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A comparative study of Maitland's mobilization along with ultrasound versus proprioceptive exercises along with ultrasound in stage ii and iii osteoarthritis of knee joint

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Abstract
Background and Objectives: Osteoarthritis is a leading cause of pain and disability in elder people worldwide and accounts for a large proportion of visits to health professionals each year. There occurs progressive destruction of articular cartilage and function of osteophytes. It usually affects people in the age group of 45 years or above and tends to worsen with age if not well treated. The treatment of knee Osteoarthritis is mainly aimed at alleviation of pain. Pain and functional impairment is the major feature of OA. The objective of this study is to compare the effectiveness between Maitland's mobilization with ultrasound and Proprioceptive exercises with ultrasound, to reduce pain (VAS) and improve functional ability (WOMAC) in OA knee.
Methods: Subjects were screened as per inclusion and exclusion criteria with knee OA. A written informed consent was signed by the subject and was rehabilitated for alternate days for 2 weeks. These subjects were randomly divided in two groups. GROUP A: (n=10): Treated with ultrasound and Maitland's mobilization. GROUP B: (n=10): Treated with ultrasound and Proprioceptive exercise program.
Results: In comparison with VAS-pain and WOMAC-pain, stiffness and difficulty scores, Group A shows significant improvement of all the parameters than Group B. Group A with VAS of pre intervention score being 8 and post intervention 2.5. Group B with VAS of pre intervention score being 5.7 and post intervention 3.6. Group A with WOMAC pain, stiffness and difficulty of pre intervention being 8.6, 3.1and 32.1 respectively and post intervention 3.7, 1.5and 11.3. Group B with WOMAC pain, stiffness and difficulty of pre intervention being 13.4, 4.6 and 41.9 respectively and post intervention 6.5, 2.2 and 21.7.
Conclusion: Following the intervention, at the end of 2nd week result showed clinically and statistically improvement in the VAS and WOMAC scores in Group A compared to Group B. Therefore, it signifies that the subject can be improve after combined treatment of Maitland's mobilization with ultrasound.

Keywords: Knee joint, Maitland's mobilization, proprioceptive exercises, ultrasound and osteoarthritis

Introduction
The Subcommittee on Osteoarthritis of the American College of Rheumatology Diagnostic and Therapeutic Criteria Committee defined osteoarthritis (OA) as "A heterogeneous group of conditions that lead to joint symptoms and signs which are associated with defective integrity of articular cartilage, in addition to related changes in the underlying bone at the joint margins" [1]. Clinically, the condition is characterized by joint pain, tenderness, limitation of movement, crepitus, occasional effusion, and variable degrees of local inflammation.Osteoarthritis commonly affects middle age to elderly population. It is the most common disease of arthritis and can occur together with other types of arthritis.

Knee Osteoarthritis
Knee osteoarthritis (OA) is characterized by pain, articular cartilage deterioration, joint space narrowing and reduced muscle strength. [2] Loss of leg muscular strength is associated with increased pain and disability, as well as a more rapid progression of knee OA. Aberrant biomechanics and abnormal joint forces have also been identified as potential culprits

underlying OA onset and progression.[3,4] Some evidence indicates that abnormal motion at the knee often precedes degenerative changes [5] with decreased tibiofemoral rotation as a mechanism contributing to the development of cartilage degradation. Increased ligament stiffness, decreased muscle strength, and alterations in muscle activation patterns are associated with aging and can adversely affect joint kinetics.

APTA's Guide to Physical Therapist Practice has defined mobilization/manipulation as "a manual therapy technique comprised of a continuum of skilled passive movements that are applied at varying speeds and amplitudes, including a small amplitude/ high velocity therapeutic movement" [6]

The intensity of mobilization is commonly categorized based on a 5-grade classification system defined by Maitland [7, 8] According to Maitland's classification, Grade I and Grade II joint mobilizations are performed primarily to decrease joint pain and Grade III and Grade IV joint mobilizations are performed to increase joint ROM [7]. Joint mobilization which involves low-velocity passive movements within or at the limit of joint range of motion reduces pain by modulating the nervous tissues and increases joint motion [7,9] Restricted joint mobility, especially in terms of knee flexion, appears to be an important determinant of disability in patients with osteoarthritis [10, 11]. Maitland mobilization has been found to be effective in reducing pain and improving ROM in knee OA subjects.

Proprioception is the perception issued from the central processing of information coming from Proprioceptive receptors and motor cortical areas [12]. Deformation or stimulation of the tissues in which the mechanoreceptors lie produces gated release of sodium, which elicits an action potential [13]. One of the common symptoms and signs of knee OA is impaired proprioception [14].

Knee proprioception derives from the integration of afferent signals from Proprioceptive receptors in different structures of the knee and is also influenced by signals from outside the knee (e.g., from the vestibular organs, visual system, and cutaneous and Proprioceptive receptors from other body parts). Muscle spindles are thought to be the most important Proprioceptive receptors of the knee [15]. Knee proprioception serves to protect against injurious movement and it is critical to the maintenance of joint stability [16]. It is also important for normal joint coordination during movement [17]. This exercise is based on the notion that when a patient performs balance-keeping exercises on unstable surfaces, proprioception responses occur first among those generated by the somatic senses.These responses allow compensatory adjustments in the lengths of various muscles, their tension levels, and the position of the joints to facilitate joint movements [18]. Proprioceptive training improves knee functions in OA patients, and quadriceps muscle strengthening is known to mitigate the symptoms of knee OA and improve knee function [19].

Ultrasound (US) treatment has been used as a non-invasive modality for the management of OA for more than 60 years because of its reputed ability to relieve pain [20], reduce edema, increase the range of motion, and accelerate tissue repair [21] via thermal and non-thermal mechanisms (mechanical effects). US can be administered in either a continuous or a pulsed mode. Pulsed US produces non-thermal effects and is beneficial for cartilage health [22], whereas continuous US aims to generate thermal effects that could enhance fibrous tissue extensibility, increase tissue metabolism, promote capillary permeability, and elevate the pain threshold [23]. A recent systematic review and meta-analysis suggested that pulsed US is the preferred treatment mode both in terms of more effective pain relief and improved function without significant adverse effects in clinical trials [24]. In addition, US can be administered in either an unfocused or a focused mode. The basic differences between FLIPUS and traditional US are that the main biological effect of FLIPUS is a mechanical effect and the targeted tissue is cartilage, while the biological effect of traditional US is a thermal effect and the targeted tissues are periarticular soft tissue lesions. The results of a number of studies have suggested that unfocused therapeutic US may be useful for reducing the pain and disability associated with knee OA [25]. However, few studies of focused low-intensity pulsed US(FLIPUS) have been published that describe knee OA rehabilitation.

Objectives

1. To assess the effectiveness of Maitland's mobilization and ultrasound to reduce the pain (VAS) and to improve the function ability (WOMAC) in OA knee.
2. To assess the effectiveness of Proprioceptive exercises and ultrasound to reduce the pain (VAS) and to improve the function ability (WOMAC) in OA knee.
3. To compare the effectiveness between Maitland's mobilization with ultrasound and Proprioceptive exercises with ultrasound, to reduce pain (VAS) and improve functional ability (WOMAC) in OA knee.

Settings

Outpatient and Inpatient department of physiotherapy department in Kempegowda Institute of Medical Sciences, Hospital and Research Centre, Bangalore, Karnataka, India.

PARTICIPANTS

A total of 20 eligible participants were recruited for participation in the study. After getting an informed consent all of them were initially screened for inclusion criteria. All 20 (10 in each group) were randomly assigned into either of 2 treatment groups namely GROUP A: Treated with ultrasound and Maitland's mobilization. GROUP B: Treated with ultrasound and Proprioceptive exercise program.

Inclusion Criteria

- Subjects with knee joint OA involvement diagnosed by Orthopaedician.
- Subject between age 40-75 years age of both sex
- Patient diagnosed as a case of knee osteoarthritis radiographic evidence of Grade II or III of Kellgren and Lawrence criteria for knee osteoarthritis as per diagnosed by orthopaedician.
- Subjects should have anterior knee pain and to some extent generalized knee pain and have difficulty in walking, using steps and stairs.
- Crepitus.

Exclusion Criteria

- Cognitive / mental disease
- Neurological, cardiac, vascular and sensory problems.
- Hip or spinal problems referring pain to knee
- Patients with knee surgeries
- Any malignancy
- Recent significant knee injury
- Metal prosthosis in or near the knee
- Rheumatoid Arthritis
- Secondary OA due to trauma
- Skin disease around treatment area

Outcome Measures and Its Measurements

(VAS) Visual Analogue Scale is a measurement instrument that tries to measure a characteristic or attitude that is believed to range across a continuum of values and cannot easily be directly measured. The most simple VAS is a straight horizontal line of fixed length, usually 100 mm. The ends are defined as the extreme limits of the parameter to be measured (symptom, pain, health) orientated from the left (worst) to the right (best). In some studies, horizontal scales are orientated from right to left, and many investigators use vertical VAS.

(WOMAC) The Western Ontario and McMaster Universities Arthritis Index is widely used in the evaluation of Hip and Knee Osteoarthritis. It is a self-administered questionnaire consisting of 24 items divided into 3 subscales:

- Pain (5 items): during walking, using stairs, in bed, sitting or lying, and standing upright
- Stiffness (2 items): after first waking and later in the day
- Physical Function (17 items): using stairs, rising from sitting, standing, bending, walking, getting in / out of a car, shopping, putting on / taking off socks, rising from bed, lying in bed, getting in / out of bath, sitting, getting on / off toilet, heavy domestic duties, light domestic duties

Study Design

TWO groups' pre and post randomized comparative study.

SAMPLING: A random sampling method

PROCEDURE:All participants who fulfilled the inclusion criteria were enrolled into the study after getting prior informed consent. All 20 (10 in each group) were randomly assigned into either of two treatment groups namely GROUP A: Treated with ultrasound and Maitland's mobilization. GROUP B: Treated with ultrasound and Proprioceptive exercise program. Following pretreatment measurements, subjects received standardized clinical examination lumbar Simple functional tests (ex, squatting and step-ups) that limited or reproduced symptoms were used to obtain daily baseline measurements to help assess effect of manual intervention. Subjects' of the GROUP A received alternate day treatment for 2 weeks except for Sunday. This included:

Pulsed mode of Ultrasound frequency: 1 MHz, intensity: 1.5W/cm^2, duration: 5 min

Manual therapy for 20 minutes. The manual therapy techniques, consisting of

- Passive physiological movements
- Accessory movements in Grade I, Grade II and Grade III
- Distraction
- AP Glide
- PA Glide

were applied by the investigator primarily to knee and surrounding structures as per Maitland's mobilization described in Mobilization of peripheral joints text book.

In addition to receiving manual therapy treatments, subjects in interventional group performed a standardized and supervised knee exercise program at each treatment session:

- Active ROM exercises
- Muscle strengthening(quadratus femoris, gastrosoleus and hamstrings)
- Muscle stretching(quadratus femoris, gastrosoleus and hamstrings)

Subjects of GROUP B group received alternate day treatment for 2 weeks except for Sunday.

- Pulsed mode of Ultrasound frequency: 1 MHz, intensity: 1.5W/cm2, duration: 5 min (88)
- Detailed verbal and hands-on instruction that included(90):
  - Wall slides
  - Straight lunge
  - Side lunge
  - Step up's
  - Closed chain isometric exercise against the resistance of resistance band.

Statistical Analysis

1. All data analysed using SPSS 16.0 software. Descriptive statistics were used to calculate Mean, SD.
2. Repeated measure ANOVA was assess the Maitland's mobilization and ultrasound to reduce the pain (VAS) and to improve the function ability (WOMAC) in OA knee Group (A) and to assess the effectiveness of Proprioceptive exercises and ultrasound to reduce the pain (VAS) and to improve the function ability (WOMAC) in OA knee Group(B).
3. Paired t-test was used to compare the efficacy between Maitland's mobilization with ultrasound Group (A) and Proprioceptive exercises with ultrasound, Group(B) to reduce pain (VAS) and improve functional ability (WOMAC) in OA knee.

Statistics and Tables

Table 1: Paired't' test to compare the VAS Score of Group A and Group BN=10

VAS	Group - A	Group - B	t' Value	p Value
	Mean ± SD	Mean ± SD		
DAY 1	8 ±1.05	5.7 ±1.06	8.83*	0
Day 7	2.5 ±1.27	3.6 ±1.17	3.16*	0.012

Df =9 at 0.05 level is 2.26

Table 2: Paired't' test to compare the WOMAC Score on pain of Group A and Group BN=10

Pain	Group - A	Group - B	t' Value	p Value
	Mean ± SD	Mean ± SD		
DAY 1	8.6 ± 3.27	13.4 ±1.07	4.27	0.002
Day 7	3.7±2.45	6.5±1.35	4.22	0.002

Df =9 at 0.05 level is 2.26

Table 3: Paired 't' test to compare the WOMAC Score on Stiffness of Group A and Group BN=10

Stiffness	Group - A	Group - B	t' Value	p Value
	Mean ± SD	Mean ± SD		
DAY 1	3.1 ±0.87	4.6 ± 1.07	4.88	0.001
Day 7	1.5±0.53	2.2 ± 0.78	2.69	0.25

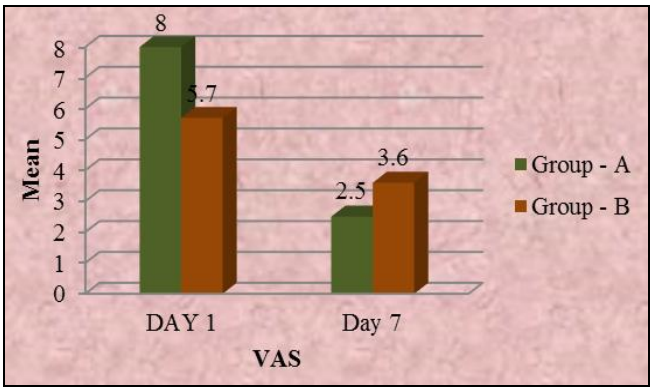
Df =9 at 0.05 level is 2.26

Table 4: Paired 't' test to compare the WOMAC Score on Difficulty of Group A and Group BN=10

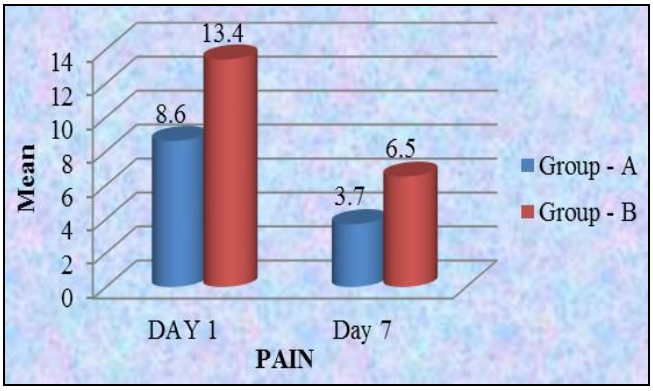
Difficulty	Group - A	Group - B	t' Value	p Value
	Mean ± SD	Mean ± SD		
DAY 1	32.1 ± 10	41.9 ± 6.33	3.32	0.009
Day 7	11.3±4.57	21.7 ± 5.62	6.74	0

Df =9 at 0.05 level is 2.26

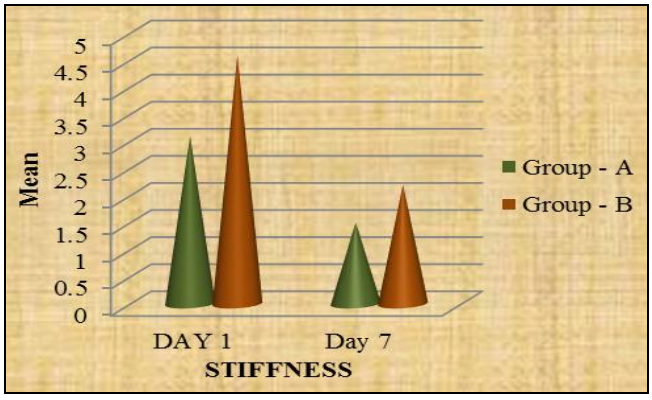
Graphical representation Pre and Post intervention mean of VAS and WOMAC in GROUP A and GROUP B



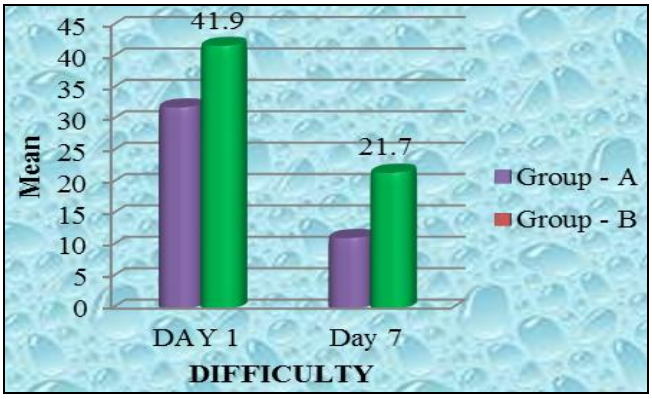
Graph 1: Paired 't' test to compare the VAS Score of Group A and Group B



Graph 2: Paired 't' test to compare the WOMAC Score on pain of Group A and Group B



Graph 3: Paired 't' test to compare the WOMAC Score on Stiffness of Group A and Group B



Graph 4: Paired 't' test to compare the WOMAC Score on Difficulty of Group A and Group B

Discussion

The present study was undertaken to determine effectiveness of Maitland Manual Therapy with ultrasound and Proprioceptive exercises with ultrasound with osteoarthritis of knee. Data collected showed highly significant improvements in VAS and WOMAC score in patients with stage II and III osteoarthritis of knee. Thus it can be concluded that Maitland's mobilization with ultrasound are beneficial in reduction of pain and improving functional activities in primary osteoarthritis patients. Maitland's mobilization with ultrasound achieved greater improvements than Proprioceptive exercises with ultrasound. The results of the present study indicate that there was highly significant ($p < 0.01$) decrease in pain, stiffness and physical function. Evidence from the various literatures demonstrated the importance of Maitland's mobilization, proprioceptive exercises and pulsed ultrasound therapy was aimed to reduce pain and improve functional ability.

GROUP A shows significant changes in terms of mean and standard deviation in pre and post intervention. Priya Singh Rangey 2015, *et al* in her study to compare the immediate effectiveness of two different Maitland protocols on pain, pressure threshold (PPT) and range of motion (ROM) in 24 subjects For Group A, the protocol used was Maitland mobilization given thrice, each for a duration of 1 minute with a break of 30 seconds between each minute. For Group B, Maitland mobilization was given once for 3 minutes continuously without any breaks. But Group A was found to be more effective in improving the ROM than Group B.

GROUP B shows significant changes in terms of mean and standard deviation in pre and post intervention. Maggo 2011, *et al*: In his study to compare the effectiveness of Proprioceptive exercises and strengthening exercises in treatment of osteoarthritis of knee in terms of pain and functional disability. Study of 24 subjects were randomized into three groups three groups. Group A were given conventional treatment (SWD and static quadriceps).Group B were given strengthening exercises along with SWD. Group C; which were given strengthening exercises and Proprioceptive exercises along with SWD. Outcome measures were pain, functional disability and joint position sense. But the Proprioceptive exercises group demonstrated greater improvement in VAS and WOMAC scores as compared to other two groups.

Limitations

1. The study sample size was relatively small.
2. This study subjects physical function, emotional function and Social levels were not considered.
3. Confounding Variables like functional limitation and environmental factors were not considered.
4. The study was limited to assess only the pain intensity by using VAS and WOMAC.

Conclusion

Based on our study though both groups showed significant reduction in pain and improvement in functional status, but experimental group (Group A) showed more improvement in the reduction pain and functional status on mean values as compared to the control group (Group B). Hence, alternate hypothesis is accepted and null hypothesis is rejected.

Thus we conclude that Maitland's Mobilization with ultrasound is more beneficial line of treatment compared to Proprioceptive exercises with ultrasound in patients with OA of knee

This study has shown that Maitland's Mobilization with ultrasound, it is possible to reduce pain and improve functional capacity with Osteoarthritis of knee. The results indicate that Maitland Mobilization with ultrasound has better influence on the reduction of pain and improve functional capacity of the patients. The study also shows that Maitland Mobilization technique is safe, effective and well tolerated by patients with OA knee.

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