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"A Study On The Effectiveness Of Mulligan Mobilisation And The-Rapeutic Laser To Improve Pain And Rom In Grade 1 Ankle Sprain ."

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Abstract

Background and Objectives: LLLT has been used in pain management for over two decades.
The objective of the study was to evaluate a study to evaluate the effect of mulligans and therapeutic laser to improve pain and ROM in grade1 ankle sprain
Methods: 40 subjects with diagnosis of pain were randomly graded 1 ankle sprain allocated in two groups. Group A received PRICE Protocol whereas Group B received Laser Therapy + Mulligan Mobilization. The outcome was assessed in terms of Universal Goniometer and Numeric Pain rating Scale (NPRS) at baseline and immediately post intervention.
Results: The result of the present study showed that in Group A there were 20 subjects with mean age 31.55 years and in Group B there were 20 subjects with mean age 32.15 years when means were analysed from pre intervention to post intervention within the groups there is a statistically significant ($p<0.05$) change in means of NPRS and UNIVERSAL GONIOMETER within study group and within control group. There is a clinically significant improvement with large effect size in both groups.
Interpretation and Conclusion: The present study concludes that both training protocols were equally effective in treatment of Grade 1 Ankle Sprain. Further it was also noticed that Group B was more effective in improving range of motion and reducing pain than Group A. Hence while applying the protocol laser therapy + mulligan mobilization were better than the price protocol alone.

Key words: Grade 1 Ankle Sprain; low level laser therapy; mulligan mobilization.

Introduction

Anatomy: .

The foot and ankle is made up of the twenty-six individual bones of the foot, together with the long-bones of the lower limb to form a total of thirty-three joints. Although frequently referred to as the 'ankle joint', there are a number of articulations which facilitate motion of the foot.The calcaneus is the largest, strongest and most posterior bone of the foot, providing attachment for the Achilles tendon. It is located inferiorly to the talus, and forms a triplanar, uniaxial joint with the talus.[1]
The ankle complex comprises 3 articulations: the talocrural joint, the subtalar joint, and the distal tibiofibular syndesmosis. These 3 joints work in concert to allow coordinated movement of the rearfoot.[1] These articulations work together, co-ordinating the hind-foot movement, which occurs in the sagittal plane, the frontal plane and the transverse plane. Mechanically,the three joints produce co-ordinated movement for the hind-foot to rotate around an axis obliquely. As such the hind-foot movements can be organized kinetically as either supination or pronation: in open kinetic movement inversion, internal rotation and plantar flexion make up supination, and external rotation, eversion and dorsiflexion make up pronation.[1]

Fig.1; anatomy of ankle joint

Talocrural Joint Anatomy;

The talocrural, or tibiotalar, joint is formed by the articulation of the dome of the talus, the medial malleolus, the tibial plafond, and the lateral malleolus. The shape of the talocrural joint allows torque to be transmitted from the lower leg (internal and external rotation) to the foot (pronation and supination) during weight bearing.
This joint is sometimes called the ‘‘mortise’’ joint and, in isolation, may thought of as hinge joint that allows the motions of plantar flexion and dorsiflexion. The axis of rotation of the talocrural joint passes through the medial and lateral malleoli. It is slightly anterior to the frontal plane as it passes through the tibia but slightly posterior to the frontal plane as it passes through the fibula. Isolated movement of the talocrural joint is primarily in the sagittal plane, but small amounts of transverse- and frontalplane motion also occur about the oblique axis of rotation[1]

Subtalar Joint Anatomy

The subtalar joint is formed by the articulations between the talus and the calcaneus and, like the talucrural joint, it converts torque between the lower leg (internal and external rotation) and the foot (pronation and supination).The subtalar joint allows the motions of pronation and supination and consists of an intricate structure with 2 separate joint cavities. The posterior subtalar joint is formed between the inferior posterior facet of the talus and the superior posterior facet of the calcaneus. The anterior subtalar, or talo calcaneonavicular, joint is formed from the head of the talus, the anterior-superior facets, the sustentaculum tali of the calcaneus, and the concave proximal surface of the tarsal navicular. This articulation is similar to a ball-and-socket joint, with the talar head being the ball and the anterior calcaneal and proximal navicular surfaces forming the socket in conjunction with the spring ligament. The anterior and posterior subtalar joints have separate ligamentous joint capsules and are separated from each other by the sinus tarsi and canalis tarsi.[1]

Distal Tibiofibular Joint Anatomy

The third joint of the ankle complex is the distal articulation between the tibia and fibula. This joint is a syndesmosis that allows limited movement between the 2 bones; however, accessory gliding at this joint is crucial to normal mechanics and subtalar joints have been shown to be extensively innervated by mechanoreceptors that contribute to proprioception.
The major importance of muscle spindles, especially of those in the peroneal muscles, to proprioception about the ankle complex has described.[1]

Muscles of the ankle

The majority of motion within the foot and ankle is produced by the twelve extrinsic muscles, which originate within the leg and insert within the foot. These muscles are contained within four compar-tments.
1. The anterior compartment consists of four muscles:
- tibialis anterior
- extensor digitorum longus
- extensor hallucis longus
- peroneus tertius.

The tibialis anterior and the extensor hallucis longus produce dorsiflexion and inversion of the foot.The peroneus tertius produces dorsiflexion and eversion of the foot. The extensor digitorum longus only produces dorsiflexion of the foot.
2. The lateral compartment is composed of two muscles:
- peroneus longus
- peroneus brevis which produce plantarflexion and eversion of the foot.

3. The posterior compartment consists of three muscles:
- gastrocnemius
- soleus
- plantaris which contribute to plantarflexion of the foot.

4. The deep posterior compartment is composed of three muscles:
- Tibialis posterior
- flexor digitorum longus
- flexor hallucis longus

which produce plantarflexion and inversion of foot.[2]

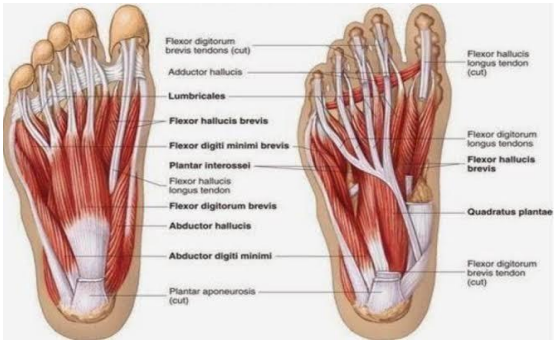


Fig2;Ligaments Of The Ankle Joint

The most common mechanism of injury to the ankle ligaments is inversion of the foot. With this mechanism of injury, the anterior talofibular ligament is the first or only ligament to sustain injury. A total rupture involves the calcaneofibular ligament and the posterior talofibular ligaments as well An eversion injury will cause damage to the deltoid ligaments, while a hyperdorsiflexion trauma might cause an injury to the syndesmotic ligaments

The ligaments around the ankle can be divided depending on their anatomic position, into three groups:

1 the lateral ligaments
2 the deltoid ligament on the medial side
3 the ligaments of the tibiofibular syndesmosis that join the distal epiphyses of the bones of the leg (tibia and fibula).

These three groups of ligaments are described separately, and in each section, the specific ligaments are described in detail.

The lateral and medial collateral ligaments

The lateral collateral ligament complex (LCL) consists of the anterior talofibular, the calcan-eofibular, and the posterior talofibular ligaments. The medial collateral ligaments (MCL), also known as the deltoid ligament, are a multifascicular group of ligaments and can roughly be divided into a superficial and deep group of fibers.

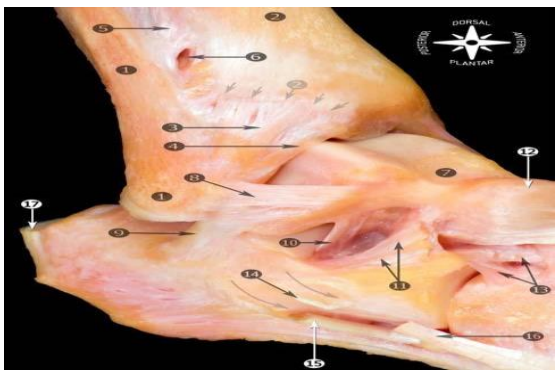


Fig3; Anatomic dissection of the lateral region of the foot and ankle showing the morphology and relationship of the anterior talofibular with the calcaneofibular ligaments. 1 Fibula and tip of the fibula; 2 tibia (anterior tubercle with arrows); 3 anterior tibiofibular ligament; 4 distal fascicle of the tibiofibular ligament;5 interosseous membrane; 6 foramen for the perforating branch of the peroneal artery; 7 talus; 8 anterior talofibular ligament; 9 calcaneofibular ligament; 10 talocalcaneal interosseous ligament; 11 inferior extensor retinaculum(cut); 12 talonavicular ligament; 13 bifurcate ligament; 14 peroneal tubercle (arrows showing the peroneal tendons sulcus); 15 peroneus longus tendon; 16 peroneus brevis tendon; 17 calcaneal tendon

Anterior talofibular ligament

The anterior talofibular ligament is the most frequently injured ligament of the ankle and is the most frequently observed injury in the emergency room. This ligament plays an important role in limiting anterior displacement of the talus and plantar flexion of the ankle. This ligament is closely related to the ankle joint capsule and is typically composed of two separate bands. The bands are separated by vascular branches from the perforating peroneal artery and its anastomosis with the lateral malleolar artery. In literature, numerous anatomic descriptions have been given, varying from a single up to three bands however, in our observation during ankle dissections, this ligament most commonly compromises a doublebanded morphology,similar to the description by Sarrafian. The anterior talofibular ligament originates at the anterior margin of the lateral malleolus. The center is on average 10 mm proximal to the tip of the fibula as measured along the axis of the fibula. The overall width (6– 10 mm) of the anterior tibiotalar ligament does not appear to vary greatly irrespective of the number of bands present, suggesting that the variations observed do not

modify the ligament's function From its origin, it runs anteromedially to the insertion on the talar body immediately anterior to the joint surface occupied by the lateral malleolus. The ligament is virtually horizontal to the ankle in the neutral position but inclines upward in dorsiflexion and downward in plantar flexion. It is only in the latter position that the ligament comes under strain and is vulnerable to injury, particularly, when the foot is inverted. In plantar flexion, the inferior band of the

ligament remains relaxed while the upper band becomes taut. In dorsiflexion, the upper band remains relaxed, and the inferior.[3]

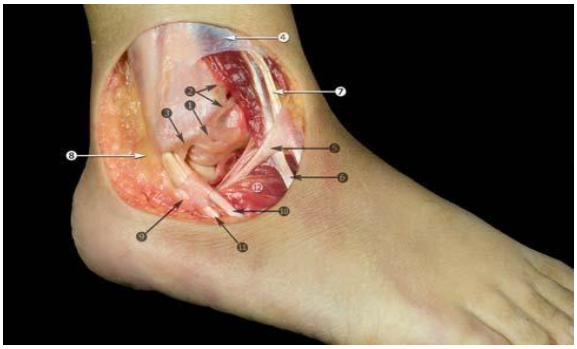


Fig4;Anterolateral view of the ankle. Anatomic dissection. 1 Anterior talofibular ligament; 2 anterior tibiofibular ligament; 3 fibular insertion of the calcaneofibular ligament; 4 superior extensor retinaculum; 5 inferior extensor retinaculum; 6 peroneus tertius tendon; 7 extensor digitorum longus tendons; 8 superior peroneal retinaculum; 9 inferior peroneal retinaculum; 10 peroneus brevis tendon; 11 peroneus longus tendon; 12 extensor digitorum brevis muscle

Calcaneofibular ligament

The calcaneofibular ligament originates from the anterior part of the lateral malleolus. It is anatomically positioned just below the lower band of the anterior talofibular ligament. Frequently, fibers connecting these ligaments can be observed. In the neutral ankle position, the ligament runs obliquely downwards and backwards to attach to the posterior region of the lateral calcaneal surface. This ligament is superficially crossed by the peroneal tendons and sheaths, which can leave a concavity over the ligament; only about 1 cm of the ligament is uncovered. The anatomic variants of the calcaneofibular ligament and their relationship with the lateral talocalcaneal ligament have been the subject of study . In 35% of the cases, the calcaneofibular ligament is reinforced by the lateral talocalcaneal ligament, attached by the former but diverging proximally or distally. In 23% of the cases, a lateral talocalcaneal ligament exists anteriorly and independent of the calcaneofibular ligament. In 42% of the cases, the lateral talocalcaneal is absent and is replaced by an anterior talocalcaneal ligament. In these cases, the calcaneofibular ligament acquires more functional significance in providing stability to the subtalar joint . The calcaneofibular ligament is the only ligament bridging both the talocrural joint and subtalar joint. Insertion of this ligament and its axis of rotation point allow flexion and extension movements of the talocrural joint. Depending on its bi-articular characteristic, this ligament also permits subtalar movement[3.]

Fig5;Anatomic dissection showing the relationship of the calcaneofibular ligament with peroneal tendons. 1 Calcaneofibular ligament; 2 peroneus longus tendon; 3 peroneus brevis tendon; 4 fibula; 5 talofibular ligament; 6 calcaneus; 7 subtalar joint; 8 septum in the peroneal tubercle; 9 superior extensor retinaculum; 10 inferior extensor retinaculum; 11 extensor digitorum longus tendons; 12 peroneus tertius tendon; 13 extensor digitorum brevis; 14 extensor digitorum brevis tendon; 15 calcaneal tendon; 16 Kager's fat pad; 17 tuberosity of the fifth metatarsal bone; 18 lateral plantar fascia; 19 abductor digiti minimi,

Posterior talofibular ligament

The posterior talofibular ligament originates from the malleolar fossa, located on the medial surface of the lateral malleolus, coursing almost horizontally to insert in the posterolateral talus. In plantar flexion and in the neutral ankle position, the ligament is relaxed, while in dorsiflexion, the ligament is tensed. Due to the multifascicular aspect of this ligament, it inserts not just in a specific area. Fibers insert in the posterior surface of the talus, the posterior view, the posterior intermalleolar ligament is situated between the transverse ligament and the posterior talofibular ligament and runs obliquely from lateral to medial and from downwards to upwards. The shape of the posterior intermalleolar ligament is variable. These variations depend on its medial arising sites, the number of composing fiber bundles, and the degree of the bundle compactness. The medial arising sites of the ligament included the lateral border of the medial malleolar sulcus, the medial border of the medial malleolar sulcus through the septum

between the flexor digitorum longus and posterior tibial tendons, the posterior distal margin of the tibia, and the posterior process of the talus through the joint capsule.[3]

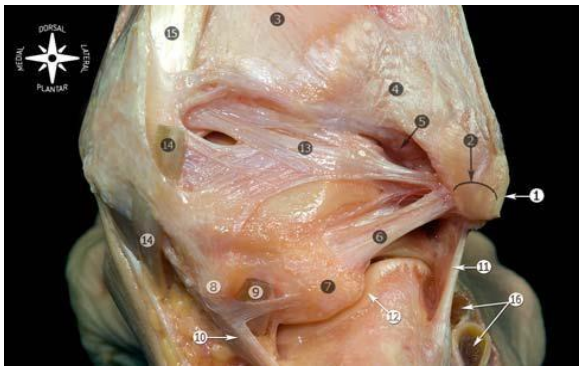


Fig6;Posterior view of the anatomic dissection of the ankle ligaments.
1 Tip of the fibula; 2 peroneal groove of the fibula; 3 tibia; 4 superficial component of the posterior tibiofibular ligament; 5 deep component of the posterior tibiofibular ligament or transverse ligament; 6 posterior calcaneofibular ligament; 7 lateral talar process; 8 medial talar process; 9 tunnel for flexor hallucis longus tendon;10 flexor hallucis longus retinaculum; 11 calcaneofibular ligament; 12 subtalar joint; 13 posterior intermalleolar ligament; 14 flexor digitorum longus tendon (cut); 15 tibialis posterior tendon; 16 peroneal tendons.

BIOMECHANICS OF THE ANKLE:

Motion of the foot and ankle

The key movement of the ankle joint complex are plantar- and dorsiflexion, occurring in the sagittal plane; ab-/adduction occurring in the transverse plane and inversion-eversion, occurring in the frontal plane Combinations of these motions across both the subtalar and tibiotalar joints create three-dimensional motions called supination and pronation. Both terms define the position of the plantar surface of the foot.

Axis of rotation of the ankle

Whilst many authors consider the tibiotalar joint to be a simple hinge joint, there has been some suggestion that it is multi-axial, due to the internal rotation that occurs during dorsiflexion, and the external rotation that occurs in plantarflexion. However, there is evidence to suggest the tibiotalar joint is indeed uniaxial, but the simultaneous motion observed occur as a result of its oblique axis.The axis of rotation of the ankle joint complex in the sagittal plane occurs around the line passing through the medial and lateral malleoli .
The coronal plane axis of rotation occurs around the intersecting point between the malleoli and the long axis of the tibia in the frontal plane. The transverse plane axis of rotation occurs around the long axis of the tibia intersecting the midline of foot.[4]

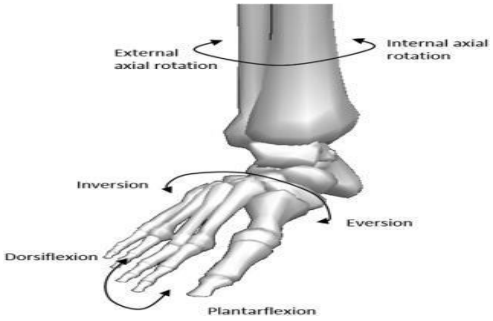


Fig7;biomechanic of ankle

Incidence:

The incidence is dependent on the type of sport, the total number of players and whether a competition is involved[5] In Dutch general practice there is an incidence of 12.8 ankle injuries per 1000 patients per year.[6] Most (85%) ankle injuries are sprains and only a small percentage are caused by ankle ligament rupture. These injuries originate from the weaker lateral ligaments in up to 85%, and only 3–5% are isolated deltoid ligament sprains. The high incidence of ligamentous ankle injuries requires clearly defined acute care and a broad knowledge of new methods in rehabilitation.[7]

AIMS AND OBJECTIVE OF THE STUDY

1. To evaluate the effectiveness of mulligan mobilization and therapeutic laser to improve pain and ROM in GRADE1 Ankle sprain.

Review Of Literature

Review of literature on anatomy & biomechanics of ankle sprain

Jay Hertel (2002) carried out the study to describe the functional anatomy of the ankle complex as it relates to lateral ankle instability and to describe the pathomechanics and pathophysiology of acute lateral ankle sprains and chronic ankle instability and concluded that Lateral ankle sprains are often inadequately treated, resulting in frequent recurrence of ankle sprains. Appreciation of the complex anatomy and mechanics of the ankle joint and the

pathomechanics and pathophysiology related to acute and chronic ankle instability is integral to the process of effectively evaluating and treating ankle injuries.

Pau Golano et al.(2010) written a review to understand the anatomy of the ankle ligaments is important for correct diagnosis and treatment. Ankle ligament injury is the most frequent cause of acute ankle pain. Chronic ankle pain often finds its cause in laxity of one of the ankle ligament. Concluded that The ankle sprain injury is the most frequently observed injury in the emergency room . Up to 40% of individuals with a history of an ankle ligament injury have been found to have residual complaints interfering with daily living. The aim of this pictorial review on the anatomy of the ankle ligaments is to provide a guide to those who are involved in diagnosing and treating ligament injury around the ankle.

Claire L Brockett et al.(2016) written a paper that provides an introduction to the biomechanics of the ankle introducing the bony anatomy involved in motion of the foot and ankle. The complexity of the ankle anatomy has a significant influence on the biomechanical performance of the joint, and this paper discusses the motions of the ankle joint complex, and the joints at which it is proposed they occur. It provides insight into the ligaments that are critical to the stability and function of the ankle joint. It describes the movements involved in a normal gait cycle concluded that the anatomy of the ankle joint complex determines that the biomechanics is not just that of a simple hinge joint but that of multi-axial motions occurring simultaneously to facilitate human gait. Simple factors such as gender and age can impact on the biomechanics of the ankle, and diseases such as arthritis can influence the range of motion and ankle power.

Ferreira DM et al (2016) conducted a study to investigate on the epidemiology of sprains in the lateral ankle. and foot. The study described the epidemiology of ankle and midfoot sprains and gives some guidelines or prophylaxis The aims of prophylaxis can be divided according to age.

Wolf Petersen,et,al.(2013) studied a systematic literature review of the last 10 years regarding evidence for the treatment and prevention of lateral ankle and study concluded that Balancing the advantages and disadvantages of surgical and non-surgical treatment we conclude that the majority of grades I, II and III lateral ankle ligament ruptures can be managed without surgery. The indication for surgical repair should be always made on an individual basis. This systematic review supports a phase adapted non-surgical treatment of acute ankle sprains with a short-term immobilization for grade III injuries followed by a semi-rigid brace. Types I and II injuries might best be treated with a semi-rigid brace. Neuromuscular training should support functional rehabilitation after ankle sprain.

Rogier M van Rijn et.al.(2006) evaluated the short- and long-term effectiveness of conventional treatment combined with supervised exercises compared with conventional treatment alone in patients with an acute ankle sprain and concluded that Conventional treatment combined with supervised exercises compared to conventional treatment alone during the first year after an acute lateral ankle sprain does not lead to differences in the occurrence of resprains or in subjective recovery.

B L Watts, B Armstrong (2001) compared functional outcome in patients with acute grade 1 or 2 (mild to moderate) lateral ankle sprains randomised to treatment with or without a double tubigrip bandage and concluded that Treatment of grade 1 and 2 ankle sprins with DTG does not seem to lead to a shorter time to functional recovery and may increase the requirement for analgesia.

Review of literature on low level laser therapy

Ferreira DM, Zângaro RA, (2005) study was carried out to evaluate the analgesic effect of the low level laser therapy (LLLT) with a He-Ne laser on acute inflammatory pain, verifying the contribution of the peripheral opioid receptors and the action of LLLT on the hyperalgesia produced by the release of hyperalgesic mediators of inflammation. All analgesic drugs have undesired effects. Because of that, other therapies are being investigated for treatment of the inflammatory pain and concluded that He-Ne LLLT inhibits the sensitization increase of nociceptors on the inflammatory process. The analgesic effect seems to involve hyperalgesic mediators instead of peripheral opioid receptors.

Jan Magnus Bjordal et al.(2006) The aim of this was to review the biological and clinical short-term effects of low-level laser therapy (LLLT) in acute pain from soft-tissue injury and concluded that there is strong evidence that LLLT modulates the

inflammatory process and relieves acute pain in the short-term. The evidence for a significant pain-relieving effect from LLLT is fairly consistent, although it is not possible to make robust estimates of the effect size for optimal doses of LLLT due to insufficient evidence. Nevertheless, we found that negative outcome trials used daily doses below 5 Joules, whereas trials reporting positive outcome used daily doses above 5 Joules.

Howard B Cotler.et al.(2015)studied the low level laser (light) therapy (LLLT) and LED (light emitting diode) therapy (also known as photobiomodulation) that has been shown to reduce inflammation and edema, induce analgesia, and promote healing in a range of musculoskeletal pathologies. The purpose of this paper is to review the use of LLLT for pain, the biochemical mechanisms of action and concluded that LLLT is beneficial for pain relief and can accelerate the body's ability to heal itself. LLLT has a long history and strong basic science evidence, which supports its use in pain management. It has few side effects and is well tolerated by the elderly. A laser or LED does not correct situations involving structural deficits or instabilities whether in bone or in soft tissue. Also, LLLT should only be used as an adjuvant therapy for pain relief in patients with neuropathic pain and neurologic deficits. Successful outcomes, like all medical management, depend on good clinical skills linked with an understanding of the nature of injury, inflammation, repair, pain, and the mechanism of laser.

Review of literature on mulligan's mobilization (mwm)

Wayne hing,et al.(2015) this book entitled the mulligan concept of manual therapy textbook of techniques presents over 106 mulligan concept and includes therapist techniques, home exercises and taping. The book is aimed at being comprehensive and easy toe follow resource for the experienced clinicians as well as researchers. There was a real need for the comprehensive presentation of the wide array of techniques under the umbrella of the mulligan concept. These techniques include MWM and other mulligan techniques.

Merlin Dj,Et.Al.(2005) study was conducted to verify if the antero-inferior displacement of the distal fibula or "positional fault" in ankle injuries can be confirmed using magnetic resonance imaging and this study has shown that there was a movement of the tip of the fibula in comparison to the surface marker on the sole of the foot in a cephalad direction. This falls in line with the MWM technique performed.

Bill Vicenzino,et,al.(2006) conducted a study to evaluate the initial effect of 2 mobilization with movement (MWM) treatment techniques performed in weight bearing and non-weight bearing on posterior talar glide and talocrural dorsiflexion in individuals with recurrent lateral ankle sprain,and concluded that this technique should be considered in rehabilitation programs following lateral ankle sprain. This study provides justification for follow-up research of the long-term effects of MWM on lateral ankle sprain.

Review of literature on conventional treatment of ankle sprain

Anton G.et,al.(2005) studied on conventional treatment is advocated as a preferable treatment strategy. Whether supervised exercises should complement conventional treatment and concluded that the best available evidence for the use of applying supervised rehabilitation training in the management of acute sprains of the lateral ankle ligaments in adolescents and adults. There is limited evidence available from RCTs that conventional treatment combined with supervised rehabilitation training may be superior to conventional treatment alone as a treatment for acute injuries of the lateral ligament complex of the ankle.

Capt Maria et al. (2001) study was conducted to investigate the relationships among figure of eight girth measurements and functional level in patients with acute lateral ankle sprains to determine the appropriate use of these clinical measures. Concluded that The figure-of eight method is highly reliable and is appropriate for measuring ankle swelling however, it does not correlate with functional level as determined by the modified AOS, FAAI, or observed weightbearing status during gait. Therefore, clinicians should refrain from making assumptions about function based on ankle swelling.

Gary B.et al.(1993) conducted the study for restoration of function following a grade I1 inversion sprain was compared among 34 subjects who received one of three methods of treatment, each of which incorporated an Air-Stirrup brace. The results of this study indicate that focal compression appears beneficial, but increased

frequency and duration of cryotherapy does not appear to enhance the rate of recovery following an inversion ankle sprain.

Review of literature on numeric pain rating scale (NPRS)

Maria Alexandra Ferreira-Valente et al. (2011) the study compared the relative validity of VAS, NRS, VRS, and FPS-R for detecting differences in painful stimulus intensity and differences between men and women in response to experimentally induced pain. The result showed that the order of responsivity was as follows: NRS, VAS, VRS, and FPS-R. The most support emerged for the NRS as being both (1) most responsive and (2) able to detect sex differences in pain intensity.

Roberta H. Mawdsley et al. (2003) the purpose of the study was to determine the test – retest reliability of a 0 to 10 numeric pain rating scale (NPRS) and a 0 to 10 cm visual analog scale (VAS) when assessing pain intensity of elderly patients. The study concluded that NPRS can be used reliably with patients who experience pain from a musculoskeletal disorder.

Review of literature on universal goniometer:

Keith Rome (1996) A spectrum of techniques exists to measure ankle joint dorsiflexion range of motion. This author reviewed the sources of measurement inaccuracies within the clinical setting and describes effective interventions used to reduce measurement error.

Methodology

Study Design

Pre to post-test experimental study design with two groups- Study group and Control group.

Sample Design

Convenience Sampling Subjects included for the study and were randomly divided into two groups.

Study Population

Patients with grade1 ankle sprain

Sample Size

The study was carried on total 40 subjects. 20 subjects were taken in study group and 20 subjects in control group.

Study Setting

Study was carried out at NAVODAYA HOSPITAL ,RAICHUR.

Study Duration

Subjects participated in 4 weeks.

Sample Selection

Inclusion Criteria:

- Diagnosed Grade 1 ankle sprain
- Restricted ROM at the ankle
- Both male and female subjects
- Mild to moderate severity of pain measured by NPRS scale
- Age group between 25 and 40 years

Exclusion Criteria:

- Inflammation arthritis
- Fracture ankle
- Neural injuries ankle
- Acute foot trauma occurring 7 day of injury
- Positive Anterior Drawer or inversion stress manoeuvre suggesting ligamentous laxity.
- Medial ankle instability.
- In ability to weight bear through the affected extremity immediately after surgery.

Materials used:

1. couch
2. Goniometer
3. Mulligan belt
4. Therapeutic laser modality

Photograph no.1;goniometer,pen,mulligan belt

Photograph no.2;therapeutic laser modality

Procedure Ethical Approval

As the study includes human subjects ethical clearance is obtained from ethical committee of NAVODAYA College of physiotherapy and NAVODAYA Hospital, RAICHUR under RAJIVGANDHI UNIVERSITY OF HEALTH SCIENCES.

Procedure:

A total number of 40 subjects diagnosed with ankle sprain.fulfilling the inclusion and exclusion criteria The subjects were randomly allocated into two groups of 20 each. 40 of papers were used, in 20 papers written with the letter "A" to identify the subjects to take into control group and other 20 with the letter "B" to identify the subjects to take into experimental group. All the 40 pieces of paper were tightly folded and placed in a box. After shaking the box, each subject was asked to withdraw a paper. 20 subjects with letter "A" were enlisted under Study control group and the other 20 subjects with letter "B" were in experimental group.

Outcome Measurements

The Numeric Pain Rating Scale (Nprs):

A variety of pain scales are used by physical therapist often favoured over other scales because of their ease and administration and time efficiency. NPRS measures the magnitude or intensity of pain or pain relief.[8]
The NPRS is an 11-point scale consisting of integers from 0 through 10; 0 representing ''no pain'' and 10 representing ''worst imaginable pain.'' respondents select the single number that best represents their pain intensity.[8]

Universal Goniometer:

The choice instrument should be related to the needs of the clinician. The choice of instrument depends on costs, availability, and time. To most clinicians, the universal goniometer remains the most versatile and widely used instrument.
The use of a standardized or stipulated protocol to measure ankle dorsiflexion in a clinical setting:
One possible approach is to standardize the bony and soft tissue locations together with subject position. Consistency of positioning requires independent location identification. Based on previous literature, a standard position can be obtained using the following bony and soft tissue locations: the most prominent part of the left fibula head; the midpoint of the lateral malleolus, parallel to the fibula; the prominent part of the fifth metatarsal head; and the projected part of the heel. The projected point of the heel can be defined as "the most inferior point on the lateral aspect of the foot, projected from the head of the fibula to the lateral malleolus." [9]

Group A: CONVENTIONAL THERAPY CONTROL GROUP INCLUDED (PRICE)

Protection ,Rest, Ice Application, Compression and Elevation.

Rest:

Rest is required to reduce the metabolic demands of the injured tissue and thus avoid increased blood flow. It also is needed to avoid stress on the injured tissues that might disrupt the fragile fibrin bond, which is the first element of the repair process. Rest can be applied selectively to allow some general activity, but the patient must avoid any activity that induces stress or strain to the injured area and thus can compromise the healing process.[10]

Compression

The ankle was positioned in *0″* dorsiflexion. The tape measure was wrapped around the ankle in a figure-of eight pattern. The goal of compression is to stop hemorrhage and reduce swelling. Compression is applied to limit the amount of edema caused by the exudation of fluid from the damaged capillaries into the tissue.[10`]

Cryotherapy

Cryotherapy (the application of ice for therapeutic purposes) is a common treatment modality employed in the management of acute soft tissue injuries. In the acute inflammatory phase after soft tissue injury, cryotherapy is thought to decrease oedema formation via induced vasoconstriction, and reduce secondary inflammation to produce a similar analgesic effect, thus facilitating earlier and more aggressive therapeutic exercise after muscle injury Evidence from a large-scale systematic review suggested that intermittent ice applications of 10 minutes are most effective at reducing tissue temperature in both injured animal and healthy human modelshypoxic damage by lowering the metabolic demand of injured tissues . Cooling skin surface temperature to below approximately 15°C is also thought to exert a localised analgesic effect by inhibiting nerve conduction velocity . Short periods of ice application have been used during the later phase[11]

Elevation.

Elevation of the injured part lowers the pressure in local blood vessels and helps to limit the bleeding. It also increases drainage of the inflammatory exudate through the lymph vessels, reducing and limiting edema and its resultant complications.[10]

Mulligan's

mobilization with movement (MWM) technique:

Patient position:

participant in a relax stand on couch.
Therapist hand position:
Therapist stabilized talus below the joint line with one hand,which is reinforced by the other hand .Alternatively, one hand was used over the knee to guide the speed and movement of the patient .

Mobilization:

- Therapist pull tibia and fibula anteriorly pulling the belt ,and thereby giving posterior glide to the fixed talus and foot relatively .
- Patient lunges forward over his fixed foot to achive dorsiflexion.
- Therapist sustains the glide by bending down along with offending movement to sustain the glide .[12]
- Number of glides:10 repetition/3 session
- 4session /week with 1minute between session .

Laser Therapy13,14,15:

The participant was given laser therapy for 8 minutes per session and 4 session per week for 2 weeks.
Position of the participants
spine lying or long sitting position with lower leg out of the plinth intensity was of 10watts in continuous mode was given .
Light beam is targeted on the sprained ankle for 8 minutes.

Discussion

In the present study an experimental study design of 40 subjects with scapular grade 1 ankle sprain were randomized into two groups: Group A (n=20) and Group B (n=20). Subjects in group A conventional therapy PRICE and Subjects in Group B received therapeutic laser and mulligan mobilization with movement for 4weeks of period .The base line data was obtained to check for grade1 ankle sprain with reference to pain and functional status, Outcome measurements of universal goniometer and NPRS was taken for each subject of the group's pre and post Study.
However significant improvement was found within the group for all variables except for ROM. Individuals with grade 1 ankle sprain in our study were found to have problems in activity and function of the lower extremity. 'Ankle sprain' refers to diverse morphological and pathological conditions that range from ligamentous overstretching to complete rupture with joint instability. Depending on the nature of severity, the scheme of ankle sprains falls into three grades. Classification helps in identifying the damage level and correct treatment.[16] Strength deficit is also evidenced in acute ankle sprain. Muscle weakness responsible for the eversion and pronation of the ankle complex contributes to functional instability in the lateral ankle sprain. Lateral ankle sprain can possibly be followed by reduced dorsiflexion which is part of overall functional instability.[16]
Group A received PRICE, and it was found to have significant improvement in pain reduction (NPRS) In studies conducted by Chris M Bleakley stated a randomised controlled trial. 120 subjects with an acute grade I or grade II ankle. Subjects will be randomized under strict double-blind conditions to either a standard cryotherapy (intermittent ice applications with compression) or cryokinetic treatment group (intermittent ice applications with compression and therapeutic exercise) Standard treatment (Group I) will consist of intermittent ice and compression only. Subjects will receive a 10

minute ice application. The ice pack will then be removed for 10 minutes before a further 10 minute ice application. This will then be followed by a further 10 minutes of rest (10 minutes ice/10 minutes rest/10 minutes ice/10 minutes rest). More intensive initial treatment and advice on potential complications may help to reduce the incidence and associated costs of long-term symptoms after an initial sprain. Intermittent, ten minute periods of ice application and therapeutic exercise in the early stages after injury may represent a simple and cost effective intervention for both athletic and non-athletic populations.[10,11]

Group B received Laser Therapy + Mulligan Mobilization

Low-Level Laser Therapy (LLLT) is thought to have an analgesic effect as well as a biomodulatory effect on microcirculation. Heged Sb, designed study to examine the painrelieving effect of LLLT and possible microcirculatory changes measured by thermography. Results show that LLLT reduces pain and improves microcirculation in the irradiated area.[17] Mulligan mobilization here helps to reduce pain, improve joint range of motion, helps in normal weight bearing and facilitates gait.

The result of present study accepted the Alternate hypothesis i.e. there is a significant difference between PRICE and LASER therapy + Mulligan Mobilization . The result of the current study showed significant improvement between the groups for pre and post values.

In the present study, PRICE and mulligan mobilization + laser therapy are compared to evaluate the effectiveness on grade 1 ankle sprain.

Statistical analysis presented Group B showing significant difference and better improvement than Group A for grade1 ankle sprain, and this could be due to combination of laser therapy along with mulligan mobilization. There was significant reduction in pain in Group B according to NPRS ranging from 0-4 with mean of 4.00 and post treatment it reduced to range of 0-1 and mean of 0.80. Pre test scores of Group A ranges from 0-4 with mean of 4.25 and post treatment it reduces to 0-4 with mean of 2.1This that shows that there is a statistically significant decrease in means of NPRS and signifies better improvement in pain reduction in Group B.

There was a significant reduction seen in functional ROM where in Group B Planter flexion AROM ranges from 0-40 with a mean of 38.50 and reduced to 0-50with a mean of 42.62 where as in Group A ranges from 0-40 with a mean of 35.75 and reduces to 0-40 with a mean of 39. This shows that there is a statistically significant reduction in means of Planter flexion AROM.

There was a significant reduction seen in functional ROM where in Group B Planter flexion PROM ranges from 0-40 with a mean of 38.15 and reduced to 0-50 with a mean of 42.65 where as in Group A ranges from 0-40 with a mean of 37.85 and reduces to 0-50 with a mean of 41.35. This shows that there is a statistically significant reduction in means of Planter flexion PROM.

There was a significant reduction seen in functional ROM where in Group B Dorsiflexion AROM ranges from 0-20 with a mean of 15.10 and reduced to 0-20 with a mean of 17.30 where as in Group A ranges from 0-20 with a mean of 12.10 and reduces to 0-20 with a mean of 16.65. This shows that there is a statistically significant reduction in means of Dorsiflexion AROM.

There was a significant reduction seen in functional ROM where in Group B Dorsiflexion PROM ranges from 0-40 with a mean of 38.15 and reduced to 0-20 with a mean of 17.30 where as in Group A ranges from 0-20 with a mean of 14.30 and reduces to 0-20 with a mean of 15.10. This shows that there is a statistically significant reduction in means of Dorsiflexion PROM.

This signifies that there is significant improvement in the pain reduction but ROM seems to be not that much significantly effective. This may be due to sampling error, i.e smaller sample size.

Our study is in agreement with the results seen in above mentioned studies. The protocol followed in Group B further supports that incorporating laser therapy + mulligan mobilization in the treatment will aid in improving the grade 1 ankle sprain.

Group B received laser therapy + mulligan mobilization and it was found to have significant improvement in pain reduction (NPRS) but no significant effect was seen in ROM in both the groups.

Both the groups showed statistically significant improvement within the groups, but not between the groups, this could be because of short duration of present study 4 session per week for 4 weeks. Group B showed significant and better improvement than group A for NPRS and GONIOMETRY, this could be due to combining of laser therapy + mulligan mobilization as a part of treatment.

Results of the present studies demonstrates that laser therapy + mulligan mobilization are effective in treatment of grade 1 ankle sprain in pain reduction but less effective in ROM.

Limitations Of The Study

- Male and female subjects are taken together under the same conditions.
- Small sample size; making it difficult to generalize the effects of laser and mulligan mobilization for group B respectively
- The treatment plan used in this study was for 4 weeks, which is a relatively short amount of time, and therefore, the results of this study could not determine the longterm effects of the treatment.
- Findings are based on only GONIOMETRY and NPRS only, other variables too can be studied.
- Weight of the patient and occupation of patient does matter in community rehab.
- Pain scale of NPRS didn't have a range bracket.
- More treatment strategies could have been in Study and Control Groups.

CONCLUSION

The present study concludes that low level laser therapy + mulligan mobilization with movement and PRICE protocol both were effective in reducing grade 1 ankle sprain. Both improved the range of motion and reduced pain. Addition of laser and mulligan showed slightly better improvement in the ankle sprain. It is recommended clinically to consider adding both for treatment for patients with grade 1 ankle sprain.

Reccomendation For Future Research

- Further study can be done to know the long term effect of laser therapy with large sample size with different severity and duration of ankle sprain.
- Further study can be done to know the long term effect of mulligan mobilization with movement with large sample size with different severity and duration of ankle sprain.
- Further studies can be done on effect of laser therapy with other conventional methods of treatment are need on different ligament sprains.
- Further studies can be done on effect of mulligan mobilization with mobilization with other conventional methods of treatment are need on different ligament sprains.
- Further study can be done measuring effect on other outcome measures. Further randomized controlled trial is needed to find long term effects of laser therapy and/or mulligan mobilization with movement.
- Follow up after 4 weeks of intervention can be used to find further effectiveness of the techniques on subjects with grade 1 ankle sprain.
- Further study can be done on subjects with specific pathology of ankle joint and its type and stages.
- Further study can be done keeping the male and female subjects constant respectively under study.
- Multimodal approach could have been used.

Summary

An experimental study design of 40 subjects with nonspecific neck pain were randomized into two groups: Group A (n=20) and Group B (n=20). Subjects in Group A received PRICE PROTOCOL and Subjects in Group B received Laser therapy, mulligan mobilization for a period of 4 weeks. The base line data was obtained to check for grade 1 ankle sprain with reference to pain and range of motion. Outcome measurements of UNIVERSAL GONIOMETER and NPRS was taken for each subject of the group's pre and post Study.

The mean values of outcome measures were analyzed within both the group and between both the groups via paired t test as test of statistics. The outcome measure UNIVERSAL GONIOMETER and NPRS were found to be statistically significant in both the groups, with Group B showing better difference than Group A. Between group comparison were significant in terms of GONIOMETRY and NPRS.

Hence based on above results of the present study it can be concluded that both groups showed significant improvement in treating grade 1 ankle sprain, improving the range of motionand reducing pain wheareas Group B(laser therapy + mulligan mobilization) showed better improvement when compared to Group A(PRICE protocol) in improving the range of motion and reduction in pain.

Results

Flow chart outlining progress throughout the trial

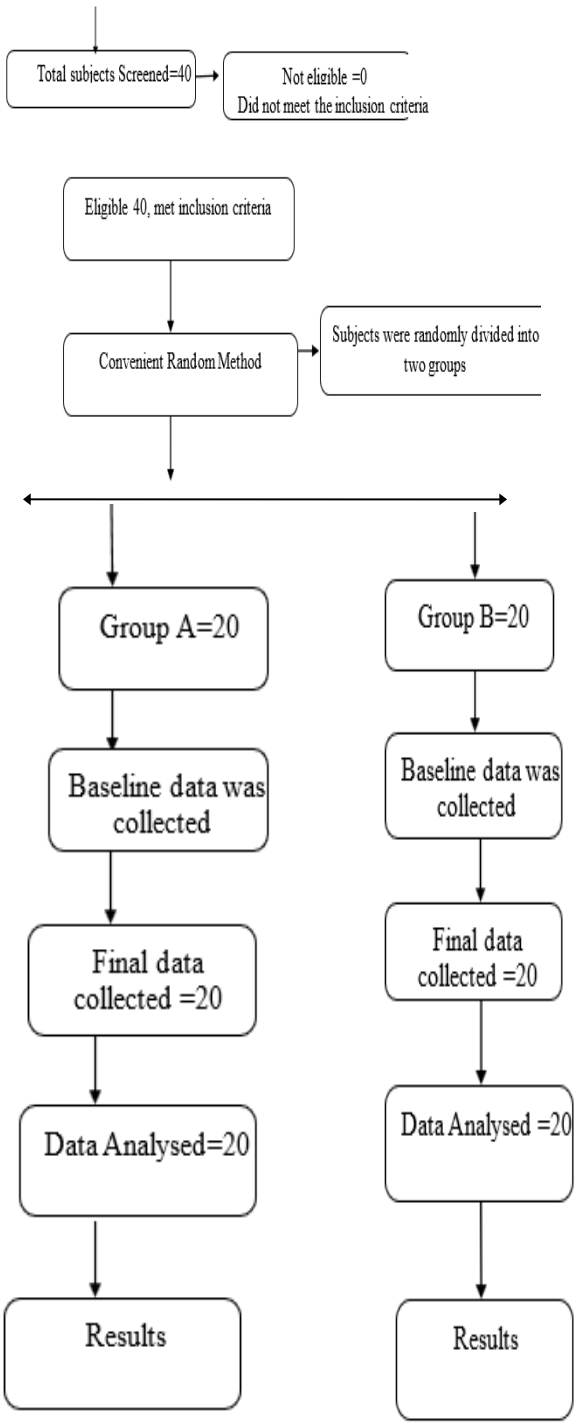
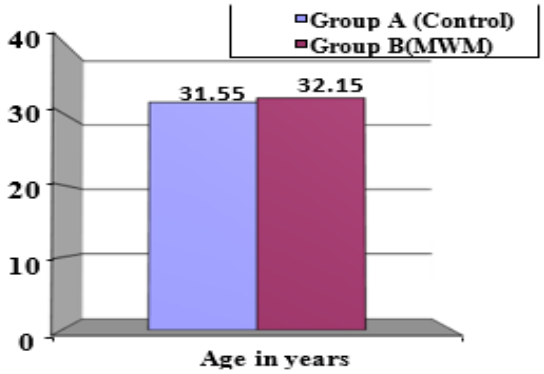

Total subjects Screened=40
Not eligible =0
Did not meet the inclusion criteria
Eligible 40, met inclusion criteria
Convenient Random Method
Subjects were randomly divided into two groups
Group A=20
Group B=20
Baseline data was collected
Baseline data was collected
Final data collected =20
Final data collected =20
Data Analysed=20
Data Analysed =20
Results
Results

Table 1: Basic Characteristics of the subjects studied

Basic Characteristics of the subjects d studied		Group A (Control)	Group B (MWM)	Between the groups Significance
Number of subjects studied (n)		20	30	--
Age in years (Mean± SD)		31.55±4.32 (26-40)	32.15±4.96 (25-43)	p=0.236 (NS)
Affected Side	Right	10	10	--
	Left	10	10	
Gender	Male	09	12	--
	Female	11	08	

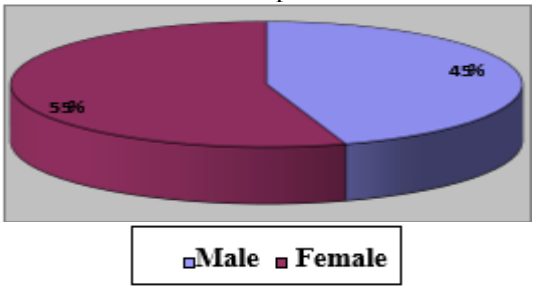
The above table shows that in Group 1(Control) there were 20 subjects with mean age 31.55 years and out of them 9 were females and 10 were males, 10 were right affected side and 10 were left affected side, included in the study. In Group 2 (MWM) there were 20 subjects with mean age 32.15 years and out of them12 were males and 08 were females, 10 were right affected side and 10 were left affected side, included in the study. There was no significant difference in mean age when compared between the groups.

Graph 1a: Age Distribution of the subjects studied



The above graph shows that in Group A there were 20 subjects with mean age 31.55 years and in Group B there were 20 subjects with mean age 32.15 years included in the study. There is no significant difference in mean ages between the groups.

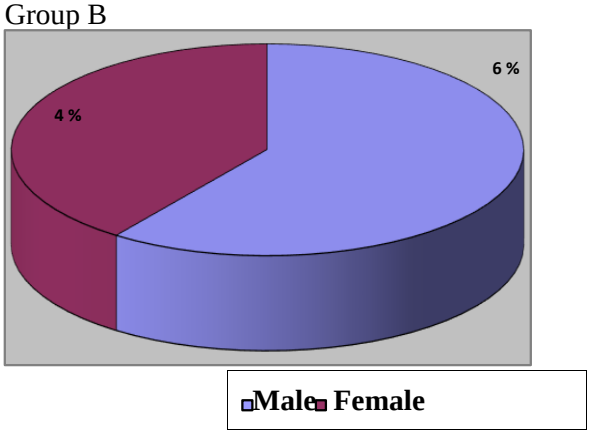
Graph 1b: Gender distribution of the subjects in Group A



Graph-(pre to post-test)

The above graph shows that 45% of males and 55% of females subjects were studied in Control Group.

Graph 1c: Gender distribution of the subjects in Group B



The above graph shows that 60% of females and 40% of males subjects were studied in mwm Group.

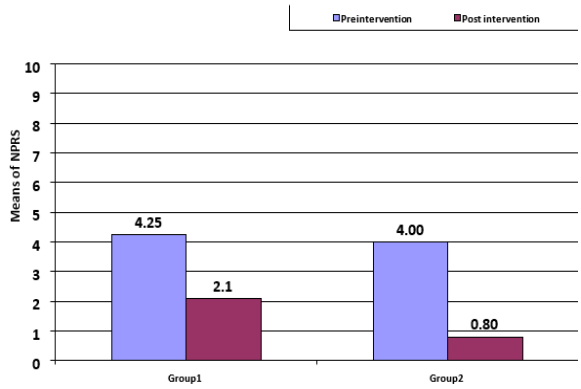
Table 2: Analysis of NPRS and ROM within Group A and Group B (Pre to post test analysis)

	Pre intervention (Mean±SD) min-max	Post intervention (Mean±SD) min-max	Percentage of change	Z value[b] (Non parametric significance)	T value a (Parametric) Parametric Significance P value	95%Confidence interval of the difference		Effect Size (r)
						Lower	Upper	
Group A								
NPRS	4.25±0.85	2.1±0.96	**-50.59%**	3.985 P=0.000**	12.903 P =0.000**	1.801	2.498	0.764
PF AROM	35.75±5.12	39±4.51	**9.09%**	-3.851 P =0.000**	-6.219 p=0.001**	-4.343	-2.156	-0.319
PF PROM	37.85±5.16	41.35±4.76	**9.25%**	3.938 P =0.000**	-10.293 P=0.000**	-4.266	-2.733	-0.332
DF AROM	12.1±2.02	16.65±1.89	**37.60%**	3.970 P =0.000**	-12.183 p=0.000**	-5.086	-4.013	-0.758
DF PROM	14.3±2.34	18.3±1.68	**27.97%**	3.957 P =0.000**	-14.063 P=0.000**	-5.0863	-4.0136	-0.700
Group B								
NPRS	4±0.20	0.8±0.17	-80%	3.949 P=0.000**	11.960 P=0.000**	2.640	3.759	0.993
PF AROM	38.15±3.82	42.65±3.32	11.79%	3.972 P=0.000**	**-19.142 P=0.000****	-4.992	-4.007	-0.532
PF PROM	40.50±3.48	44.85±3.01	10.74%	3.969 P =0.000**	-13.657 p=0.000**	-5.016	-3.683	-0.555
DF AROM	15.10±2.46	17.30±1.65	14.57%	3.958 P =0.000**	-8.903 P=0.000**	-2.717	-1.682	-0.462
DF PROM	16.40±2.28	18.65±0.50	13.72%	3.939 P=0.000**	**-8.643 P=0.000****	-2.794	-1.705	-0.563

** Statistically Significant difference p<0.05; NS- Not significant; a. Pared t test. b. Wilcoxon Signed Ranks Test

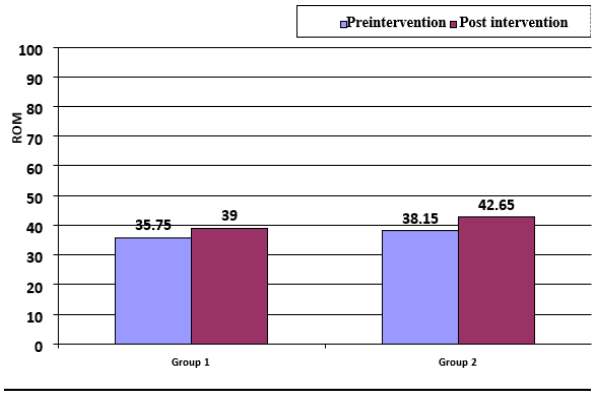
The above table shows that in Group 1 and Group 2 there is a statistically significant change in means of NPRS and PF AROM, PF PROM, DF AROM, DF PROM when means were analysed from pre intervention to post intervention within the group with $p<0.05$ with positive percentage of change showing that there is increase in the post means and negative percentage of change showing that there is decrease in post means of Control and MWM Groups.

Graph-2a: Analysis of NPRS test within Group A and Group B (Pre to post test analysis)



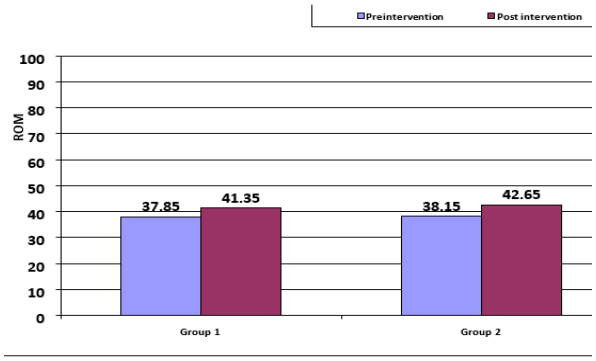
The above graph shows that there is a statistically significant decrease in means of NPRS when analysed from pre intervention to post intervention within Group A and Group B.

Graph-2b: Analysis of PF AR0M within Group A and Group B (Pre to post test analysis)



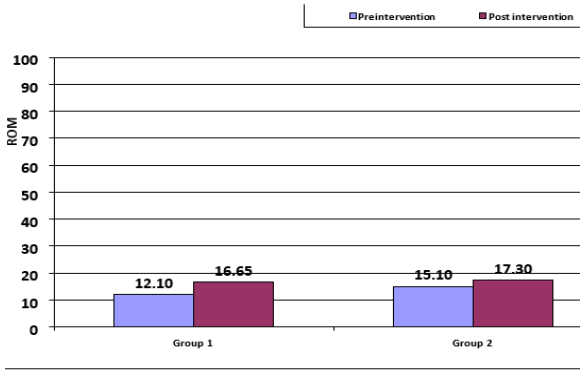
The above graph shows that there is a statistically significant reduction in means PF AROMscores when analyzed from pre intervention to post intervention within Group A and Group B.

2c: Analysis of PF PR0M within Group A and Group B analysis)



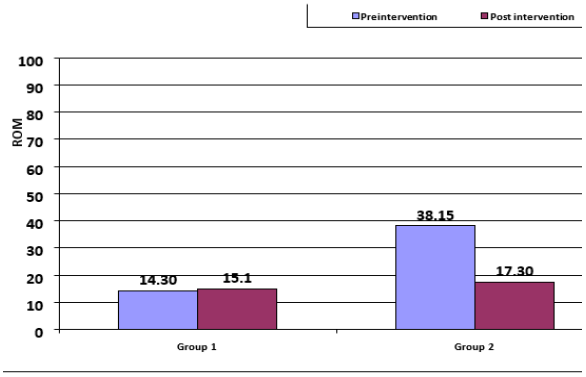
The above graph shows that there is a statistically significant reduction in means PF AROM scores when analyzed from pre intervention to post intervention within Group A and Group B.

2d: Analysis of DF AR0M within Group A and Group B analysis)



The above graph shows that there is a statistically significant reduction in means DF AROM scores when analyzed from pre intervention to post intervention within Group A and Group B.

2e: Analysis of DF PR0M within Group A and Group B analysis)



The above graph shows that there is a statistically significant reduction in means DF PROM scores when analyzed from pre intervention to post intervention within Group A and Group B.

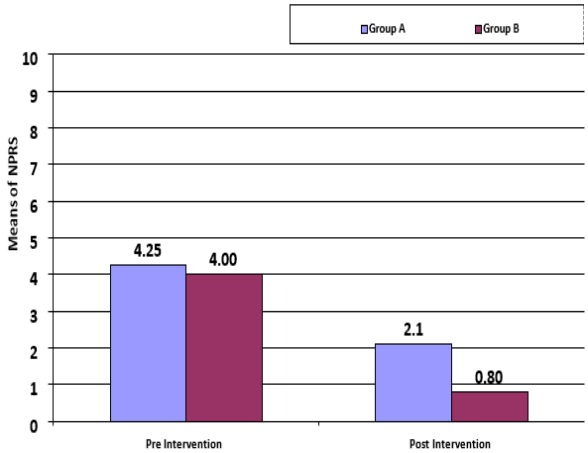
Table 3: Analysis of NPRS and ROM Between Group A and Group B (Pre and post test comparative analysis)

	Group 1 (Mean± SD) min-max	Group 2 (Mean± SD) min-max	Percentage of change	Z value " (Non parametric significance)	t value ' (Parametric) Parametric Significance P value	95%Confidence interval of the difference Lower	Upper	Effect Size (r)
Pre intervention								
NPRS	4.25±0.85	4±0.25	-5.88%	0.864 p=0.387 (NS)	0.8935 P =0 .377 (NS)	-0.316	0.816	0.195
PF AROM	35.75±5.12	38.15±3.82	6.71%	-1.522 p=0.127(NS)	-1.670 P =0 .800 (NS)	-5.297	0.497	-0.256
PF PROM	37.85±5.16	40.50±3.48	7.00%	-1.769 p=0.076 (NS)	-1.902 p=0.065 (NS)	-5.470	0.170	-0.288
DF AROM	12.10±2.02	15.10±2.46	24.79%	-3.613 p=0.000**	-4.203 p=0.000**	-4.444	-1.555	-0.554
DF PROM	14.3±2.34	16.40±2.28	14.68%	-2.699 p=0.006**	-2.873 p=0.006**	-3.579	-0.620	-0.413
Post intervention								
NPRS	2.1±0.96	0.8±0.17	-61.90%	3.832 p=0.000**	2.024 p=0.000**	0.740	1.859	0.686
PF AROM	39±4.51	42.65±3.32	9.36%	-2.551 p=0.010**	-2.908 p=0.006**	-6.190	-1.101	-0.419
PF PROM	41.35±4.76	44.85±3.01	8.46%	-2.498 p=0.012**	-2.778 p=0.008**	-6.050	-0.949	-0.402
DF AROM	16.65±1.89	17.30±1.65	3.90%	-1.072 p=0.283(NS)	-1.153 p=0.256(NS)	-1.791	0.491	-0180
DF PROM	18.3±1.68	18.65±0.50	1.92%	0.342 p=0.731 (NS)	2.024 p=0.473 (NS)	-1.328	0.628	-0.139

** Statistically Significant difference p<0.05; NS-Not significant; a. Independent t test.b. Mann Whitney U Test

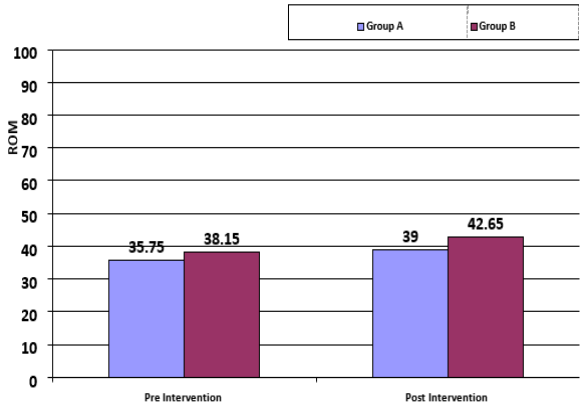
The above table shows that, when pre-intervention means were compared between the Group 1 and Group 2 there is no statistically significant difference in means of NPRS, PF AROM and PF PROM and significant difference was seen in means of DF AROM and DF PROM. When post-intervention means were compared between the Group1 and Group 2 there is highly statistically significant difference in means of NPRS PF AROM and PF PROM with larger effect size and larger percentage of change and no significant difference was seen in means of DF AROM and DF PROM.

Graph-3a: Comparison of NPRS between Group A and Group B.



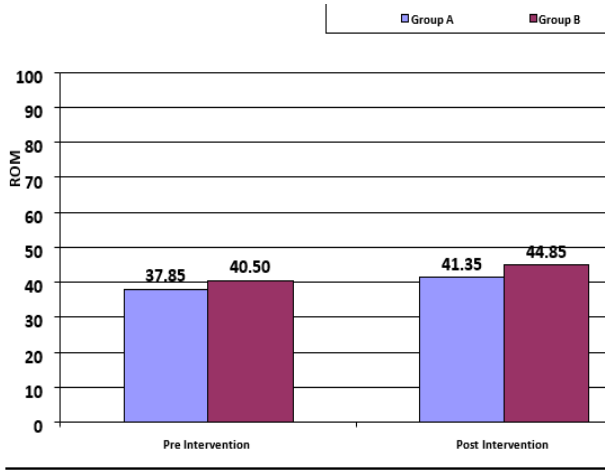
The above graph shows that when pre-intervention means were compared between the groups there is no statistically significant difference in means of NPRS, when means of post intervention were compared between the groups there is a significant difference in means of NPRS between the groups.

Graph-3b: Comparison of PF AROM between Group A and Group B.



The above graph shows that when pre-intervention means were compared between the groups there is no statistically significant difference in means of PF AROM, when means of post intervention were compared between the groups there is a significant difference in means of PF AROM between the groups.

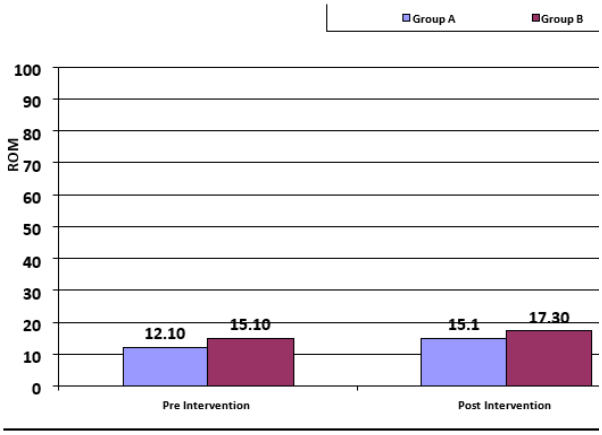
Graph-3c: Comparison of PF PROM between Group A and Group B.



The above graph shows that when pre-intervention means were compared between the groups there is no statistically significant difference in means of PF PROM, when means of post intervention were compared between the groups there is a significant

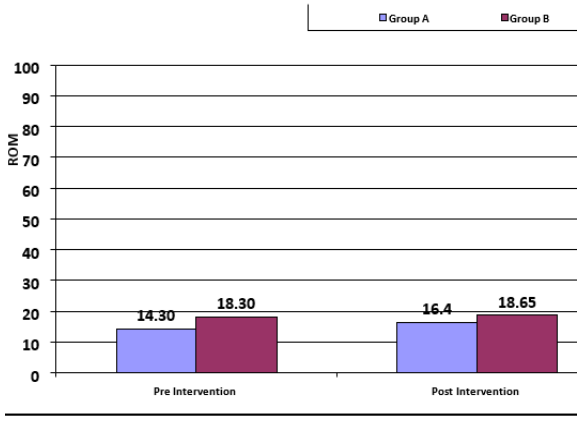
difference in means of PF PROM between the groups.

Graph-3c: Comparison of DF AROM between Group A and Group B.



The above graph shows that when pre-intervention means were compared between the groups there is statistically significant difference in means of DF AROM, when means of post intervention were compared between the groups there is a no significant difference in means of DF AROM between the groups.

Graph-3d: Comparison of DF AROM between Group A and Group B.



The above graph shows that when pre-intervention means were compared between the groups there is statistically significant difference in means of DF PROM, when means of post intervention were compared between the groups there is a no significant difference in means of DF PROM between the groups.

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