier and/or tolerance to stretch. This is continued until no further gains was achieved.[54]
2 set of 5 repetitions a day. 3 days a week for 4 weeks.

Contract Relax: 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.
2 set of 5 repetitions a day. 3 days a week for 4 weeks.

Mulligan's Movement with Mobilization Technique: Mulligan's MWM was performed for distal tibiofibular joint. Patient position was supine with ankle out of the bed. Therapist stands on the foot side of the treatment table. Therapists 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. Patients 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. [25]

2 set of 10 repetitions a day. 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.[31]

(I) Starting position of MET for soleus and gastrocnemius. Patient performs plantar flexion, isometrically using 20% of available strength for 10 second.

(II) During relaxation the ankle is passively stretched to dorsiflexion up to the palpated barrier. (step I,II repeated until no further gain in ROM can be achieved)

Fig 3.7.1 Muscle Energy Technique

(I) Starting position of contract relax for gastrocnemius and soleus. Gastrocnemius and soleus muscle is placed in the maximum stretched position.

(II) Patient performs plantarflexion against resistance concentrically, and then relax.

Fig 3.7.2 Contract Relax

(I) Beginning position of the tibiofibular MWM. Therapist's thenar eminence is placed over the distal portion of lateral malleolus

(II) MWM is applied by gliding the fibula posteriorly along the line of ATFL with Therapists overpressure being added after the patient plantar flexes and inverts the ankle.

(III) Completion of the MWM mobilization and tape application

Fig 3.7.3 Mulligans Movement with Mobilisation

3.8 STATISTICAL TOOLS

Analysis was done by using paired t- test and unpaired t-test to know the significance within the group as well as between the groups.

Arithmetic mean: Using arithmetical formula for the mean, for a given number of subjects, mean was calculated:

$$\overline{X} = \sum X/n$$

Where,

$\overline{X}$ = Arithmetic Mean

$\sum X$ = Sum of all the variables

n = Number of observations

Standard Deviation(σ): was calculated by

$$SD = \sqrt{\sum X^2/n}$$

Where:

$\sum X^2$ = The sum of the squares of the difference between the mean and each score

n = Number of scores

Standard Deviation Error (SE): Enables the management of magnitude of sampling error. It was calculated by the following formula.

$$SE = SD/\sqrt{N}$$

Where,

SD = Standard deviation

SE = Standard error.

Paired t test

This is considered an appropriate test for determining the significance of mean within the group when population variance is not known. The relevant t test statistics is calculated from the data and then compared with its probable value based on the t distribution at the specified level of significance for concerning degrees of freedom for accepting or rejecting the null hypothesis (Kothari, 2007).

Formula:

$$t = \frac{(\bar{X}_D - \mu_0)}{S_D/\sqrt{n}}$$

$\overline{X}_D$ = Average

S_D= Standard deviation

μ_0= Constant

Unpaired t test

Student t test is considered an appropriate test for judging the significance of a sample mean or for judging the significance of difference between the means of two samples when population variance is not known, the relevant t test statistics is calculated from the data and then compared with its probable value based on the t distribution at a specified level of significance for concerning degree of freedom for accepting or rejecting the null hypothesis (Kothari,2007).

Formula:

$$t = \overline{X}_1 - \overline{X}_2 / S_{X1X2} . \sqrt{1/n_1 + 1/n2}$$

S_{X1X2} = Standard deviation

n1 = Number of participants in group A

n2 = Number of participants in group B

CHAPTER 4

DATA ANALYSIS AND RESULTS

4. DATA ANALYSIS AND RESULTS

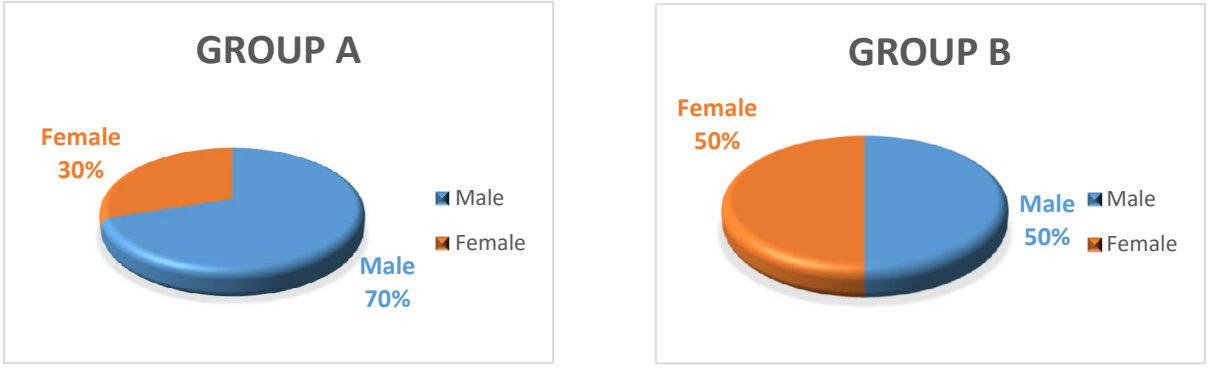
All statistical analyses were performed using SPSS ver. 20 for Windows 10.1. The paired samples t-test was performed to verify change in pain, tenderness, ROM and gait variables within the group and independent samples t-test was performed to compare the effect between both the intervention group in reducing pain, improving PPT, increasing ROM and gait variables. The significance level was set at 0.05

TABLE 4.1

Demographic characteristics of the participants of Group A and Group B

Characteristics	Group	Mean	SD	Number	Maximum	Minimum	Range
Age	Group A	22.60	2.80	20	27	18	9
	Group B	23.00	2.34	20	27	19	8
			N			**%**	
Gender	Group A	Male	14			70	
		Female	6			30	
	Group B	Male	10			50	
		Female	10			50	
Affected Ankle	Group A	Right	13			65	
		Left	7			35	
	Group B	Right	15			75	
		Left	5			25	

Demographic characteristics of the participants of Group A and Group B are presented in Table 4.1. A total of 40 subjects were included in the study among which 20 subject participated in Group A (14 male, 6 Female) and 20 subject participated in Group B (10 male, 10 female).



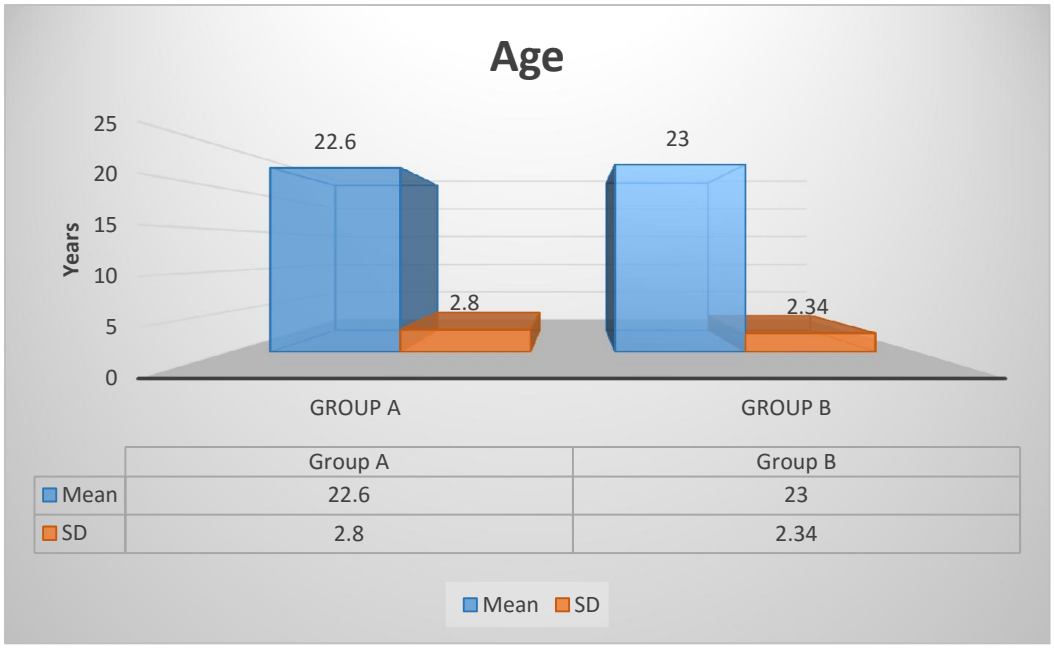
Graph 4.1: Percentage of male and female in Group A and Group B

TABLE 4.2

Comparison of Mean and SD of age between Group A & Group B

	Group A	Group B	Mean difference	P value	T
Age (Mean ± SD)	22.60 ± 2.80	23.00 ± 2.34	.400	.627	.490

Mean ± SD of age for Group A and Group B were 22.60 ± 2.80 and 23.00 ± 2.34 respectively. Independent samples T test showed no significant difference in age between Group A and Group B.



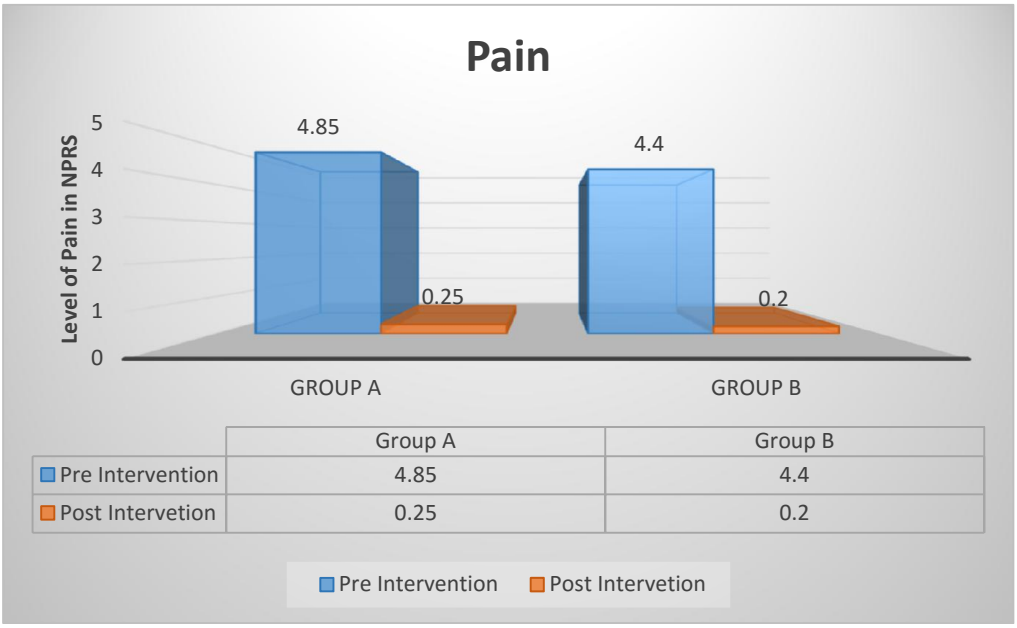
Graph 4.2: Comparison of Mean and SD of age between Group A and Group B

TABLE 4.3

Within and between group pre and post comparison of level of pain in NPRS for Group A & Group B

	Pre Intervention (Mean ± SD)	**Post Intervention** (Mean ± SD)	**Improvement from Pretest to Posttest** (Mean ± SD)	**P Value**	**T**
Group A	4.85 ± .81	.25 ± .44	4.60 ± .75	.000	27.286
Group B	4.40 ± .88	.20 ± .41	4.20 ± .89	.000	21.000
P Value	.102	.714	.134		
T	1.677	.370	1.529		

Level of pain on NPRS scale for Group A and Group B were 4.85 ± .81 (Mean ± SD) and 4.40 ± .88 respectively before the intervention, which significantly reduced ($p < 0.05$) after the intervention to .25 ± .44 and .20 ± .41 respectively. Within group reduction in pain was 4.60 ± .75 for Group A and 4.20 ± .89 for Group B. However, between group comparison of pre, post and improvement from pre to post data was not statistically significant ($p > 0.05$) (Table 4.3).



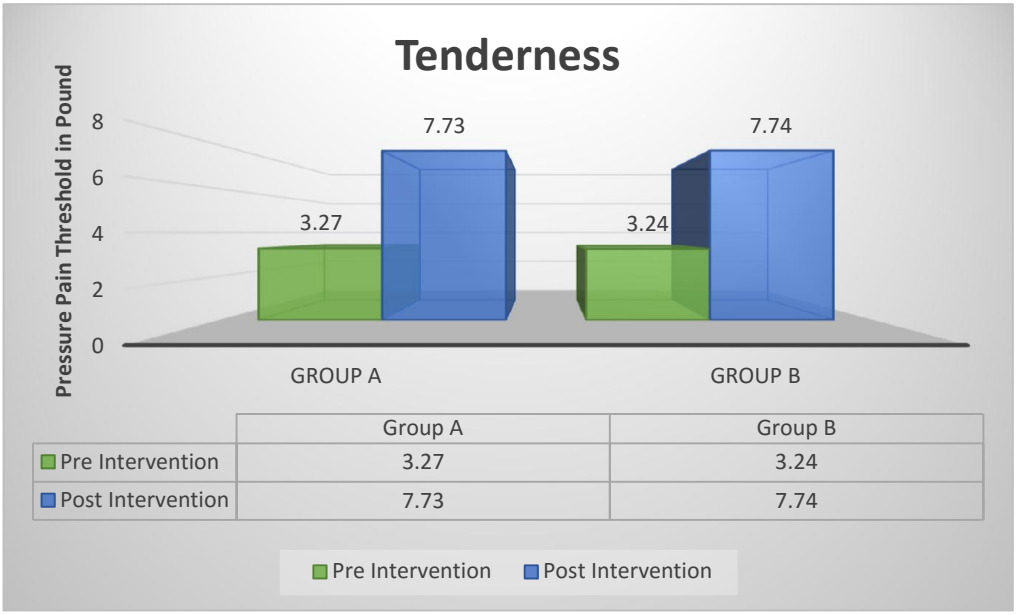
Graph 4.3: Comparison of pre and post intervention level of pain in NPRS within and between Group A and Group B

Table 4.4

Within and between group pre and post comparison of pressure pain threshold in pound for Group A & Group B

	Pre Intervention (Mean ± SD)	**Post Intervention** (Mean ± SD)	**Improvement from Pretest to Posttest** (Mean ± SD)	**P Value**	**T**
Group A	3.27 ± .93	7.73 ± .85	4.46 ± .85	.000	23.534
Group B	3.24 ± .78	7.74 ± .94	4.50 ± 1.12	.000	17.891
P Value	.898	.986	.900		
T	.129	.018	.127		

Pressure pain threshold level for Group A and Group B were 3.27 ± .93 pound (Mean ± SD) and 3.24 ± .78 pound respectively before the intervention, which significantly improved ($p < 0.05$) after the intervention to 7.73 ± .85 pound and 7.74 ± .94 pound respectively. Within group improvement was 4.46 ± .85 pound for Group A and 4.50 ± 1.12 pound for Group B. However, between group comparison of pre, post and improvement from pre to post data was not statistically significant ($p > 0.05$) (Table 4.4).



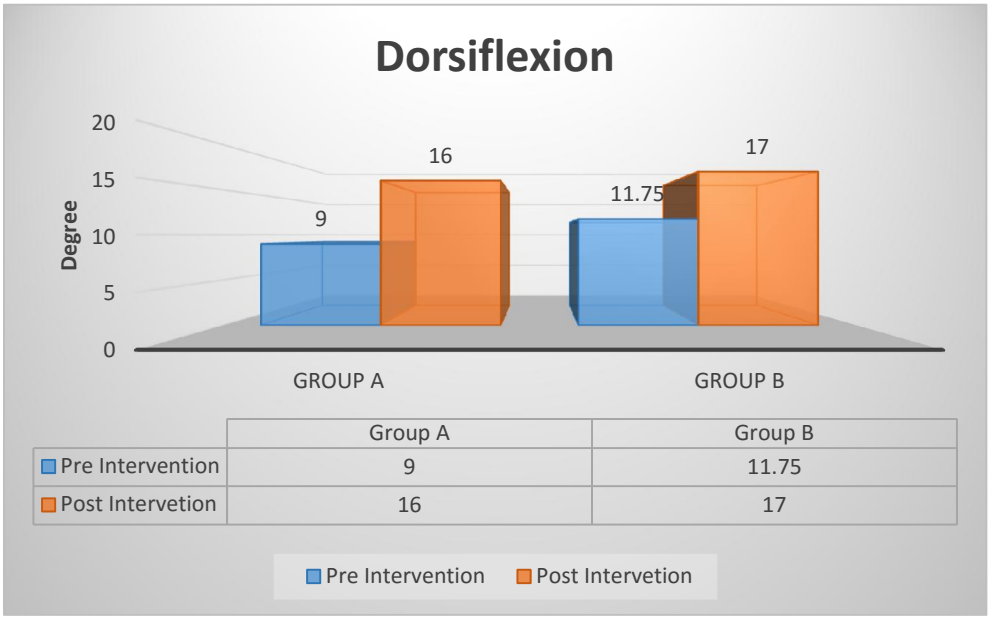
Graph 4.4: Comparison of pre and post intervention level of pressure pain threshold in pound within and between Group A and Group B

Table 4.5

Within and between group pre and post comparison of ankle dorsiflexion range for Group A & Group B

	Pre Intervention (Mean ± SD)	**Post Intervention** (Mean ± SD)	**Improvement from Pretest to Posttest** (Mean ± SD)	**P Value**	**T**
Group A	9 ± 4.47	16 ± 3.08	7 ± 3.40	.000	9.20
Group B	11.75 ± 4.38	17 ± 3.77	5.25 ± 2.55	.000	9.20
P Value	.057	.364	.074		
T	1.966	.911	1.840		

Ankle dorsiflexion range of motion for Group A and Group B were 9 ± 4.47 degree (Mean ± SD) and 11.75 ± 4.38 degree respectively before the intervention, which significantly improved ($p < 0.05$) after the intervention to 16 ± 3.08 degree and 17 ± 3.77 degree respectively. Within group improvement was 7 ± 3.40 degree for Group A and 5.25 ± 2.55 degree for Group B. However, between group comparison of pre, post and improvement from pre to post data was not statistically significant ($p > 0.05$) (Table 4.5).



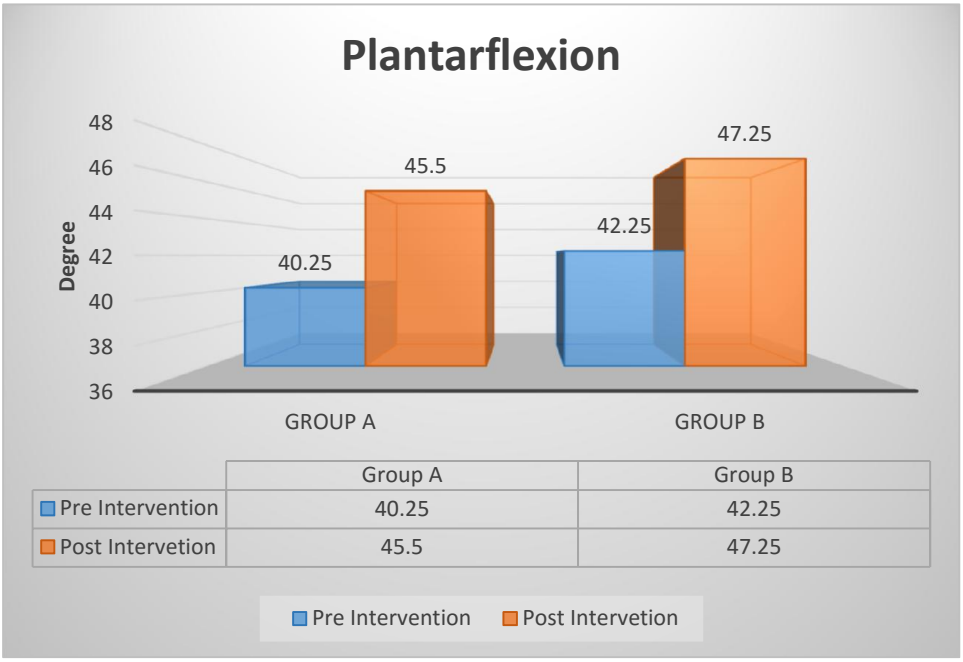
Graph 4.5: Comparison of pre and post intervention range of ankle dorsiflexion within and between Group A and Group B

Table 4.6

Within and between group pre and post comparison of ankle plantarflexion range for Group A & Group B

	Pre Intervention (Mean ± SD)	**Post Intervention** (Mean ± SD)	**Improvement from Pretest to Posttest** (Mean ± SD)	**P Value**	**T**
Group A	40.25 ± 5.73	45.50 ± 4.26	5.25 ± 4.13	.000	5.688
Group B	42.25 ± 5.73	47.25 ± 4.44	5 ± 3.63	.000	6.164
P Value	.277	.211	.840		
T	1.104	1.272	.203		

Ankle plantarflexion range of motion for Group A and Group B were 40.25 ± 5.73 degree (Mean ± SD) and 42.25 ± 5.73 degree respectively before the intervention, which significantly improved ($p < 0.05$) after the intervention to 45.50 ± 4.26 degree and 47.25 ± 4.44 degree respectively. Within group improvement was 5.25 ± 4.13 degree for Group A and 5 ± 3.63 degree for Group B. However, between group comparison of pre, post and improvement from pre to post data was not statistically significant ($p > 0.05$) (Table 4.6).



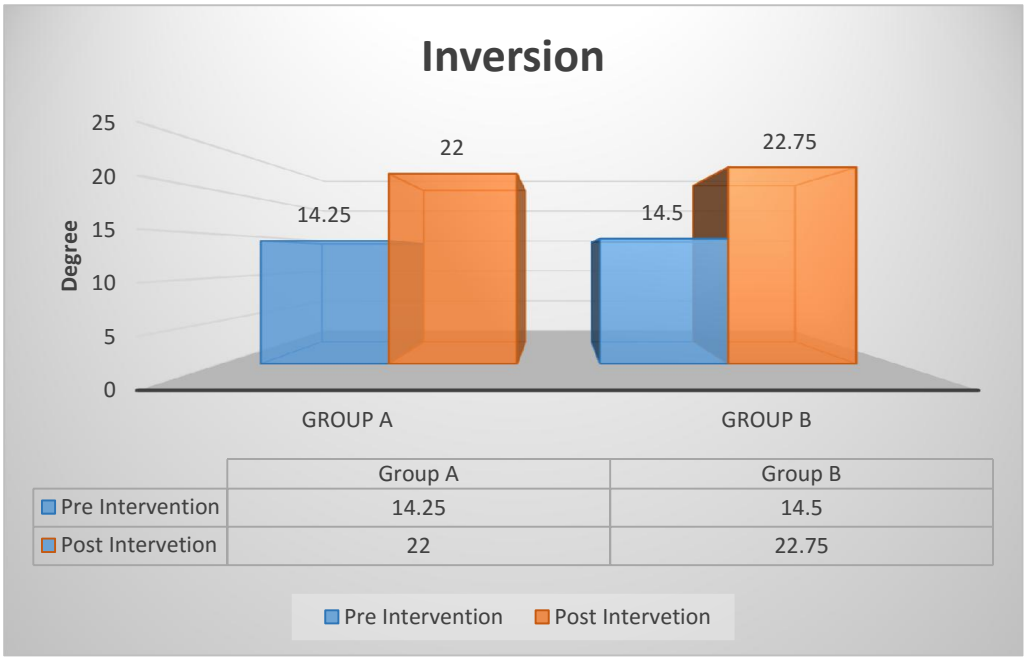
Graph 4.6: Comparison of pre and post intervention range of ankle plantarflexion within and between Group A and Group B

Table 4.7

Within and between group pre and post comparison of ankle inversion range for Group A & Group B

	Pre Intervention (Mean ± SD)	**Post Intervention** (Mean ± SD)	**Improvement from Pretest to Posttest** (Mean ± SD)	**P Value**	**T**
Group A	14.25 ± 5.20	22.00 ± 4.97	7.75 ± 4.97	.000	7.815
Group B	14.50 ± 5.00	22.75 ± 4.72	8.25 ± 5.20	.000	7.095
P Value	.884	.628	.745		
T	.146	.489	.327		

Ankle inversion range of motion for Group A and Group B were 14.25 ± 5.20 degree (Mean ± SD) and 14.50 ± 5.00 degree respectively before the intervention, which significantly improved ($p < 0.05$) after the intervention to 22.00 ± 4.97 degree and 22.75 ± 4.72 degree respectively. Within group improvement was 7.75 ± 4.97 degree for Group A and 8.25 ± 5.20 degree for Group B. However, between group comparison of pre, post and improvement from pre to post data was not statistically significant ($p > 0.05$) (Table 4.7).



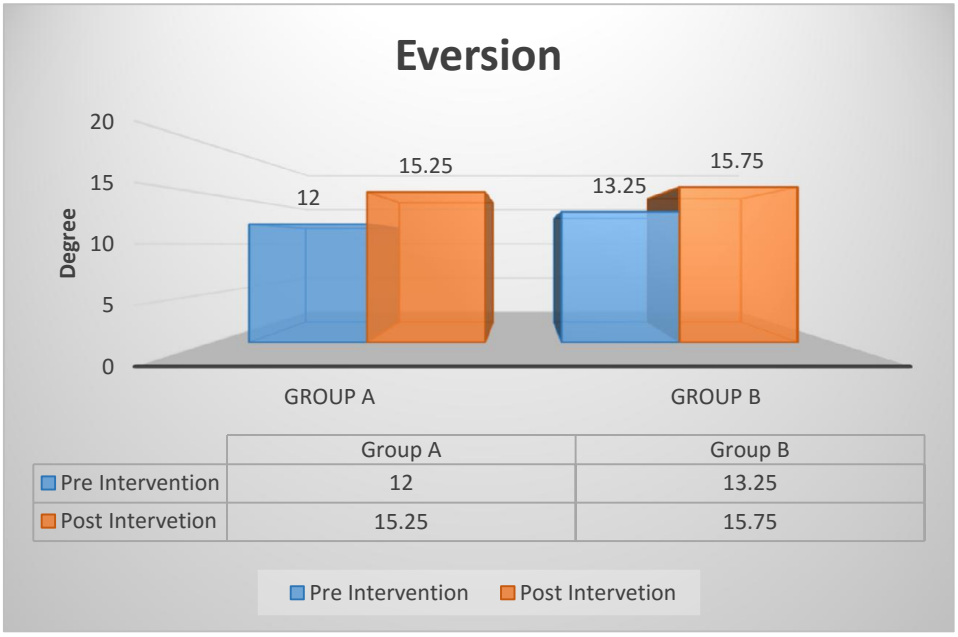
Graph 4.7: Comparison of pre and post intervention range of ankle inversion within and between Group A and Group B

Table 4.8

Within and between group pre and post comparison of ankle eversion range for Group A & Group B

	Pre Intervention (Mean ± SD)	**Post Intervention** (Mean ± SD)	**Improvement from Pretest to Posttest** (Mean ± SD)	**P Value**	**T**
Group A	12 ± 3.77	15.25 ± 3.02	3.25 ± 2.94	.000	4.951
Group B	13.25 ± 4.06	15.75 ± 3.73	2.50 ± 3.04	.002	3.684
P Value	.320	.644	.432		
T	1.009	.466	.794		

Ankle eversion range of motion for Group A and Group B were 12 ± 3.77 degree (Mean ± SD) and 13.25 ± 4.06 degree respectively before the intervention, which significantly improved ($p < 0.05$) after the intervention to 15.25 ± 3.02 degree and 15.75 ± 3.73 degree respectively. Within group improvement was 3.25 ± 2.94 degree for Group A and 2.50 ± 3.04 degree for Group B. However, between group comparison of pre, post and improvement from pre to post data was not statistically significant ($p > 0.05$) (Table 4.8).



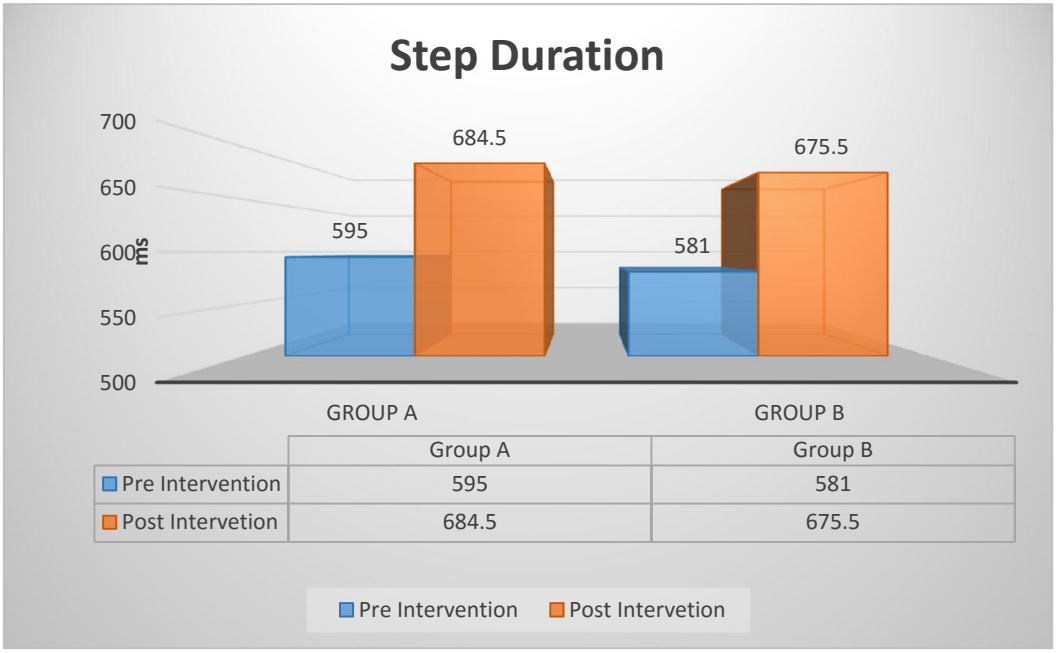
Graph 4.8: Comparison of pre and post intervention range of ankle eversion within and between Group A and Group B

Table 4.9

Within and between group pre and post comparison of step duration for Group A & Group B

	Pre Intervention (Mean ± SD)	**Post Intervention** (Mean ± SD)	**Improvement from Pretest to Posttest** (Mean ± SD)	**P Value**	**T**
Group A	595 ± 137.02	684.50 ± 111.43	89.50 ± 108.12	.002	3.702
Group B	581 ± 149.38	675.50 ± 124.96	94.50 ± 170.80	.023	2.474
P Value	.759	.811	.913		
T	.309	.240	.111		

Step duration of the affected foot for Group A and Group B were 595 ± 137.02 ms (Mean ± SD) and 581 ± 149.38 ms respectively before the intervention, which significantly improved ($p < 0.05$) after the intervention to 684.50 ± 111.43 ms and 675.50 ± 124.96 ms respectively. Within group improvement was 89.50 ± 108.12 ms for Group A and 94.50 ± 170.80 ms for Group B. However, between group comparison of pre, post and improvement from pre to post data was not statistically significant ($p > 0.05$) (Table 4.9).



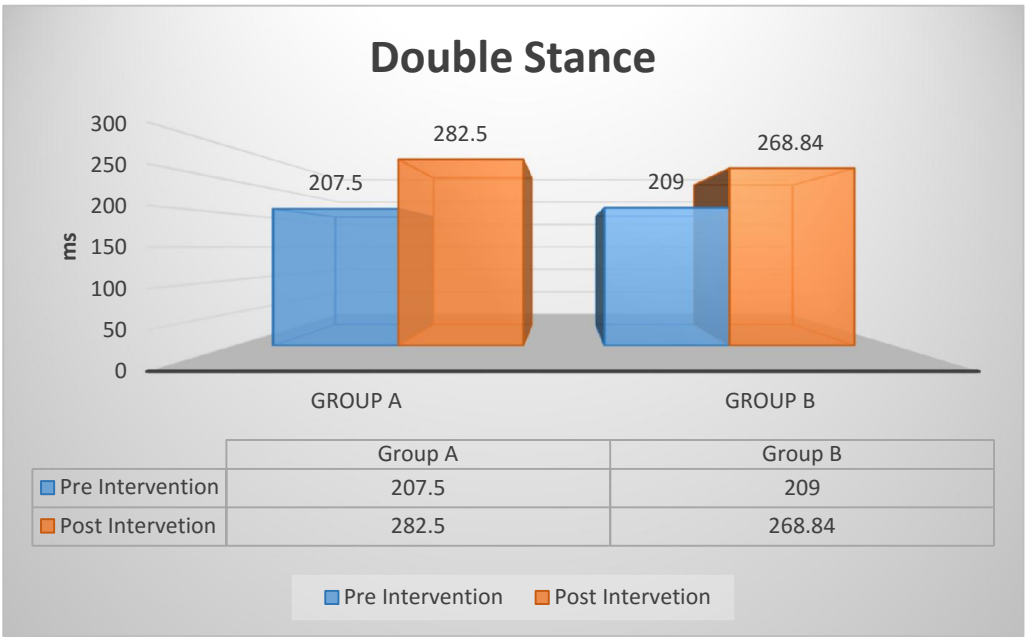
Graph 4.9: Comparison of pre and post intervention step duration within and between Group A and Group B

Table 4.10

Within and between group pre and post comparison of double stance for Group A & Group B

	Pre Intervention (Mean ± SD)	**Post Intervention** (Mean ± SD)	**Improvement from Pretest to Posttest** (Mean ± SD)	**P Value**	**T**
Group A	207.50 ± 97.65	282.50 ± 102.34	75.00 ± 91.68	.002	3.658
Group B	209 ± 81.94	268 ± 84.64	59 ± 105.78	.022	2.494
P Value	.958	.628	.612		
T	.053	.488	.511		

Double stance of the affected foot for Group A and Group B were 207.50 ± 97.65 ms (Mean ± SD) and 209 ± 81.94 ms respectively before the intervention, which significantly improved ($p < 0.05$) after the intervention to 282.50 ± 102.34 ms and 268 ± 84.64 ms respectively. Within group improvement was 75.00 ± 91.68 ms for Group A and 59 ± 105.78 ms for Group B. However, between group comparison of pre, post and improvement from pre to post data was not statistically significant ($p > 0.05$) (Table 4.10).



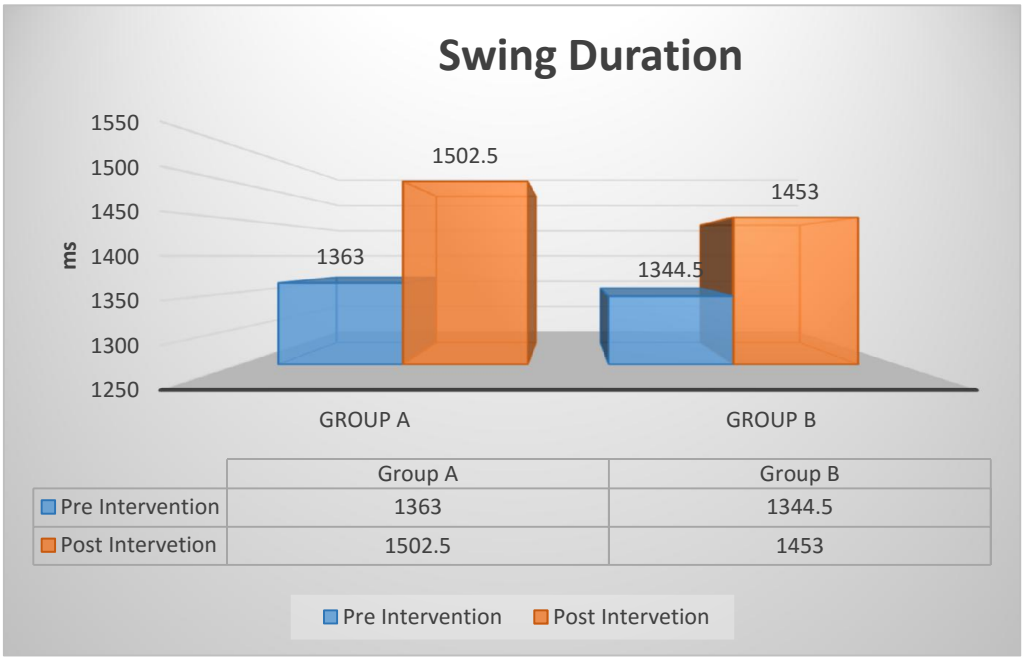
Graph 4.10: Comparison of pre and post intervention double stance within and between Group A and Group B

Table 4.11

Within and between group pre and post comparison of swing duration for Group A & Group B

	Pre Intervention (Mean ± SD)	**Post Intervention** (Mean ± SD)	**Improvement from Pretest to Posttest** (Mean ± SD)	**P Value**	**T**
Group A	1363 ± 194.02	1502.50 ± 227.27	139.50 ± 153.95	.001	4.052
Group B	1344.50 ± 237.56	1453 ± 195.13	108.50 ± 281.90	.101	1.721
P Value	.789	.464	.669		
T	.270	.739	.432		

Swing duration of the affected foot for Group A was 1363 ± 194.02 ms before the intervention, which significantly improved ($p < 0.05$) after the intervention to 1502.50 ± 227.27 ms. Pre intervention value for Group B was 1344.50 ± 237.56 ms which increased to 1453 ± 195.13 ms during post intervention but the improvement was not significant ($p > 0.05$). Within group improvement was 139.50 ± 153.95 ms for Group A and 108.50 ± 281.90 ms for Group B. However, between group comparison of pre, post and improvement from pre to post data was not statistically significant ($p > 0.05$) (Table 4.11).



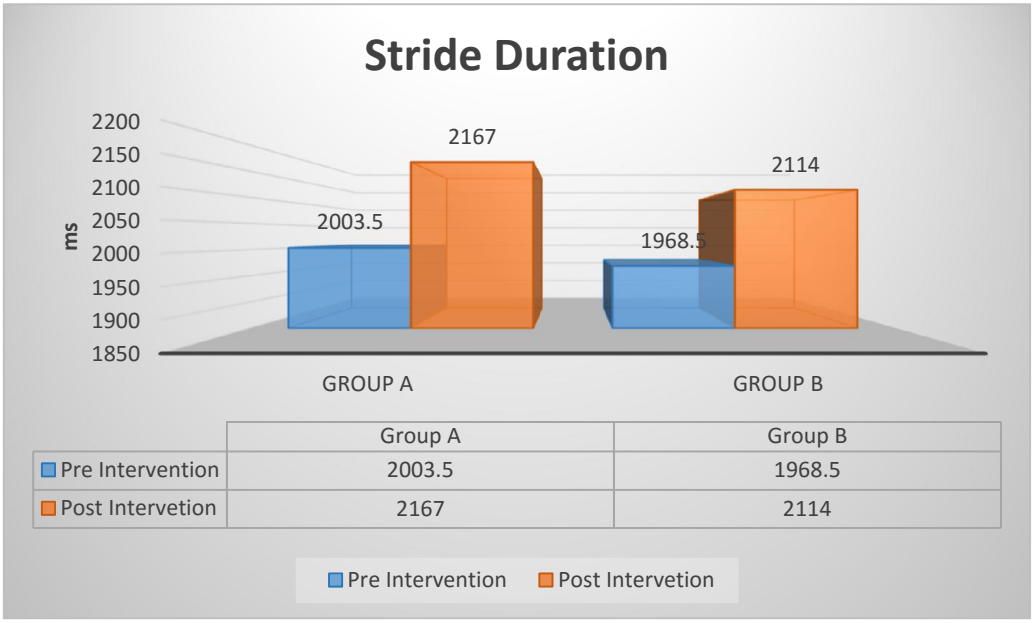
Graph 4.11: Comparison of pre and post intervention swing duration within and between Group A and Group B

Table 4.12

Within and between group pre and post comparison of stride duration for Group A & Group B

	Pre Intervention (Mean ± SD)	**Post Intervention** (Mean ± SD)	**Improvement from Pretest to Posttest** (Mean ± SD)	**P Value**	**T**
Group A	2003.50 ± 247.71	2167 ± 337.63	163.50 ± 257.77	.011	2.837
Group B	1968.50 ± 374.41	2114 ± 303.62	145.50 ± 467.96	.180	1.391
P Value	.605	.729	.881		
T	.522	.349	.151		

Stride duration of the affected foot for Group A was 2003.50 ± 247.71 ms (Mean ± SD) before the intervention, which significantly improved ($p < 0.05$) after the intervention to 2167 ± 337.63 ms. Pre intervention value for Group B was 1968.50 ± 374.41 ms which increased to 2114 ± 303.62 ms during post intervention but the improvement was not significant ($p > 0.05$). Within group improvement was 163.50 ± 257.77 ms for Group A and 145.50 ± 467.96 ms for Group B. However, between group comparison of pre, post and improvement from pre to post data was not statistically significant ($p > 0.05$) (Table 4.12).



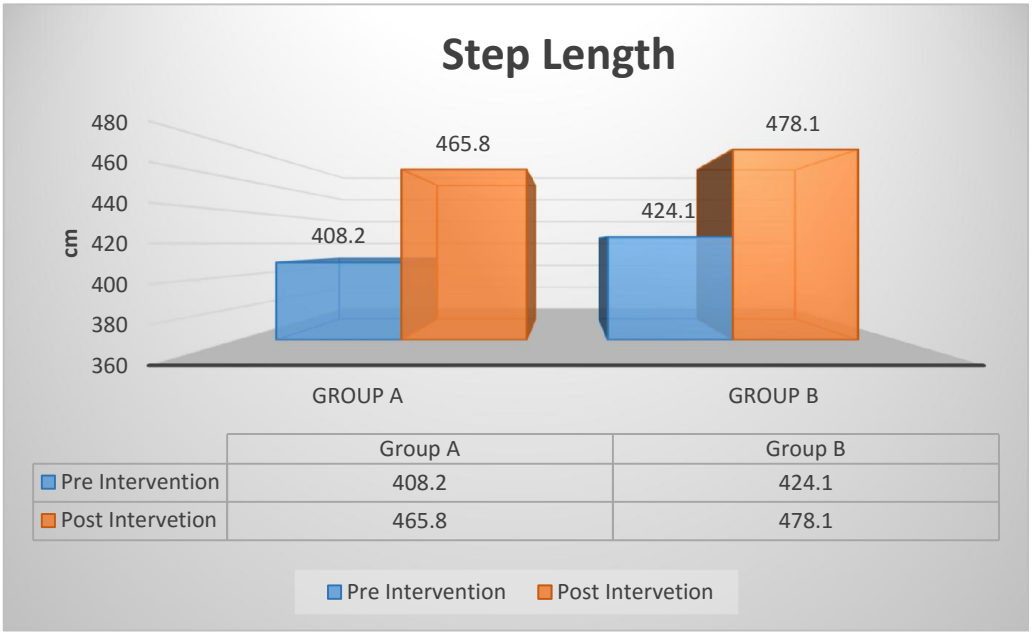
Graph 4.12: Comparison of pre and post intervention stride duration within and between Group A and Group B

Table 4.13

Within and between group pre and post comparison of step length for Group A & Group B

	Pre Intervention (Mean ± SD)	**Post Intervention** (Mean ± SD)	**Improvement from Pretest to Posttest** (Mean ± SD)	**P Value**	**T**
Group A	408.20 ± 80.16	465.80 ± 75.52	57.60 ± 102.19	.021	2.521
Group B	424.10 ± 76.863	478.10 ± 86.59	54.00 ± 93.99	.019	2.569
P Value	.526	.635	.908		
T	.640	.479	.116		

Step length of the affected foot for Group A and Group B were 408.20 ± 80.16 cm (Mean ± SD) and 424.10 ± 76.863 cm respectively before the intervention, which significantly improved ($p < 0.05$) after the intervention to 465.80 ± 75.52 cm and 478.10 ± 86.59 cm respectively. Within group improvement was 57.60 ± 102.19 cm for Group A and 54.00 ± 93.99 cm for Group B. However, between group comparison of pre, post and improvement from pre to post data was not statistically significant ($p > 0.05$) (Table 4.13).



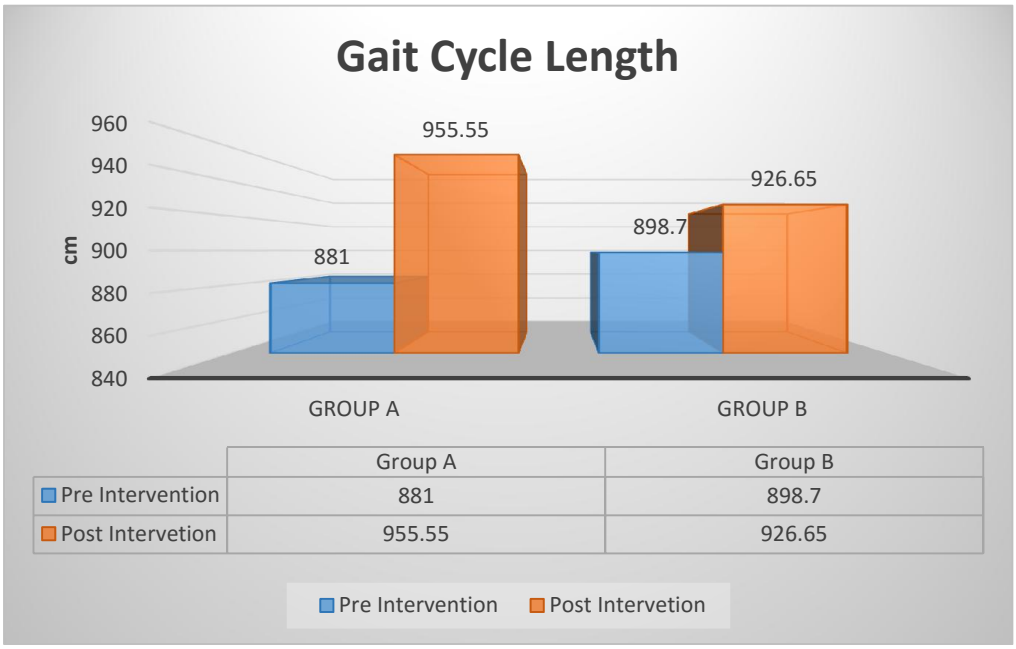
Graph 4.13: Comparison of pre and post intervention step length within and between Group A and Group B

Table 4.14

Within and between group pre and post comparison of gait cycle length for Group A & Group B

	Pre Intervention (Mean ± SD)	**Post Intervention** (Mean ± SD)	**Improvement from Pretest to Posttest** (Mean ± SD)	**P Value**	**T**
Group A	881 ± 109.58	955.55 ± 114.81	74.55 ± 110.48	.007	3.018
Group B	898.70 ± 101.19	926.65 ± 100.18	27.95 ± 98.29	.219	1.272
P Value	.599	.402	.167		
T	.531	.848	1.409		

Gait cycle length of the affected foot for Group A was 881 ± 109.58 cm (Mean ± SD) before the intervention, which significantly improved ($p < 0.05$) after the intervention to 955.55 ± 114.81 cm. Pre intervention value for Group B was 898.70 ± 101.19 cm which increased to 926.65 ± 100.18 cm during post intervention but the improvement was not significant ($p > 0.05$). Within group improvement was 74.55 ± 110.48 cm for Group A and 27.95 ± 98.29 cm for Group B. However, between group comparison of pre, post and improvement from pre to post data was not statistically significant ($p > 0.05$) (Table 4.14).



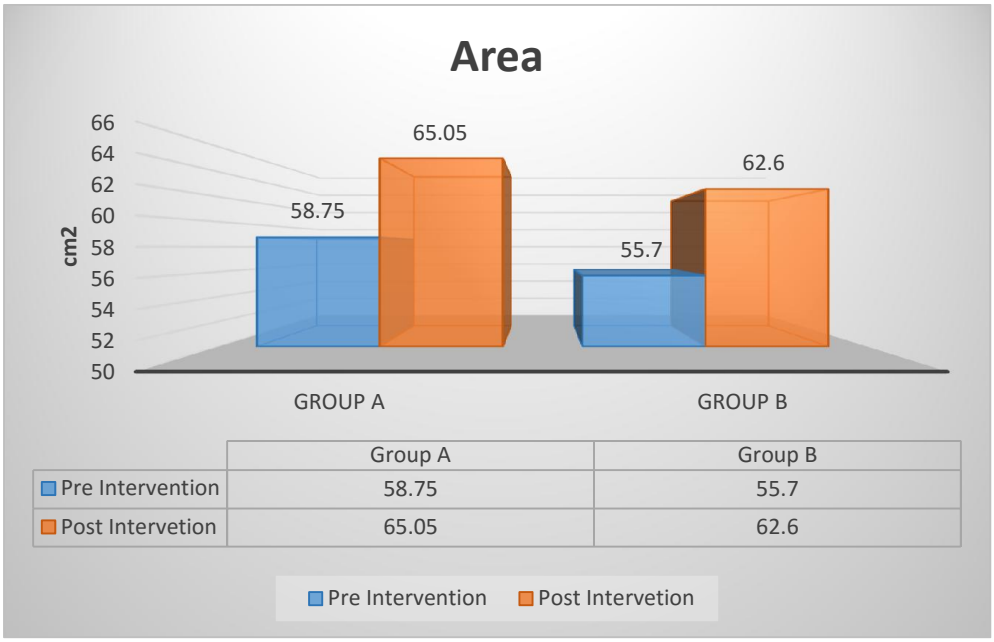
Graph 4.14: Comparison of pre and post intervention gait cycle length within and between Group A and Group B

Table 4.15

Within and between group pre and post comparison of sole area for Group A & Group B

	Pre Intervention (Mean ± SD)	**Post Intervention** (Mean ± SD)	**Improvement from Pretest to Posttest** (Mean ± SD)	**P Value**	**T**
Group A	58.75 ± 14.131	65.05 ± 11.283	6.30 ± 6.191	.000	4.551
Group B	55.70 ± 16.342	62.60 ± 15.906	6.90 ± 4.973	.000	6.206
P Value	.532	.578	.737		
T	.631	.562	.338		

Sole area of the affected foot for Group A and Group B were 58.75 ± 14.131 cm^2 (Mean ± SD) and 55.70 ± 16.342 cm^2 respectively before the intervention, which significantly improved ($p < 0.05$) after the intervention to 65.05 ± 11.283 cm^2 and 62.60 ± 15.906 cm^2 respectively. Within group improvement was 6.30 ± 6.191 cm^2 for Group A and 6.90 ± 4.973 cm^2 for Group B. However, between group comparison of pre, post and improvement from pre to post data was not statistically significant ($p > 0.05$) (Table 4.15).



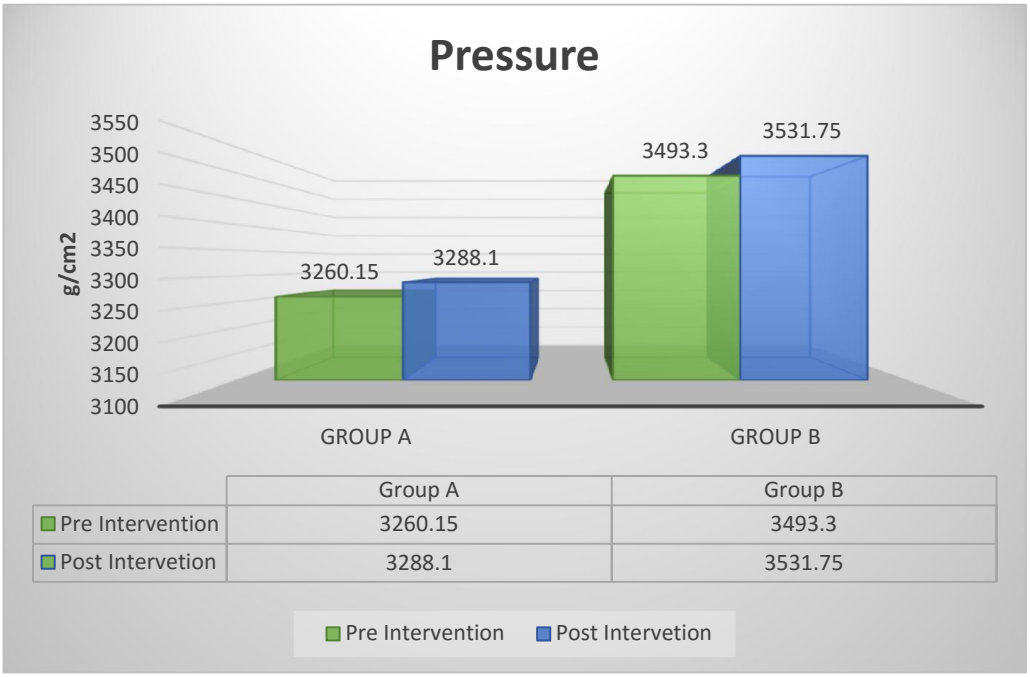
Graph 4.15: Comparison of pre and post intervention sole area within and between Group A and Group B

Table 4.16

Within and between group pre and post comparison of foot pressure for Group A & Group B

	Pre Intervention (Mean ± SD)	**Post Intervention** (Mean ± SD)	**Improvement from Pretest to Posttest** (Mean ± SD)	**P Value**	**T**
Group A	3260.15 ± 932.75	3288.10 ± 992.84	27.95 ± 1151.88	.915	.109
Group B	3493.30 ± 866.07	3531.75 ± 997.18	38.45 ± 899.29	.850	.191
P Value	.418	.444	.975		
T	.819	.774	.032		

Foot pressure of the affected foot for Group A and Group B were 3260.15 ± 932.75 g/cm^2 (Mean ± SD) and 3493.30 ± 866.07 g/cm^2 respectively before the intervention, which increased after the intervention to 3288.10 ± 992.84 g/cm^2 and 3531.75 ± 997.18 g/cm^2 respectively but the improvement was not significant ($p > 0.05$) for any group. Within group improvement was 27.95 ± 1151.88 g/cm^2 for Group A and 38.45 ± 899.29 g/cm^2 for Group B. Between group comparison of pre, post and improvement from pre to post data was not statistically significant ($p > 0.05$) (Table 16).



Graph 4.16: Comparison of pre and post intervention foot pressure within and between Group A and Group B

CHAPTER 5

DISCUSSION

5.1 DISCUSSION

The present study found that the pre post comparison of pain level on NPRS within group (Table 4.3) was statistically significant ($p = 0.000$) for both treatment group and there was significant reduction of pain in both group (Graph 4.3), 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 (Table 4.3) on pre, post and improvement between pre post data.

This reduction in pain might be due to the Mulligan 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.[25]

Significant improvement ($p < 0.05$) in pressure pain threshold was evident for both treatment group (Graph 4.4). This significant improvement in PPT confirms the physiological changes such as reduction in pain by the techniques.

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 the both intervention group. There is significant improvement ($p = 0.000$) in range of motion in pre post comparison for the both intervention group (Table 4.5,4.6,4.7,4.8). 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[31], Anthony D. Kay et al concluded that significant increases in dorsiflexion ROM and reductions in whole muscle tendon stiffness occurred following contract relax stretching[28], 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 [32].

Amin DI suggested that active release and MET both have equal effect in increasing hamstring flexibility than Mulligan technique in normal male adults.[27] 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 group.

Ghram A et al concluded that CR PNF stretching might be effective to improve dynamic balance control.[47] 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.

5.2 LIMITATIONS

- The study had a small sample size
- The study had no control group and there by fails to bring the placebo effect of the both intervention used.
- Only lateral ankle sprain patients were selected for the study.
- Mulligan's MWM was given only for distal tibiofibular joint.

5.3 FUTURE SCOPE OF THE STUDY

In future researches can be conducted to see the comparison of effect between MET and Contract relax in acute or chronic stage of ankle sprain with or without the combination of any other technique.

CHAPTER 6

CONCLUSION

6. CONCLUSION

This study concluded that both MET and Contract relax with Mulligans movement with mobilization are equally effective techniques to reduce pain, increase ROM, pressure pain threshold and gait variables in subacute stage of lateral ankle sprain.

CHAPTER 7

REFERENCES

7. REFERENCES

1. Fong DT, Hong Y, Chan, LK, Yung PS, Chan KM. A systematic review on ankle injury and ankle sprain in sports. Sports Med. 2007;37(1):73–94.
2. Hertel J. Functional instability following lateral ankle sprain. Sports Med. 2000;29(5):361–371.
3. Ankle Sprain: Practice Essentials, Background, Anatomy [Internet]. Emedicine.medscape.com. 2016 [cited 20 March 2016]. Available from:http://emedicine.medscape.com/article/1907229-overview
4. Soboroff SH, Pappius EM, Komaroff AL. Benefits, risks, and costs of alternative approaches to the evaluation and treatment of severe ankle sprain. Clin Orthop. 1984;160–168.
5. Smith RW, Reischl SF. Treatment of ankle sprains in young athletes. Am J Sports Med.1986;14: 465–471.
6. Kaur J, Sinha AG. Prevalence of ankle sprain and service utilization among players of Punjab. International Journal of Therapies and Rehabilitation Research. 2015 Jan 1;4(1):16.
7. Zech A, Hubscher M, Vogt L, Banzer W, Hansel F, Pfeifer KL. Neuromuscular training for rehabilitation of sports injuries: a systematic review. Med Sci Sports Exerc. 2009 Oct 1;41(10):1831-41.
8. Verhagen E, Van der Beek A, Twisk J, Bouter L, Bahr R, Van Mechelen W. The effect of a proprioceptive balance board training program for the prevention of ankle sprains a prospective controlled trial. The American journal of sports medicine. 2004 Sep 1;32(6):1385-93.
9. Mehta J, Sinha AG. Prevalence of Functional Ankle Instability and Its Association with risk factors in Basketball Players of Punjab.2015
10. Ankle Sprain Classification [Internet]. Myhealth.alberta.ca. 2016 [cited 20 March 2016]. Available from: https://myhealth.alberta.ca/Health/Pages/conditions.aspx?hwid=te7663
11. Safran MR, Benedetti RS, Bartolozzi AR, Mandelbaum BR. Lateral ankle sprains: a comprehensive review: etiology, pathoanatomy, histopathogenesis, and diagnosis.Med Sci Sports Exerc.1999;31:S429–S437.
12. Eiff MP, Smith AT, Smith GE. Early mobilization versus immobilization in the treatment of lateral ankle sprains. The American journal of sports medicine. 1994 Jan 1;22(1):83-8.

13. Holme E, Magnusson SP, Becher K, Bieler T, Aagaard P, Kjaer M. The effect of supervised rehabilitation on strength, postural sway, position sense and re-injury risk after acute ankle ligament sprain. Scand J Med Sci Sports.1999;9:104–109.
14. Morgan Boyle, ATC,Steven Jacoby, clinical editors. Evidence-based Clinical Protocols Lateral Ankle Sprains
15. Behm DG, Bambury A, Cahill F, Power K. Effect of acute static stretching on force, balance, reaction time, and movement time. Medicine and science in sports and exercise. 2004 Aug 1;36:1397-402.
16. STRETCHING AND FLEXIBILITY - Physiology of Stretching [Internet]. People.bath.ac.uk. 2016 [cited 17 March 2016]. Available from: http://people.bath.ac.uk/masrjb/Stretch/stretching_2.html
17. Osborne MD, Rizzo Jr TD. Prevention and treatment of ankle sprain in athletes. Sports Medicine. 2003 Dec 1;33(15):1145-50.
18. Hertling D. and Kessler R. Management of common musculoskeletal disorders. 3rd Edition. U.S.A., Lippincott Williams & Wilkins; 1996.
19. Denegar C, Hertel J, Fonseca J. The Effect of Lateral Ankle Sprain on Dorsiflexion Range of Motion, Posterior Talar Glide, and Joint Laxity. J Orthop Sports Phys Ther. 2002;32(4):166-173.
20. Greenman, P.E.: Principles of Manual Medicine, third ed. Lippincott Williams and Wilkins, Baltimore, 2003.
21. Agrawal SS. Comparison between post isometric relaxation and reciprocal inhibition manuevers on hamstring flexibility in young healthy adults: randomized clinical trial. International Journal of Medical Research & Health Sciences. 2016;5(1):33-7.
22. Collins N, Teys P, Vicenzino B. The initial effects of a Mulligan's mobilization with movement technique on dorsiflexion and pain in subacute ankle sprains. Manual therapy. 2004 May 31;9(2):77-82.
23. Verhagen E, Van der Beek A, Twisk J, Bouter L, Bahr R, Van Mechelen W. The effect of a proprioceptive balance board training program for the prevention of ankle sprains a prospective controlled trial. The American journal of sports medicine. 2004 Sep1;32(6):1385-93
24. Stretching [Internet]. Wikipedia. 2016 [cited 20 March 2016]. Available from: https://en.wikipedia.org/wiki/Stretching
25. Baker RT, Nasypany A, Seegmiller JG. The mulligan concept: mobilizations with movement. international journal. 2013 Jan;31

26. Ghram A, Damak M, Rhibi F, Marchetti PH. The contract-relax proprioceptive neuromuscular facilitation (PNF) stretching can affect the dynamic balance in healthy men. MedicalExpress. 2016 Aug;3(4).
27. Amin DI. Comparison of different therapeutic techniques on hamstring flexibility in normal adults: randomized controlled trial. International Journal of Physiotherapy. 2016 Dec 1;3(6):630-6.
28. Kay AD, Husbands-Beasley J, Blazevich AJ. Effects of Contract-Relax, Static Stretching, and Isometric Contractions on Muscle-Tendon Mechanics. Medicine and science in sports and exercise. 2015 Oct;47(10):2181-90.
29. Narayan A, Jagga V. Efficacy of muscle energy technique on functional ability of shoulder in adhesive capsulitis. Journal of Exercise Science and Physiotherapy. 2014 Dec;10(2):72.
30. Reddy BC, Metgud S. A randomized controlled trial to compare the effect of muscle energy technique with conventional therapy in stage ii adhesive capsulitis. Int J Physiother Res. 2014;2(3):549-.
31. Mau H, Baker Rt. A Modified Mobilization-With-Movement to Treat a Lateral Ankle Sprain. International Journal of Sports Physical Therapy. 2014 Aug;9(4):540.
32. Nisha K, Megha NA, Paresh P. Efficacy of weight bearing distal tibiofibular joint mobilization with movement (mwm) in improving pain, dorsiflexion range and function in patients with postacute lateral ankle sprain. Int J Physiother Res. 2014;2(3):542-48.
33. Ghadi P, Verma C. Study of the efficacy of the Mulligan's Movement with Mobilization and Taping Technique as an Adjunct to the Conventional Therapy for Lateral Ankle Sprain. Indian Journal of Physiotherapy and Occupational Therapy. 2013 Jul 1;7(3):167.
34. Morcelli MH, Oliveira JM, Navega MT. Comparison of static, ballistic and contract-relax stretching in hamstring muscle. Fisioterapia e Pesquisa. 2013 Sep;20(3):244-9.
35. Zakaria AR, Melam G, Buragadda S. Efficacy of PNF Stretching Techniques on Hamstring Tightness in Young Male Adult Population. World J Med Sci. 2012;7(1):23-6.
36. Shenouda MM. Efficacy of Stretching Exercises Versus Postisometric Relaxation Technique on Pain, Functional Disability and Range of Motion in Patients with Cervical Spondylosis. A Randomized controlled trial. Bulletin of Faculty of Physical Therapy. 2012;17(2).
37. Azevedo DC, Melo RM, Corrêa RV, Chalmers G. Uninvolved versus target muscle contraction during contract–relax proprioceptive neuromuscular facilitation stretching. Physical Therapy in Sport. 2011 Aug 31;12(3):117-21.

38. Moore SD, Laudner KG, Mcloda TA, Shaffer MA. The immediate effects of muscle energy technique on posterior shoulder tightness: a randomized controlled trial. journal of orthopaedic & sports physical therapy. 2011 Jun;41(6):400-7.
39. Fujii M, Suzuki D, Uchiyama E, Muraki T, Teramoto A, Aoki M, Miyamoto S. Does distal tibiofibular joint mobilization decrease limitation of ankle dorsiflexion?. Manual therapy. 2010 Feb 28;15(1):117-21.
40. Smith M, Fryer G. A comparison of two muscle energy techniques for increasing flexibility of the hamstring muscle group. Journal of Bodywork and Movement Therapies. 2008 Oct 31;12(4):312-7.
41. Reid A, Birmingham TB, Alcock G. Efficacy of mobilization with movement for patients with limited dorsiflexion after ankle sprain: a crossover trial. Physiotherapy Canada. 2007 Jul;59(3):166-72.
42. Shadmehr A, Hadian MR, Naeimi SS, Jalaie S, Mokhtari A. 28 Muscles. Modern Rehabilitation. 2007 Jul 15;1(2):60-5.
43. Feland JB, Marin HN. Effect of submaximal contraction intensity in contract-relax proprioceptive neuromuscular facilitation stretching. British journal of sports medicine. 2004 Aug 1;38(4):e18-.
44. Ballantyne F, Fryer G, McLaughlin P. The effect of muscle energy technique on hamstring extensibility: the mechanism of altered flexibility. Journal of Osteopathic Medicine. 2003 Oct 1;6(2):59-63.
45. Lenehan KL, Fryer G, McLaughlin P. The effect of muscle energy technique on gross trunk range of motion. Journal of osteopathic medicine. 2003 Apr 30;6(1):13-8.
46. Valenza MC, Torres-Sánchez I, Cabrera-Martos I, Demet MC, Valenza MC. Acute Effects of contract-relax stretching vs. TENS in young subjects with anterior knee pain: a randomized controlled trial Brief running head: Contract-relax stretching vs TENS in anterior knee pain. The research was conducted at the university-laboratory, of the Faculty of Health Sciences in the University of Granada, Spain.
47. Handel M, Horstmann T, Dickhuth HH, Gülch RW. Effects of contract-relax stretching training on muscle performance in athletes. European journal of applied physiology and occupational physiology. 1997 Oct 1;76(5):400-8.
48. McCarthy PW, Olsen JP, Smeby IH. Effects of contract-relax stretching procedures on active range of motion of the cervical spine in the transverse plane. Clinical Biomechanics. 1997 Mar 31;12(2):136-8.

49. Rehab Measures - Numeric Pain Rating Scale [Internet]. The Rehabilitation Measures Database. 2017 [cited 18 May 2017]. Available from: http://www.rehabmeasures.org/Lists/RehabMeasures/DispForm.aspx?ID=891
50. Pöntinen PJ. Reliability, validity, reproducibility of algometry in diagnosis of active and latent tender spots and trigger points. Journal of Musculoskeletal Pain. 1998 Jan 1;6(1):61-71.
51. Farooq MN, Bandpei MA, Ali M, Khan GA. Reliability of the universal goniometer for assessing active cervical range of motion in asymptomatic healthy persons. Pakistan journal of medical sciences. 2016 Mar;32(2):457.
52. Ramachandra P, Maiya AG, Kumar P. Test-retest reliability of the Win-Track platform in analyzing the gait parameters and plantar pressures during barefoot walking in healthy adults. Foot & ankle specialist. 2012 Oct;5(5):306-12.
53. The P.R.I.C.E. Protocol Principles [Internet]. Sports-health. 2016 [cited 8 November 2016]. Available from: http://www.sports-health.com/treatment/price-protocol-principles
54. Chaitow L. Muscle energy techniques. 2nd Edition. Edinburgh: Churchill Livingstone 1996.

CHAPTER 8
APPENDICES

8.1 APPENDIX – 1

INFORMED CONSENT

PERSONAL DETAILS:

Name:	Address:
Phone No:	Email Address:
Date of Birth:	Occupation:

Please carefully read and sign this form.

1. I understand that it is important that I give the most accurate health history and information to my physiotherapist so that any planned treatments and therapies are in by best interest.
2. I understand that my physiotherapist will discuss any assessment and treatment plans with me before they are administered.
3. I understand that information given by me will be kept confidential and private during the study.
4. I understand the importance and method of assessment and treatment used in the study as discussed with my physiotherapist.
5. I understand the risk of physiotherapy treatment can include but it is not limited to an exacerbation of symptoms, strains, sprains allergic reactions, electrical shocks and burns.
6. I understand the consequences of not receiving treatment can include but is not limited to a continued exacerbation of symptoms or no improvement of symptoms.
7. I understand that I can discuss my interest or disinterest in the treatments with my physiotherapist.
8. I have read and understand the contents of this form. I hereby grant permission to my physiotherapist to perform the assessment and treatments that may that may be necessary to treat my condition or injury.
9. I understand that my physiotherapist will also provide further details regarding the benefits, risks, consequences, and availability of alternative and adjunctive therapies specific to my symptoms during the course of the assessment and treatment.
10. I also understand that I can withdraw consent to any component of the assessment or treatment at any time.

DATE: _____ PATIENT'S SIGNATURE: _____

8.2 APPENDIX – 2

Patient Assessment Form

Name of Hospital: **Date: / /**

Name of Patient:

Age:

Gender: Male /Female

Occupation:

Address:

Chief Complain:

History of Present illness:

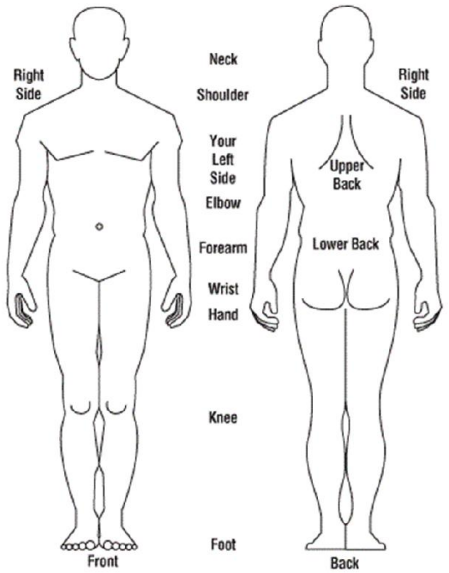
History of Past illness:

Family History:

Personal History: Smoker/Non-smoker/ Alcoholic/Non alcoholic

Pain Evaluation:

- **Side and Site:**
- **Onset:** Gradual/Sudden
- **Pattern of Pain:** Continuous/Intermittent/Hourly
- **Types of Pain:** Sharp/Shooting/Radiating/Dull
- **Aggravating Factor:**
- **Relieving Factor:**
- **Intensity of Pain: NPRS**



0 1 2 3 4 5 6 7 8 9 10

No Pain____I_____I_____I____I____I____I____I____I____I____I____I Worst Pain Imaginable

Observation:

- Body Type: Ectomorph/Mesomorph/Endomorph
- Posture/Gait:
- Deformity:
- Tropical Change: Scaly/Dry/Shiny _____
- Swelling/Oedema: Present/Absent _____
- Soft Tissue Contour: (Muscle Wasting) _____

Palpation:

- Temperature: Hypo/Hyperthermia _____
- Tenderness: Present/Absent _____
- Oedema: Pitting/Non pitting _____
- Muscle Tone: Hard/Firm/Flabby _____

Examination:

Motor Examination:

Manual Muscle Testing:

Muscle	**Right**	**Left**
Ankle Dorsiflexor		
Ankle Plantar flexor		
Ankle Invertor		
Ankle Evertor		

Range of Motion:

ROM (In degree)	**Right**		**Left**	
	Active	**Passive**	**Active**	**Passive**
Ankle Dorsiflexion				
Ankle Plantarflexion				
Ankle Inversion				
Ankle Eversion				

Investigation: (If available)

Provisional Diagnosis:

8.3 APPENDIX – 3

DATA COLLECTION

Data Collection form

Date……..… Patient's code ……. Group……. Serial no.....

Name:

Age:

Gender:

Occupation:

Address:

Contact no:

Diagnosis:

1. PAIN MEASURED BY NPRS

Parameters	Pre-reading	Post-reading
NPRS		

2. TENDERNESS MEASURED BY ALGOMETER

Parameters	Pre-reading	Post-reading
PPT		

3. ANKLE ACTIVE RANGE OF MOTION BY UNIVERSAL GONIOMETER

Parameters	Pre-reading	Post-reading
Dorsiflexion (in degrees)		
Plantarflexion (in degrees)		
Inversion (in degree)		
Eversion (in degree)		

4. GAIT ASSESSMENT USING WINTRACK

Parameters	Pre-reading	Post-reading
Step duration (ms, affected side)		
Double stance duration (ms)		
Swing duration (ms, affected side)		
Stride duration (ms, affected side)		
Step length (cm, affected side)		
Gait cycle length (cm, affected side)		
Area (cm^2), affected side		
Pressure (g/cm^2, affected side)		

8.4 APPENDIX – 4

MASTER CHART

Group A

Sr. No.	Age	NPRS		PPT		Ankle Range of Motion (Active)							
						Ankle Dorsiflexion		Ankle Plantarflexion		Ankle Inversion		Ankle Eversion	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
A1	25	6	1	2	6.7	10	20	30	45	10	25	10	15
A2	20	5	0	1.6	7.2	10	20	35	40	15	15	15	15
A3	21	5	1	3.2	7.3	10	15	40	50	10	15	10	15
A4	20	4	0	4.5	8.4	10	15	35	45	15	20	10	20
A5	25	5	0	2.4	6.5	5	15	40	45	15	20	15	15
A6	24	3	0	5.2	8.6	15	20	50	55	25	25	10	15
A7	22	6	0	2.2	5.7	0	15	45	45	5	20	5	10
A8	20	4	0	3.7	8.3	10	15	40	50	10	20	10	15
A9	19	5	0	4.1	7.5	10	15	35	40	20	30	15	20
A10	18	5	1	3.8	8.1	15	20	40	50	15	20	15	15
A11	27	6	1	2.6	6.8	0	10	30	40	5	15	5	10
A12	26	5	0	4.2	7.6	5	15	35	40	15	25	15	15
A13	25	4	0	3.4	8.2	10	20	50	50	15	20	10	15
A14	27	5	1	3.6	7.8	15	15	40	40	20	25	15	15
A15	23	5	0	2.7	8.4	10	15	45	50	10	15	10	15
A16	19	4	0	4.2	8	15	20	40	45	20	25	20	20
A17	22	4	0	3.4	7.8	10	15	45	45	20	30	10	10
A18	23	6	0	2.4	8.4	5	15	40	45	15	25	10	15
A19	21	5	0	3.4	9.4	5	10	50	50	10	20	15	15
A20	25	5	0	2.8	7.9	10	15	45	45	15	30	15	20

Group A

	Gait Parameters															
Sr. No.	Step duration (ms)		Double stance duration (ms)		Swing duration (ms,)		Stride duration (ms)		Step length (cm)		Gait cycle length (cm)		Area (cm^2)		Pressure (g/cm^2)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
A1	510	600	10	190	1230	1320	1770	1920	211	406	773	875	31	52	3570	3317
A2	380	610	10	240	1150	1360	1670	1930	289	453	758	898	38	52	3219	2312
A3	670	750	180	310	1320	1490	1920	2190	414	492	812	1078	66	58	4241	2225
A4	580	590	110	250	1470	1400	2140	2030	469	430	922	812	46	62	3023	3182
A5	610	580	390	260	1520	1270	2280	1840	344	500	828	992	78	84	2282	4689
A6	580	710	200	310	1200	1420	1800	1990	453	422	742	883	68	73	4867	2249
A7	380	550	160	190	1120	1270	1740	1870	406	508	929	1023	52	60	2601	2692
A8	540	660	220	170	1320	1340	2020	1900	328	625	875	1164	44	53	3072	3200
A9	400	610	180	160	1120	1400	1720	2030	461	570	1000	1117	54	64	3064	3130
A10	670	840	370	470	1640	2100	2360	2990	320	390	765	851	53	54	2440	2973
A11	580	600	260	310	1380	1510	1990	2250	398	320	719	695	71	72	2417	3761
A12	500	610	150	170	1100	1340	1660	1960	469	555	976	1039	67	70	3329	3472
A13	700	720	280	360	1430	1580	2240	2260	445	437	906	937	43	48	5772	6295
A14	540	580	170	200	1210	1290	1720	1850	383	375	812	789	64	64	3489	2728
A15	630	660	240	250	1350	1420	2070	1830	375	445	898	1023	80	84	3009	4744
A16	710	810	290	360	1540	1650	2240	2460	453	592	1039	1015	77	83	1867	2545
A17	840	880	300	530	1720	1960	2460	2760	430	445	883	984	75	79	2876	2915
A18	920	770	230	380	1720	1750	2220	2570	555	453	836	976	54	63	2788	3316
A19	570	930	210	340	1300	1680	1960	2570	461	453	1093	984	53	58	4330	3520
A20	590	630	190	200	1420	1500	2090	2140	500	445	1054	976	61	68	2947	2497

Group B

Sr. No.	Age	NPRS		PPT		Ankle Range of Motion (Active)							
						Ankle Dorsiflexion		Ankle Plantarflexion		Ankle Inversion		Ankle Eversion	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
B1	26	3	0	2.8	8.2	10	20	40	50	15	20	15	15
B2	24	5	0	4	9	15	20	45	50	15	20	10	15
B3	21	4	0	2.4	6.4	15	15	40	50	15	20	15	15
B4	24	3	0	3	8.3	15	20	40	50	15	15	10	20
B5	24	5	0	1.8	7.6	15	20	35	40	20	30	15	20
B6	25	4	1	3.7	5.7	5	15	30	35	15	20	10	10
B7	21	3	0	4.6	8.4	10	15	35	45	10	15	10	10
B8	23	4	0	3.5	6.8	10	15	40	45	15	20	10	15
B9	20	5	1	2.7	7.4	5	10	35	45	0	15	15	15
B10	22	4	0	3.3	5.7	10	20	50	55	15	25	10	10
B11	27	5	1	2.4	7.8	5	10	45	50	20	25	10	15
B12	25	4	0	4.2	7.6	15	20	50	50	20	30	15	20
B13	26	4	0	4.6	8.4	15	20	40	45	25	25	20	20
B14	25	6	0	3.4	8.2	10	15	45	45	5	25	5	10
B15	19	5	0	3.1	8.4	15	20	50	50	15	25	15	15
B16	22	5	0	2.6	7.6	10	15	40	45	20	25	15	15
B17	23	4	0	3.6	7.8	15	20	45	50	10	25	15	20
B18	21	5	1	2.4	8.8	15	20	45	45	15	25	20	20
B19	19	6	0	2.7	7.9	5	10	50	50	10	20	10	15
B20	23	4	0	3.9	8.7	20	20	45	50	15	30	20	20

Group B

Gait Parameters																
Sr. No.	Step duration (ms)		Double stance duration (ms)		Swing duration (ms)		Stride duration (ms)		Step length (cm)		Gait cycle length (cm)		Area (cm^2)		Pressure (g/cm^2)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
B1	690	720	320	290	1580	1580	2280	2400	523	569	898	1000	48	51	4643	4590
B2	690	760	140	200	1490	1590	2250	2070	328	445	711	836	56	63	2656	2453
B3	500	550	80	140	1180	1210	1820	1640	508	437	812	765	53	68	5381	4756
B4	530	850	80	320	1140	1800	1270	2540	320	453	961	820	39	48	3295	3502
B5	670	720	130	290	1420	1560	2160	2390	400	498	1062	983	59	74	3020	3024
B6	540	620	230	280	1370	1370	1860	1900	344	390	843	929	29	34	4295	3492
B7	700	730	250	460	1470	1550	2120	2210	422	430	750	875	46	57	4454	2715
B8	500	860	220	230	1090	1640	1590	2590	523	559	760	781	66	71	3107	2107
B9	410	770	220	260	1030	1600	1550	2360	515	422	1023	875	62	71	3247	2368
B10	880	860	420	310	2060	1740	3040	2600	461	547	922	1047	56	63	3593	4915
B11	540	340	240	220	1350	1080	1860	1740	344	484	859	1054	32	41	2796	4895
B12	440	640	200	200	1240	1400	1920	1980	375	515	922	1039	62	58	2202	2998
B13	580	640	150	230	1290	1400	1910	1940	359	367	922	875	41	41	4705	4560
B14	620	480	190	490	1470	1230	2110	1710	312	344	750	742	56	65	2289	2650
B15	770	680	310	230	1580	1250	2450	1860	406	484	937	1015	87	91	3605	4794
B16	590	680	260	220	1280	1330	1860	1870	461	615	968	1054	76	84	3352	3904
B17	640	670	140	200	1240	1240	1910	1910	476	684	914	961	64	76	2730	2430
B18	160	630	210	210	1050	1400	1730	2070	375	515	922	984	33	44	3197	3777
B19	550	650	170	310	1150	1430	1660	2090	515	398	1015	961	86	86	3020	2394
B20	620	660	220	270	1410	1660	2020	2410	515	406	1023	937	63	66	4279	4311

8.5 APPENDIX – 5
TREATMENT PROTOCOL

INTERVENTION GROUP 1: Muscle Energy Technique & Mulligan's MWM Technique
MET: MET for gastrocnemius and soleus muscle was done. Patient used 20% of the available strength for the isometric contraction. 2 set of 5 repetitions a day. 3 days a week for 4 weeks.
Mulligans MWM: Mulligan's MWM was performed for distal tibiofibular joint in supine position. It was followed by tape application. 2 set of 10 repetitions a day. 3 days a week for 4 weeks.

INTERVENTION GROUP 2: Contract Relax & Mulligan's MWM Technique
Contract Relax: Contract relax for gastrocnemius and soleus muscle was done. Patient used sub maximal force for the isotonic contraction towards plantarflexion. 2 set of 5 repetitions a day. 3 days a week for 4 weeks
Mulligans MWM: Mulligan's MWM was performed for distal tibiofibular joint in supine position. It was followed by tape application. 2 set of 10 repetitions a day. 3 days a week for 4 weeks.

8.6 APPENDIX – 6
ASSESSMENT TOOLS

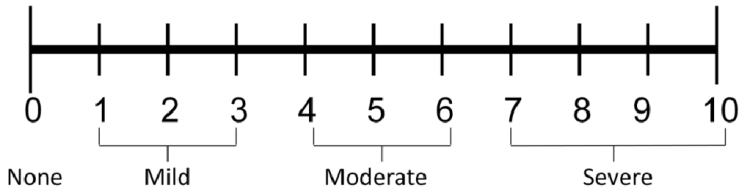


Fig 8.6.1 Numeric Pain Rating Scale (NPRS) was used to measure the level of pain which was administered by the patient himself/herself

Fig 8.6.2 Algometer was used to measure the level of tenderness, pressure pain threshold was measured using algometer

Fig 8.6.3 Universal Goniometer was used to measure the active range of motion of the ankle which includes range of motion of dorsiflexion, plantarflexion, inversion and eversion

Fig 8.6.4 Win Track or force platform was used for the analysis of gait parameters such as step duration, double stance duration, swing duration, stride duration, step length, gait cycle length, area and pressure

Dynamic Gait Analysis Report

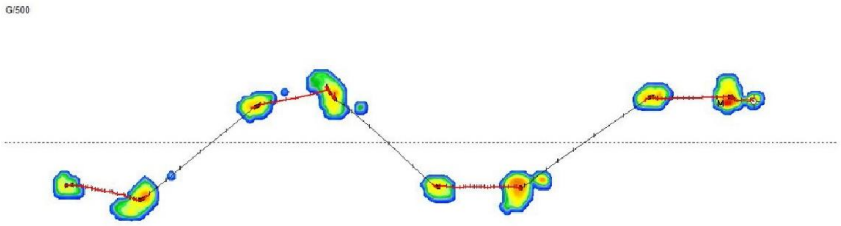
Lovely Professional University

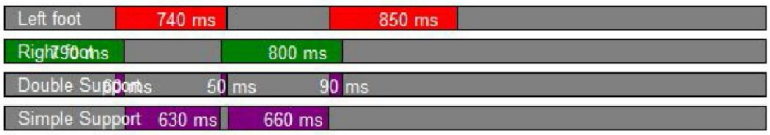
Jalandhar-Delhi G.T. Road, National Highway 1, Phagwara, Punjab 144411

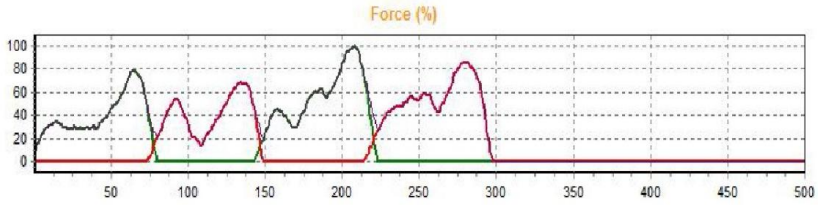
http://www.lpu.in/

Dashpreet Kaur	Age : 24 year Weight : 50 Height : 164 Foot size : 23,	Complaint :
Referral :		

Walk analysis







Podometric Results

	1	2	3
Area	48	56	52
Average P.	1430	1442	1640
Maximal P.	2656	2656	3205

GaitLine MaxLine

Spacio-Temporal Results

	Left	Right
Step Duration (ms)	690	730
Gait Cycle Duration (Ms)	1400	1420
Single Stance Duration (ms)	630	
Double Stance Duration (ms)	140	110
Swing Duration (ms)	1490	1470
Stride Duration (ms)	2250	2220
Step length (mm)	328	328
Gait Cycle Length (mm)	711	656
Angle	3.23	3.25

\- +

Medicapteurs Software

ABSTRACT

Efficacy of Muscle Energy Technique and Contract Relax with Mulligan's Movement with Mobilization Technique in Subacute Ankle Sprain.

Prosenjit Baidya*, Manni Wadhwa**

MPT (Ortho)*, MPT (Ortho)**, LPU

Introduction: The ankle is a standout amongst the most well-known body part that got harmed at game events, while ankle sprain is the most widely recognized ankle injury. Muscle Energy technique (MET), Contract relax, Mulligans Movement with Mobilization (MWM) have been advocated for reducing pain, increasing range of motion, flexibility after ankle sprain. But little research exists to compare the effect between MET and Contract relax in the treatment of ankle sprain. This study examined whether there is significant difference between the effectiveness between MET and Contract relax in the treatment of subacute stage of ankle sprain.

Method: Forty patients (mean age = 22.80 ± 2.55 years, male: female 60%: 40%) were randomly selected to one of two groups (Group 1: Muscle Energy Technique with Mulligan's Movement with Mobilization Technique; Group 2: Contract Relax with Mulligan's Movement with Mobilization Technique). Pre intervention measure of Pain, Tenderness, Joint range of motion and Gait variables were recorded. Patient received allocated intervention for 4 weeks (3 days per week) and then post intervention data was recorded.

Result: Analysis with paired T test revealed significant reduction ($P < 0.05$) in pain and improvement in tenderness, range of motion and some gait variables within the group for both Group A and Group B. However independent T test for comparing the pre, post and improvement from pre to post data between Group A and Group B showed no significant difference ($P > 0.05$).

Conclusion: This study concluded that both MET and Contract relax are equally effective techniques to reduce pain, increase ROM, pressure pain threshold and gait variables in subacute stage of lateral ankle sprain.

Keywords: Ankle Sprain, Tibiofibular MWM, Contract Relax, MET