TO STUDY THE EFFECTIVENESS OF MAITLAND MOBILIZATION AND CLINICAL EXERCISE Vs MAITLAND MOBILIZATION ALONE IN CHRONIC TIBIOFEMORAL ARTHRITIS

Register No: 271410284

Guide : Mr. S. Prabhakar. MPT., MIAP.,

A Dissertation Submitted to
THE TAMIL NADU Dr. M.G.R. MEDICAL UNIVERSITY,
CHENNAI.

In partial fulfillment of requirement for the Post Graduate Degree of
Masters of Physiotherapy (Advanced Orthopedics)
APRIL – 2016

TO STUDY THE EFFECTIVENESS OF MAITLAND MOBILIZATION AND CLINICAL EXERCISE Vs MAITLAND MOBILIZATION ALONE IN CHRONIC TIBIOFEMORAL ARTHRITIS

GUIDE

Mr. S. PRABHAKAR. ***MPT., MIAP.,***
Associate Professor
Jaya College of Paramedical Sciences, College of Physiotherapy,
MTH Road, Thiruninravur – 602 024.
Thiruvallur District, Tamilnadu.

EXAMINERS

1.

2.

A Dissertation Submitted to
THE TAMIL NADU Dr. M.G.R. MEDICAL UNIVERSITY
In partial fulfillment for the requirement of the Post Graduate degree of Masters of Physiotherapy
APRIL -2016

CERTIFICATE

This is to certify that the dissertation titled ***"TO STUDY THE EFFECTIVENESS OF MAITLAND MOBILIZATION AND CLINICAL EXERCISE Vs MAITLAND MOBILIZATION ALONE IN CHRONIC TIBIOFEMORAL ARTHRITIS"*** is a bonafide record of work done under my guidance and supervision in partial fulfilment for the Post Graduate Degree of Master of Physiotherapy (MPT II YEAR, APRIL - 2016) by Mr. T.R. SARAVANAN (Register No.271410284) Post Graduate (MPT) student of Jaya College of Paramedical Sciences, College of Physiotherapy, Thiruninravur - 602024.

GUIDE

Mr. S. PRABHAKAR. *MPT., MIAP.,*
Associate Professor,
Jaya College of Paramedical Sciences,
College of Physiotherapy,
MTH Road, Thiruninravur – 602 024.
Thiruvallur District, Tamilnadu.

PRINCIPAL

Mr. V. BALCHANDAR.
MPT., MIAP., MBA., PGDHM.,
Professor / Principal,
Jaya College of Paramedical Sciences,
College of Physiotherapy,
MTH Road, Thiruninravur – 602 024.
Thiruvallur District, Tamilnadu.

DECLARATION BY THE CANDIDATE

I hereby declare that the Dissertation entitled **"*TO STUDY THE EFFECTIVENESS OF MAITLAND MOBILIZATION AND CLINICAL EXERCISE Vs MAITLAND MOBILIZATION ALONE IN CHRONIC TIBIOFEMORAL ARTHRITIS*"** was done by me for partial fulfillment of the requirement of **Master of Physiotherapy** degree. The dissertation had been done under the direct supervision and guidance of my Guide Mr. S. Prabhakar, Associate Professor at **Jaya College of Paramedical Sciences, College of Physiotherapy**, Thiruninravur, and submitted the same during the year April 2016 to **The Tamilnadu Dr. M.G.R Medical University**.

Date:

Place: Thiruninravur.

…..…….

Signature of the Candidate

ACKNOWLEDGEMENT

First and foremost my grateful thanks to almighty for his divine blessing and grace in making this project successful and I thank my Parents for giving me all this life and opportunity. I acknowledge my sincere thanks to The Chairman and The Secretary of Jaya Educational Trust, Thiruninravur for providing me this opportunity and necessary facilities for completing this study.

My deepest appreciation goes to Prof. *Dr. V. BALCHANDAR* (PT) MPT., MIAP., MBA., PGDHM., PhD., Principal, Jaya College of Physiotherapy , an ideal head of the institution and a living legend in my opinion, an ideal supervisor and a living legend in my opinion. Never putting other people down, always praising collaboration. And never taking himself too seriously. Sir, thank you for your expertise, enthusiasm, and especially for your precious time and for the kind help and support, valuable suggestions and constant guidance throughout the academics.

My profound gratitude and heartfelt thanks to my coordinator & co-guide Prof. *Mr. V.S.SARAVANNAN* (PT) MPT., MIAP., MBA., PGDHM., PGDSM., Vice Principal, Jaya College of Physiotherapy an ideal supervisor. Never negative, always looking ahead with new ideas, guiding with patience and support. My special thanks to my guide Mr. S. Prabhakar (PT) MPT., MIAP., Associate Professor, Jaya College of Physiotherapy who is always readily available for discussions and comments on manuscripts. Sir, thank you for your expertise, enthusiasm, and especially for your precious time and for the kind help and support, valuable suggestions and constant guidance throughout the study.

It is a proud privilege to express my sincere gratitude to all my senior PG Faculty members for their kind help and support, valuable suggestions and constant guidance throughout the academics. I gladly extend my sincere thanks to my subjects involved in this study and also my special thanks to the statistician Mr. *V. CHANDAR* MSC., MPHIL (STATISTICS) for his valuable suggestions regarding to this study.

Last but not least, I would like to show my humble gratitude to all my Friends who were the back bone for me to complete this study successfully. I am also very grateful to librarian of *JAYA COLLEGE OF PHYSIOTHERAPY* who helped me in this study.

LIST OF ABBREVIATIONS USED

1. OA : Osteoarthritis
2. AP : Antero-posterior
3. PA : Postero- anterior.
4. WOMAC : Western Ontario and McMaster Universities Osteoarthritis Index .
5. MRC : Muscle power grading.
6. MMCE : Maitland mobilisation with clinical exercise .
7. MM : Maitland mobilisation .
8. VAS : Visual Analog Scale.
9. NPRS : Numerical Pain Rating Scale.
10. N : No. of Subjects.
11. SD : Standard Deviation.
12. M : Mean.
13. MD : Mean Deviation.
14. ROM : Range of Motion.

Table of Contents

List of Tables

List of Figures

List of Graphs

TO STUDY THE EFFECTIVENESS OF MAITLAND MOBILIZATION AND CLINICAL EXERCISE vs MAITLAND MOBILIZATION ALONE IN CHRONIC TIBIOFEMORAL ARTHRITIS

ABSTRACT

BACKGROUND: Osteoarthritis (OA) is a common, progressive degenerative health problem among adults. The term osteoarthritis was first introduced by **John K Spender** in 1886, England.

OBJECTIVE: To compare the effect of Maitland mobilization with clinical exercise (group A) VS Maitland mobilization alone (group B) in terms of pain, ROM, muscle power and functional activities in chronic tibio-femoral arthritis

METHODOLOGY: Group A(n= 15) receive Maitland Mobilization & Clinical Exercise (include stretching, strengthening, range of motion exercise) and Group B (n=15) receive Maitland Mobilization alone (include accessory & physiological movement). Both group received treatment for about 4 weeks.

RESULT: By comparing the effectiveness of each treatment with respect to all standard measures, we see that the treatment "Maitland Mobilization with Clinical Exercise" is more effective or the "Maitland Mobilization" is effective in terms of Pain,ROM,Muscle Power and function**.**

KEYWORDS: Tibiofemoral arthritis , Maitland mobilization, Clinical exercise.

1. INTRODUCTION:

Osteoarthritis (OA), is a chronic degenerative disorder of multifactorial etiology.[1]It is a progressive disorder of the joints characterised by degradation of the articular cartilage, resulting in an alteration of its biomechanical properties.[2] This contributes to a focal loss of articular cartilage, loss of joint space, osteophyte formation, focal areas of synovitis, periarticular bone remodelling and subchondral cysts.[3] Prevalence -of osteoarthritis is 22% - 39% in India[1] .

At the knee presence of osteoarthritis may result in changes that accelerate the deterioration of systems or compound the effects of ageing.[2,4] This condition is strongly age related heterogeneous group of disorders in synovial joint being less common before 40 years, but rising in frequency with age(6). Medial compartment osteoarthritis (OA) is more frequent than lateral compartment (OA) and commonly follow damage to the meniscus and cartilages.(7) At the knee joint, soft tissue changes can include decreases in the strength of the quadriceps and sagittal range of motion, as well as increased soft tissue contracture. Collectively these changes produce the typical clinical picture of joint pain; worsening symptoms with activity and weight bearing, and stiffness developing at rest. These facilitate the decline in physical function and progression of disability.[3]

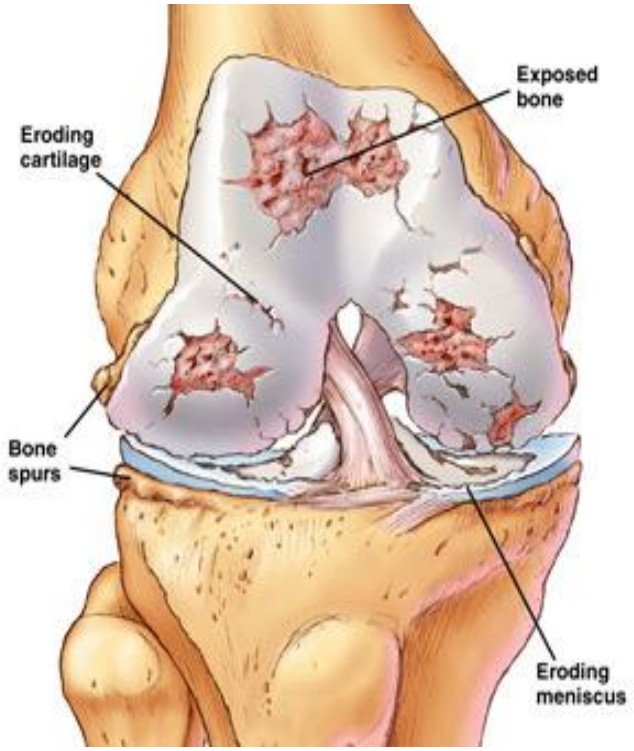


Figure. : 1. Osteoarthritis of knee

There are various changes associated with in osteoarthritis they are[25]

- Loss of joint space (due to destruction of articular cartilage)
- Sclerosis (due to increase cellularity and bone deposition)
- Subchondral cysts due to synovial fluid intrusion into the bone
- Osteophytes (revascularization of remaining cartilage and capsular traction)

The relationship between joint pain and declines in muscle strength are beginning to be recognized as more complex than simply disuse because of joint pain contributing to muscle atrophy and muscle weakness surrounding joints.[9],[10]

Maitland, Kaltenborn, Cyriax, and Mulligan are some very well-known manual therapists, who have contributed in the field of manual therapy. Maitland and Kaltenborn present different sets of widely employed manual therapy techniques for treating pain and stiffness in human joints.

Mobilization is a gentle oscillating movement of the articular surface of the joint that can relieve pain and improve joint range of motion by neuro physiological or mechanical mechanism or combination of neuro physiological and mechanical mechanism.[11]

Various studies on manual therapy techniques based on, passive physiological and accessory joint movements and soft tissue mobilisation were administered to the lumbar spine, hip and ankle were symptomatic and contributing to overall lower limb dysfunction patients reported 20% to 40% relief of symptoms in two or three clinical treatment sessions, they concluded that manual physical therapy techniques and exercises yields functional benefits for osteoarthritis patients.[24]

Joint mobilization which involves low velocity passive movement within or at the limit of joint range of motion reduces pain by modulating the Nervous tissue and joint motion.[12],[13]

Several studies proved that mobilization techniques plays important role in improving pain, strength and functional performance in OA knee.[10]

For the treatment of pain and motion impairment, application of joint mobilization has been utilized by a variety of healthcare professional in both the spine and peripheral joints. However, most of these research studies are used technique for the spine and upper extremity, with less evidence for the efficacy of mobilization to the lower extremity.[8]

Recent study concluded that physical therapy interventions including manual therapy (maitland mobilization) and exercises improves muscle strength, functional ability and reduces pain in patients with OA of knee. It may therefore reduce the need for knee arthroplasty and intra-articular injections. **[11]**

Joint mobilization include antero-posterior (AP) glide of tibia on femur in all direction technique of application were based on guidelines.[12],[13]Mobilization of tibio-femoral joint resulted in significantly increased pressure pain threshold and reduced timing on the 3minute timed "Up and Go" walk test.[14]

Osteoarthritis of knee can cause functional disabilities, reduced lower limb muscle strength and several studies have suggested that knee extensor, knee flexor's muscle strength both lost with established symptomatic osteoarthritis.[20],[21]

Active and passive range of motion exercise is considered an important part of rehabilitation program for patients with osteoarthritis.[17],[18],[19]Fitness walking, aerobic exercise and strength training have all been reported to result in functional improvement in patient with osteoarthritis.[15],[16].A variety of exercise program for knee Osteoarthritis have been described its focus on improving quadriceps strength.[22],[23]

Previous studies has no evidence of use of such manual mobilization technique in Tibio-femoral osteoarthritis. Maitland mobilization technique include accessory movement like Distraction, Anteroposterior glide, Posteroanterior glide, Medial glide, Lateral glide and Physiological movement like Extension abduction and extension adduction. These were not applied to lower extremity condition like Osteoarthritis for improving in pain, ROM etc. hence the objective of the present study is to highlight the efficacy of Maitland mobilization technique in the management of degenerative joint condition like Osteoarthritis in the Indian population.

2. OBJECTIVES OF THE STUDY:

* To study the effect of Maitland mobilization with clinical exercise in terms of Pain, Range Of Motion, Muscle Power and Functional Activities in tibio-femoral arthritis.

* To study the effect of Maitland mobilization alone in terms of Pain, Range Of Motion, Muscle Power and Functional Activities in tibio-femoral arthritis.

* To compare the effect of Maitland mobilization with clinical exercise (group A) VS Maitland mobilization alone (group B) in terms of Pain, Range Of Motion, Muscle Power and Functional Activities in tibio-femoral arthritis.

3. HYPOTHESIS:

- **NULL HYPOTHESIS**:

There is no significant difference between group A (Maitland mobilization & Clinical exercise) and group B (Maitland mobilization alone) in Tibio-femoral arthritis.

- **ALTERNATE HYPOTHESIS:**

There is a significant difference between group A (Maitland mobilization & Clinical exercise) and group B (Maitland mobilization alone) in Tibio-femoral arthritis.

4. OPERATIONAL DEFINITION:

4.1 OSTEOARTHRITIS:

Osteoarthritis(OA) also known as degenerative arthritis or degenerative joint disease or Osteoarthrosis is a group of mechanical abnormalities involving degradation of joints, including cartilage and subcondylar bone.

4.2 GONIOMETER:

Goniometer is a device used in physical therapy to measure the range of motion around the joint in the body.

4.3 WOMAC SCALE :

WOMAC Western Ontario and McMaster Universities Osteoarthritis Index is used to assess pain, stiffness, physical function in patients with hip and knee osteoarthritis. It consists of 24 items and 3 subscales.

4.4 NUMERICAL PAIN RATING SCALE :

The **NPRS** (NRS – 11) is an 11- point scale for patients self reporting pain. It is for adults and children 10 years old (or) older.

RATING	PAIN LEVEL
0	No pain
1-3	Mild pain (nagging, annoying, interfering little with ADL's)
4-6	Moderate pain (interferes significantly with ADL's)
7-10	Severe pain (disability, unable to perform ADL's)

4.5 MAITLAND MOBILIZATION:

Maitland mobilization is a technique that involves the application of passive and accessory, oscillatory movements to peripheral joints to treat pain and stiffness of a mechanical nature.

5. REVIEW OF LITERATURE:

1. Nor Azlin M.N conducted a study to determine the effects of passive joint mobilization on pain and stairs ascending-descending time in subjects with knee osteoarthritis (OA knee). The addition of passive joint mobilization to conventional physiotherapy reduced pain but not stairs ascending-descending time among subjects with knee osteoarthritis.[26]

2. Gail D.Deyle they conducted a study to find the effectiveness of manual physical therapy and exercise in osteoarthritis of the knee. Clinically and statistically significant improvements in 6-minute walk distance and WOMAC score at 4 week.[31]

3. DA Skyba in his study on Joint manipulation observed reduced hyperalgesia by activation of monoamine receptors but not opioid (or) GABA receptors in the spinal cord. He concluded that anti hyperalgesia produced by joint manipulation appears to involve descending inhibitory mechanism that utilize serotonin & Noradrenaline which inhibit transmission of nociceptive information resulting in pain relief.[34]

4. Wright, Vicenzino 1995 suggested that manipulation induce analgesia may be a multifactorial effect resulting from beneficial influence in chemical environment of peripheral joints, facilitation of tissue repair processes, segmental inhibitory processes within the central nervous system and activation of descending inhibitory pathway projecting from brain to spinal cord.[35]

5. Sara Maher examined the effectiveness of manual traction mobilization. A combination of manual physical therapy and supervised exercise yields functional benefits for patients with osteoarthritis of the knee and may delay or prevent the need for surgical intervention.[28]

6. Penny Moss et al investigated the initial effects of accessory knee joint mobilization on measures of pain and function in individuals with knee osteoarthritis. The effects of a 9-min, non-noxious, AP mobilization of the tibio-femoral joint were compared with manual contact and no-contact interventions. Knee joint mobilization also increased

Pain Pressure Threshold at a distal, non-painful site and reduced 'up and go' time significantly. It may therefore be an effective means of reducing pain local and widespread hypoalgesic effects.[29]

7. Gail D Deyle et al conducted study find out the Physical Therapy Treatment Effectiveness for Osteoarthritis of the Knee in a Randomized Comparison of Supervised Clinical Exercise and Manual Therapy Procedures Versus a Home Exercise Program. This study concluded that there is significant improvement after following one year regular home exercise program.[36]

8. J Haxby Abbott et al conducted study factorial randomized controlled trail on exercise therapy, manual therapy, or both, for osteoarthritis of hip or knee concluded that manual therapy and exercise intervention is effective.[37]

9. Marlene Fransen concluded that physical therapy is effective for patients with osteoarthritis of knee. Suggested that both individually delivered treatment or in combination of small group format is an effective for patient with OA knee.[32]

10. G.K.Fitzgerald concluded that the therapeutic exercise has the major functional influence outcome in improving the functional outcome in knee rehabilitation[27].

11. Marlene fransen, Sara McConnell conducted study on Exercise for osteoarthritis of the knee. They concluded that therapeutic exercise has at least short term benefit in terms of reducing knee pain and improved physical function for people with knee OA[38].

12. KIM L.Bennell et al conducted a review of the clinical evidence for osteoarthritis of hip and knee, conclude that exercise is key component management for osteoarthritis[39].

13. Mariatte J Jansen conducted study on strength training alone, exercise therapy alone, and exercise therapy with passive manual mobilisation each reduce pain and disability in people with OA knee. To achieve better pain relief in patients with knee

osteoarthritis physiotherapist or manual therapist might consider adding manual mobilisation to optimize supervised active exercise programs[33].

14. Robert Topp RN et al conducted study the effect of dynamic versus isometric resistance training on pain and function among adults with osteoarthritis of knee concludes that dynamic or isometric resistance training improves functional ability and reduce pain on osteoarthritis[40].

15.Neil A. Segal et al conducted study to find the effects of quadriceps strength and proprioception on risk for knee osteoarthritis this study conclude that quadriceps strength protected against incident symptomatic but not radiographic knee osteoarthritis finally suggest that strength is more important than joint proprioception in mediating risk for knee osteoarthritis[41].

16.M E Van Baar et al conducted study on effectiveness of exercise in patients with osteoarthritis of hip and knee this study concludes that exercise is effective in Osteoarthritis knee patients however these effects decline over time and finally disappear[42].

17. LucieBrosseau recommendations of clinical benefit were developed for therapeutic exercises, especially strengthening exercises and general physical activity, particularly for the management of pain and improvement of functional status. Manual therapy combined with exercises also is recommended in the management of patients with OA. The Ottawa Panel recommends the use of therapeutic exercises alone, or combined with manual therapy, for managing patients with OA. The Ottawa Panel recommends the use of therapeutic exercises because of the strong evidence[43].

18. Brain T maurer conducted study on osteoarthritis of the knee isokinetic quadriceps exercise versus educational intervention however results found that isokinetic exercise is an effective form of treatment than that of the education intervention[44].

19. Ferraz MB et al - conducted study on reliability of pain scales in the assessment of literate and illiterate patients and founded that Numerical Pain Rating Scale has higher reliability[45].

20. Gillian A. Hawker et al (2011) - The study conducted as, Measures of Adult pain. The study concluded as, the pain scale NPRS is easy to administer and score[46].

21. Erin E Krebs et al - conducted study on Accuracy of Pain numeric rating scale as a screening test in primary care. Most commonly used measure for pain screening may have only modest accuracy for identifying patients with clinically important pain in primary care[47].

22. Maria Alexandra Ferreira-Valente Numerical Rating Scale (NRS) are among the most commonly used measures of pain intensity in clinical and research settings. The current study compared the relative validity of NPRS for detecting differences in painful stimulus intensity and differences between men and women in response to experimentally induced pain.Results showed statistically significant differences in pain intensity between temperatures for each scale, with lower temperatures resulting in higher pain intensity[48].

23.Ellen Flaherty et al (2012) - The study conducted as, pain Assessment for older adults. This study concluded as, the most popular tool NRS ask the patient to rate their pain[49].

24. American thoracic society- NPRS is a valid scale for chronic pain measures [50].

25. Jules M Rothstein et al, 1983conducted study on Goniometric reliability in a clinical setting: Elbow and Knee Measurements. This study indicates Goniometric measurements performed in a clinical setting can be highly reliable[51].

26. Prem P Gogia, James H. Braatz et al, 1987 conducted study on Reliability and Validity of Goniometric measures at the knee. They concluded that goniometric measurements of knee joint are both valid and reliable[52].

27. K.G.Auw Yang et al WOMAC function scale is valid, reliable and responsive alternative to the traditional WOMAC in the evaluation of patient with osteoarthritis of the knee[53].

28. N.Bellamy et al conducted study on the WOMAC knee and hip osteoarthritis indices. Development validation, globalization and influence on the development Auscan hand osteoarthritis indices concluded WOMAC and Auscan indices health status measurement questionnaire that are valid, reliable, responsive, easy to complete and multiple language forms and scaling format[(54)].

29. Varsha C. Naik, JebaChitra, SubhashKhatri [64] They showed in their studies that Pain, mobility and function significantly improved with Maitland's and Mulligan's mobilization technique. Mulligan's technique was found better for pain relief, his concept of pain reduction proposed that a major positional fault of joint may occur following an injury or strain, resulting in movement restriction and pain. Maitland's mobilization technique was found effective in active and passive wrist flexion.

30. **Paul A van den Dolder and David L Roberts** [65] Did a randomized, controlled trial study and demonstrated that six sessions of manual therapy to the lateral aspect of the patella-femoral joint results in significantly greater improvement in active knee flexion and the ability to step up/down a step in people with anterior knee pain than does no intervention.

31. Salaffif, leardiniG et al [66]A reliability and validity study on Western Ontario and Mc master universities osteoarthritis Index in patients with osteoarthritis of knee, concludes that WOMAC is a reliable and valid instrument for evaluating the severity of osteoarthritis of knee.

32. Cynthia C norkin Joyce white [67]

A study presented that intratester reliability was better than intertester in universal Goniometer in measurement of knee Range of motion, hence indicating that the measurement should be taken by the same therapist.

6. DESIGN AND METHODOLOGY :

6.1 STUDY DESIGN:-

Experimental study design

6.2 STUDY SETTING:-

The study was conducted in the Department of physiotherapy, Jaya college of physiotherapy, Chennai.

6.3 SOURCE OF DATA:-

Data was collected from outpatient department of Jaya College of Physiotherapy, Chennai. All subjects were clinically diagnosed as Tibio – Femoral Osteoarthritis and referred for physiotherapy. Patients were selected based upon who fulfilled the inclusion criteria. The purpose of the study was explained to all subjects and Informed consent was obtained from each subject was taken. The subjects were randomly assigned into either of Maitland Mobilisation with clinical exercise (Group A) or Maitland mobilisation alone (Group B).

6.4 SAMPLE SIZE:-

A Total of 30 subjects fulfilled the inclusion criteria are randomly assigned as

Group A (n= 15; 6 Male, 9 Female) received Maitland Mobilisation & Clinical Exercise (include stretching, strengthening, range of motion exercise)

Group B (n=15; 5 Male, 10 Female) received Maitland Mobilization alone (include accessory & physiological movement)

STUDY DURATION:

Total duration of 4 weeks was adopted for this study.

TREATMENT DURATION:

3 Sitting per week for 4 weeks.

The subjects in both the groups received physical therapy thrice weekly for a period of 4 weeks.

6.5 SAMPLING CRITERIA

6.5.1 INCLUSION CRITERIA:

- Clinical diagnosed as OA knee (tibio-femoral joint) patient.
- Age group between 40 and 70 years.
- Unilateral involvement of osteoarthritis.
- Both male and female.
- Those who are willing to participate in the study and willing to take treatment

6.5.2 EXCLUSION CRITERIA:

- Patellofemoral arthirits.
- Recent surgery
- Rheumatoid arthritis.
- Recent fracture in the lower limb.
- Recent ligament injury.
- Osteophytes.

6.6 METHODOLOGY:-

A total of 40 subjects referred for OP department of Jaya college of physiotherapy, Chennai with knee pain. The subjects were clinically diagnosed as Tibio-femoral osteoarthritis and they are selected based on the inclusion and exclusion criteria. In which 30 patients fulfilled the inclusion criteria and on that 10 subjects were excluded as they were not willing to participate in this study. The purpose of the study was explained to all subjects and consent from each subject was taken. All subjects were assessed using a special Performa. Subjects were randomly assigned into either Maitland Mobilisation with clinical exercise (Group A) or Maitland mobilisation alone (Group B).

6.7 MATERIALS USED:-

- Treatment Couch
- Pillow
- Goniometer
- NPRS Pain Scale
- WOMAC scale
- ROM chart
- Muscle power grading (MRC)
- Evaluation form
- Patient consent form.

Figure. : 2. TREATMENT COUCH

Figure. : 3. GONIOMETER

6.8 PROCEDURE:

Total of 30 subjects were selected for the study who were clinically diagnosed as osteoarthritis. simple random sampling technique was used in the allocation of subjects into Group A & Group B.

Group A: 15 subjects were allocated in the Group A(Maitland mobilisation with clinical exercise)

Group B: 15 subjects were allocated in the Group B (Maitland mobilisation alone)

Following pre treatment clinical examination including pain score by using NPRS scale, muscle power for quadriceps by using manual muscle testing, active ROM and passive ROM using universal goniometry and WOMAC score consists 24 questions designed to measure patient perception of pain, stiffness, and physical function

GROUP A:

MAITLAND MOBILIZATION

A) Accessory movements :

1 . DISTRACTION :

Patient starting position: Supine, knee in extension (or pain-free position).

Therapist starting position: Standing level with the patient's knee, facing across the patient's body.

Technique: tibia is distracted away from the femur.

Figure. : 4. **DISTRACTION**

2 . ANTEROPOSTERIOR GLIDE :

Patient starting position:

Supine lying with the foot resting on the couch so that the knee is flexed to approximately 70° or to its available limit.

Therapist starting position:

Standing by the patient's right ankle, right lower leg resting on the couch the patient's foot is in stabilized position.

Technique:

large or small amplitude force applied a pressure against the upper end of tibia in anteroposterior view.

Figure. : 5. **ANTERO POSTERIOR GLIDE**

3 . POSTEROANTERIOR GLIDE :

Patient starting position:

Prone, lying with the knee flexed to approximately 70° or at the available limit

Therapist starting position:

Standing by the side of the patient beyond the flexed knee and facing the patient's head; the left tibia rests on the couch, the therapist's knee is fully flexed so that the upper thigh supports across the patient's distal shin.

Technique: The stretching oscillatory movements are produced by the therapist's arms and body acting through the thumbs. Pressure exerted on the posteroanterior view.

Figure. : 6. **POSTERO ANTERIOR GLIDE**

4 . MEDIAL GLIDE AND LATERAL GLIDE :

Patient starting position: Supine lying position, hip and knee flexed accordingly and the foot resting on the couch.

Therapist starting position: Standing level with the patient's foot facing the patient's head.

Technique: The therapist leans forward and extends both wrists so that both forearms are directed parallel to each other force are applied to the fixed direction side in laterally / medially.

Figure. : 7. **MEDIAL AND LATERAL GLIDE**

B) Physiological Movements:

1 . EXTENSION AND ABDUCTION :

Patient starting position: Supine lying in the middle of the couch.

Therapist starting position: Standing by the patient's right thigh facing the feet, kneeling on own left shin to support under the lower end of the patient's femur with the left thigh. When the patient's knee is flexed, the therapist's left thigh also moves to the patient's calf.

Technique: when the heel of the left hand is against the femur with a strong abduction force the femur will tend to move slightly medially on the tibia during extension/abduction.

2 . EXTENSION AND ADDUCTION:

Patient starting position: Supine lying in the middle of the couch.

Therapist starting position: Standing by the patient's right thigh facing the feet, kneeling on own left shin to support under the lower end of the patient's femur with the left thigh. When the patient's knee is flexed, the therapist's left thigh also moves to the patient's calf.

Technique: when the heel of the left hand is against the femur with a strong adduction force the femur will tend to move slightly laterally on the tibia during extension/adduction.

CLINICAL EXERCISE

A. Stretching exercise will be given to Calf, Hamstring, Quadriceps. Each stretch will be sustained for 30seconds for 3 session per day.

B. Strengthening exercise include

1.Partial squat: perform partial squat keeping the knees centred over the feet, return to normal position by contracting gluteus muscle, quadriceps muscle and hold for 3 seconds each contraction, repeat it for 30 seconds, three times per week.

Figure. : 7. **PARTIAL SQUATS**

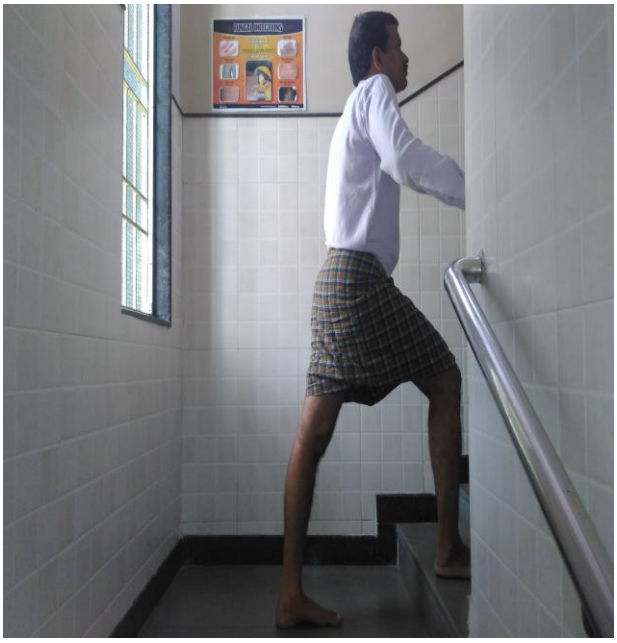


Figure. : 8 **STEP UP**

2 .Step up: The foot of the involved limb placed on step & bring body over foot to stand on the step use little push off assistance from contralateral foot, step down with contralateral foot & repeat for 3 seconds for three times per week.

C .Range Of Motion exercise includes,

Knee in mid flexion to full extension and hold it for 3 seconds at end range once per day.
Knee in mid flexion to full flexion and hold it for 3 seconds at end range once per day.

GROUP B

MAITLAND MOBILIZATION ALONE

This group receives the Maitland Mobilization in both physiological and accessory movements.

After 4 weeks, subjects from both the group had undergone post treatment assessment of pain, muscle power, active ROM, passive ROM, and WOMAC score.

7. DATA ANALYSIS & STATISTICS :

7.1 Statistical Methodology :

In this study, the sample data includes both categorical (or nominal) and scale (or quantitative) variables. Both descriptive statistics and inferential statistics (i.e., hypothesis tests) have been performed to analyze the sample data.

In this study, two hypothetical tests have been conducted to test our hypothesis and those tests are:

(i) Paired Samples t-test, and

(ii) Independent Samples t-test

These two tests are performed at 5% level of significance. That is, $\alpha = 5\%$ or 0.05

- **Paired Samples t-test**:

Hypotheses:

Null hypothesis, H_0: $\mu_d = 0$

(That is, there is no significant mean change in a standard measure between two treatments

Alternative hypothesis, H_1: $\mu_d \neq 0$) (Two-tailed test)

(That is, there is significant mean change in a standard measure (such as NPRS) due to Treatment 1 or due to Treatment 2)

Let the level of significance be $\alpha = 0.05$

Test Statistic:

In order to test the above hypothesis, it is appropriate to use Paired Samples t-test and the corresponding test statistic is given below:

$$t = \frac{\bar{d} - \mu_d}{s_d / \sqrt{n}}, \quad \text{where} \quad \bar{d} = \frac{\sum d}{n}, \; s_d = \sqrt{\frac{\sum (d - \bar{d})^2}{n-1}}$$

Where, $\bar{d}$ = Mean of the differences of sample; d = $X_2 - X_1$ = Post Test Score – Pre Test Score; S_d = Standard error of the difference; and μ_d = Population Mean difference to be tested

In order to test the effectiveness of each treatment separately, the Pre-test and Post-test scores for each standard measures have been considered and then a Paired t-test has been performed with these Pre and Post-test scores separately for each treatment.

❖ Independent Samples t-test:

Hypotheses:

Null hypothesis, H_0: $\mu_1 = \mu_2$

(That is, there is no significant difference between two groups (*such as Group A and Group B*) with respect to the changes in corresponding mean scores of standard measures (such as NPRS)

Alternative hypothesis, H_1: $\mu_1 \neq \mu_2$ (*Two-tailed test*)

(That is, there is significant difference between two groups (*such as Group A and Group B*) with respect to the changes in corresponding mean scores of standard measures (such as NPRS)

Test Statistic:

In order to test the above hypothesis, it is appropriate to use Independent Samples t-test and the corresponding test statistic is given below:

$$t = \frac{\overline{X}_1 - \overline{X}_2}{S\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}, \qquad \text{where S = Pooled S.D} = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$$

Where, $\overline{X}_1$ = mean of sample group 1 (i.e., Treatment 1), $\overline{X}_2$ = mean of sample group 2 (i.e., Treatment 2), s_1^2 = variance of sample group 1, s_2^2 = variance of sample group 2, n_1 = Sample size of group1 and n_2 = Sample size of group 2.

In order to compare the effectiveness of two treatments, the difference between Pre-test and Post-test scores would be calculated and then the mean of these differences would be calculated separately for Group A and Group B. These mean of the differences for two Group (A and B) would be considered as the sample means of two groups (i.e., $\overline{X}_1$ *and* $\overline{X}_2$) respectively.

7.2. Dataset:

The dataset includes 17 variables and 30 observations. The description of these variables are presented below:

Table 1

S. No.	Variable	Description	Type
1	Group A&B	1 = Maitland Mobilization with Clinical Exercise (MMCE) & 2 = Maitland Mobilization alone (MM)	Nominal
2	NPRS1	NPRS PRE Test	Scale
3	AR_FLEX1	Active ROM Flexion PRE Test	Scale
4	AR_EXT1	Active ROM Extension PRE Test	Scale
5	PR_FLEX1	Passive ROM Flexion PRE Test	Scale
6	PR_EXT1	Passive ROM Extension PRE Test	Scale
7	MUSCLE_POWR1	Muscle Power PRE Test	Scale
8	WOMAC_TOTAL1	WOMAC Total PRE Test	Scale
9	WOMAC_PRCENT1	WOMAC % PRE Test [=(WOMACTotal1/ 96)*100]	Scale
10	NPRS2	NPRS POST Test	Scale
11	AR_FLEX2	Active ROM Flexion POST Test	Scale
12	AR_EXT2	Active ROM Extension POST Test	Scale
13	PR_FLEX2	Passive ROM Flexion POST Test	Scale
14	PR_EXT2	Passive ROM Extension POST Test	Scale
15	MUSCLE_POWER2	Muscle Power POST Test	Scale
16	WOMAC_TOTAL2	WOMAC Total POST Test	Scale
17	WOMAC_PERCENT2	WOMAC % POST Test [=(WOMACTotal2 / 96)*100]	Scale

17 variables are quantitative variables measured on continuous scale (i.e., ratio scale variables).

7.3 Analysis:

1. Descriptive Statistics for all Standard Measures by Treatments

Table 2

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
NPRS(PRE)	30	5.00	10.00	7.7667	1.45468
AR_FLEX(PRE)	30	70.00	118.00	95.4667	13.25540
AR_EXT(PRE)	30	.00	16.00	7.7667	4.24819
PR_FLEX(PRE)	30	77.00	120.00	97.6333	12.33577
PR_EXT(PRE)	30	.00	15.00	7.0000	4.19359
MUSCLE_POWER(PRE)	30	2.00	3.00	2.4333	.50401
WOMAC_TOTAL(PRE)	30	52.00	96.00	71.4667	12.87000
WOMAC_PERCENT(PRE)	30	54.17	100.00	74.4450	13.40560
Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
NPRS(POST)	30	.00	4.00	2.0000	1.20344
AR_FLEX(POST)	30	102.00	120.00	114.4333	6.01540
AR_EXT(POST)	30	.00	6.00	1.6000	1.71404
PR_FLEX(POST)	30	105.00	120.00	115.2333	5.23044
PR_EXT(POST)	30	.00	5.00	1.3667	1.47352
MUSCLE_POWER(POST)	30	2.00	5.00	3.5667	1.00630
WOMAC_TOTAL(POST)	30	7.00	38.00	23.3000	7.39128
WOMAC_PERCENT(POST)	30	7.29	39.58	24.2713	7.69974

2. Descriptive Statistics for all Standard Measures by Treatments

(Table 3)

Descriptive Statistics

Treatment		N	Minimum	Maximum	Mean	Std. Deviation
Group A	NPRS(PRE)	15	5.00	10.00	7.8000	1.47358
	AR_FLEX(PRE)	15	70.00	114.00	93.2000	12.74587
	AR_EXT(PRE)	15	.00	16.00	6.8667	4.71876
	PR_FLEX(PRE)	15	78.00	114.00	96.3333	11.28632
	PR_EXT(PRE)	15	.00	15.00	6.0667	4.75795
	MUSCLE_POWER(PRE)	15	2.00	3.00	2.4667	.51640
	WOMAC_TOTAL(PRE)	15	53.00	96.00	70.5333	13.61127
	WOMAC_PERCENT(PRE)	15	55.21	100.00	73.4720	14.17751
Group B	NPRS(PRE)	15	5.00	10.00	7.7333	1.48645
	AR_FLEX(PRE)	15	76.00	118.00	97.7333	13.80200
	AR_EXT(PRE)	15	.00	14.00	8.6667	3.65800
	PR_FLEX(PRE)	15	77.00	120.00	98.9333	13.57238
	PR_EXT(PRE)	15	.00	14.00	7.9333	3.45309
	MUSCLE_POWER(PRE)	15	2.00	3.00	2.4000	.50709
	WOMAC_TOTAL(PRE)	15	52.00	96.00	72.4000	12.48885
	WOMAC_PERCENT(PRE)	15	54.17	100.00	75.4180	13.00870

Descriptive Statistics

Treatment		N	Minimum	Maximum	Mean	Std. Deviation
Group A	NPRS(POST)	15	.00	3.00	1.6667	1.11270
	AR_FLEX(POST)	15	102.00	120.00	113.0667	6.44168
	AR_EXT(POST)	15	.00	6.00	1.5333	1.84649
	PR_FLEX(POST)	15	105.00	120.00	114.0667	5.77515
	PR_EXT(POST)	15	.00	4.00	1.2000	1.37321
	MUSCLE_POWER(POST)	15	4.00	5.00	4.4000	.50709
	WOMAC_TOTAL(POST)	15	7.00	38.00	21.2000	8.35977
	WOMAC_PERCENT(POST)	15	7.29	39.58	22.0833	8.70846
Group B	NPRS(POST)	15	.00	4.00	2.3333	1.23443
	AR_FLEX(POST)	15	102.00	120.00	115.8000	5.42744
	AR_EXT(POST)	15	.00	5.00	1.6667	1.63299
	PR_FLEX(POST)	15	105.00	120.00	116.4000	4.51664
	PR_EXT(POST)	15	.00	5.00	1.5333	1.59762
	MUSCLE_POWER(POST)	15	2.00	4.00	2.7333	.59362
	WOMAC_TOTAL(POST)	15	12.00	35.00	25.4000	5.81623
	WOMAC_PERCENT(POST)	15	12.50	36.46	26.4593	6.05895

The frequency distribution tables shows that majority of the subjects involved in this study are female (60%) and only 40% are male, while majority of the subjects have the problem on their left side of the **knee** (53.3%) and the remaining subjects (46.7%) have such problem on their right side of the **knee**. The sample of 30 subjects have been randomized into two treatments in 1:1 ratio - that is, 50% of the subjects received Group A (*Maitland Mobilization with Clinical Exercise or MMCE*) and the remaining 50% received Group B (*Maitland Mobilization alone or MM*). The average age of this sample of subjects is 54.83 years with the standard deviation of 8.23 years.

In addition, the descriptive statistics for age by treatment shows that the average age of the subjects who treated by MMCE is 55.60 years with the standard deviation of 8.63 and the average age of the subjects who treated by MM is 54.07 years with the standard deviation of 8.03. Similarly, the descriptive statistics for all the standard measures (before and after treatment) have been calculated for the whole sample and also separately for each treatment group and the corresponding outputs are shown in Table 2 and Table 3.

7.4. Testing the changes (from PRE to POST test) in all standard measures due to Group A (MMCE) and Group B (MM)

7.4.1 Testing the mean difference (from PRE to POST test) in all standard measures due to Group A (MMCE)

Hypotheses:

H_0: There is no significant mean difference (from PRE to POST test) in all standard measures due to Group A (MMCE)

H_1: There is significant mean difference (from PRE to POST test) in all standard measures due to Group A (MMCE)

Let the level of significance be $\alpha = 0.05$

Test to be applied: Paired Samples t-test

The **output** of this test is presented below:

Table 4

Pre and Post Test Mean and SD for Testing all standard measures (i.e., NPRS, ROM, MUSCLE POWER and WOMAC scores) due to Group A (*MMCE*)

Paired Samples Statistics					
Treatment			Mean	N	Std. Deviation
Group A	Pair 1	NPRS(PRE)	7.8000	15	1.47358
		NPRS(POST)	1.6667	15	1.11270
	Pair 2	AR_FLEX(POST)	113.0667	15	6.44168
		AR_FLEX(PRE)	93.2000	15	12.74587
	Pair 3	AR_EXT(PRE)	6.8667	15	4.71876
		AR_EXT(POST)	1.5333	15	1.84649
	Pair 4	PR_FLEX(POST)	114.0667	15	5.77515
		PR_FLEX(PRE)	96.3333	15	11.28632
	Pair 5	PR_EXT(PRE)	6.0667	15	4.75795
		PR_EXT(POST)	1.2000	15	1.37321
	Pair 6	MUSCLE_POWER(POST)	4.4000	15	.50709
		MUSCLE_POWER(PRE)	2.4667	15	.51640
	Pair 7	WOMAC_PERCENT(PRE)	73.4720	15	14.17751
		WOMAC_PERCENT(POST)	22.0833	15	8.70846

Table 5

Pre and Post Test Comparison of Mean, SD and MD for Testing the mean reduction in all standard measures (i.e., NPRS, ROM, MUSCLE POWER and WOMAC scores) due to Group A (*MMCE*)

Treatment			Paired sample test	
			Mean	Std. Deviation
Group A	Pair 1	NPRS(PRE) - NPRS(POST)	6.13333	.99043
	Pair 2	AR_FLEX(POST) - AR_FLEX(PRE)	19.86667	8.83877
	Pair 3	AR_EXT(PRE) - AR_EXT(POST)	5.33333	3.49830
	Pair 4	PR_FLEX(POST) - PR_FLEX(PRE)	17.73333	7.43992
	Pair 5	PR_EXT(PRE) - PR_EXT(POST)	4.86667	3.99762
	Pair 6	MUSCLE_PWR(POST) - MUSCLE_PWR(PRE)	1.93333	.70373
	Pair 7	WOMAC_%(PRE) - WOMAC_%(POST)	51.38867	7.01682

From the above output, we conclude that

- There is significant mean difference in **NPRS** scores due to Group A "MMCE" ($t(14) = 23.984$, p-value = $0.000 < 0.05$). The mean difference in NPRS scores due to this treatment is 6.13 with the standard deviation of 0.99. From this result, we conclude that there is significant mean **reduction** in NPRS scores due to Group A "MMCE".

- There is significant mean difference in **Active ROM Flexion** scores due to Group A "MMCE" ($t(14) = 8.705$, p-value = $0.000 < 0.05$). The mean difference in Active ROM Flexion scores due to this treatment is 19.87 with the standard deviation of 8.84. From this result, we conclude that there is significant mean **increase** in Active ROM Flexion scores due to Group A "MMCE".

- There is significant mean difference in **Active ROM Extension** scores due to Group A"MMCE" (t(14) = 5.905, p-value = 0.000 < 0.05). The mean difference in Active ROM Extension scores due to this treatment is 5.33 with the standard deviation of 3.49. From this result, we conclude that there is significant mean **reduction, so there will be increase** in Active ROM Extension scores due to Group A "MMCE".

- There is significant mean difference in **Passive ROM Flexion** scores due to Group A "MMCE" (t(14) = 9.231, p-value = 0.000 < 0.05). The mean difference in Passive ROM Flexion scores due to this treatment is 17.73 with the standard deviation of 7.44. From this result, we conclude that there is significant mean **increase** in Passive ROM Flexion scores due to Group A "MMCE".

- There is significant mean difference in **Passive ROM Extension** scores due to Group A "MMCE" (t(14) = 4.715, p-value = 0.000 < 0.05). The mean difference in Passive ROM Extension scores due to this treatment is 4.87 with the standard deviation of 3.998. From this result, we conclude that there is significant mean **reduction, so there will be increase** in Passive ROM Extension scores due to Group A "MMCE".

- There is significant mean difference in **Muscle Power** scores due to Group A "MMCE" (t(14) = 10.640, p-value = 0.000 < 0.05). The mean difference in Muscle Power scores due to this treatment is 1.93 with the standard deviation of 0.704. From this result, we conclude that there is significant mean **increase** in Muscle Power due to Group A "MMCE".

- There is significant mean difference in **WOMAC percent** due to Group A "MMCE" (t(14) = 28.364, p-value = 0.000 < 0.05). The mean difference in WOMAC percent due to this treatment is 51.39 with the standard deviation of 7.02. From this result, we conclude that there is significant mean **reduction** in **WOMAC rate** due to Group A "MMCE".

4.2 Testing the mean difference (from PRE to POST test) in all standard measures due to Group B (MM)

Hypotheses:

H_0: There is no significant mean difference (from PRE to POST test) in all standard measures due to Group B (MM)

H_1: There is significant mean difference (from PRE to POST test) in all standard measures due to Group B (MM)

Let the level of significance be $\alpha = 0.05$

Test to be applied: Paired Samples t-test

The **output** of this test is presented below:

Table 6

Pre and Post Test Mean and SD for Testing all standard measures (i.e., NPRS, ROM, MUSCLE POWER and WOMAC scores) due to Group B (*MM*)

Paired Samples Statistics					
Treatment			Mean	N	Std. Deviation
Group B	Pair 1	NPRS(PRE)	7.7333	15	1.48645
		NPRS(POST)	2.3333	15	1.23443
	Pair 2	AR_FLEX(POST)	115.8000	15	5.42744
		AR_FLEX(PRE)	97.7333	15	13.80200
	Pair 3	AR_EXT(PRE)	8.6667	15	3.65800
		AR_EXT(POST)	1.6667	15	1.63299
	Pair 4	PR_FLEX(POST)	116.4000	15	4.51664
		PR_FLEX(PRE)	98.9333	15	13.57238
	Pair 5	PR_EXT(PRE)	7.9333	15	3.45309
		PR_EXT(POST)	1.5333	15	1.59762
	Pair 6	MUSCLE_POWER(POST)	2.7333	15	.59362
		MUSCLE_POWER(PRE)	2.4000	15	.50709
	Pair 7	WOMAC_%(PRE)	75.4180	15	13.00870
		WOMAC_%(POST)	26.4593	15	6.05895

Table 7

Pre and Post Test Comparison of Mean, SD and MD for Testing the mean reduction in all standard measures (i.e., NPRS, ROM, MUSCLE POWER and WOMAC scores) due to Group B (*MM*)

Treatment			Paired sample test			
			Mean	Std. Deviation	t	dt
Group B	Pair 1	NPRS(PRE) - NPRS(POST)	5.40000	.63246	**33.068**	**14**
	Pair 2	AR_FLEX(POST) - AR_FLEX(PRE)	18.06667	10.37488	**6.744**	**14**
	Pair 3	AR_EXT(PRE) - AR_EXT(POST)	7.00000	2.87849	**9.418**	**14**
	Pair 4	PR_FLEX(POST) - PR_FLEX(PRE)	17.46667	10.85533	**6.232**	**14**
	Pair 5	PR_EXT(PRE) - PR_EXT(POST)	6.40000	2.72029	**9.112**	**14**
	Pair 6	MUSCLE_POWR(POST) - MUSCLE_POWR(PRE)	.33333	.48795	**2.646**	**14**
	Pair 7	WOMAC_%(PRE) - WOMAC_%(POST)	48.95867	11.86329	**15.983**	**14**

From the above output, we conclude that

- There is significant mean difference in **NPRS** scores due to Group B "MM" ($t(14) = 33.068$, p-value = $0.000 < 0.05$). The mean difference in NPRS scores due to this treatment is 5.40 with the standard deviation of 0.632. From this result, we conclude that there is significant mean **reduction** in NPRS scores due to Group B "MM".

- There is significant mean difference in **Active ROM Flexion** scores due to Group B "MM" ($t(14) = 6.744$, p-value = $0.000 < 0.05$). The mean difference in Active ROM Flexion scores due to this treatment is 18.07 with the standard deviation of 10.37.

From this result, we conclude that there is significant mean **increase** in Active ROM Flexion scores due to Group B "MM".

- There is significant mean difference in **Active ROM Extension** scores due to Group B "MM" (t(14) = 9.418, p-value = 0.000 < 0.05). The mean difference in Active ROM Extension scores due to this treatment is 7.0 with the standard deviation of 2.88. From this result, we conclude that there is significant mean **reduction, so there will be increase** in Active ROM Extension scores due to Group B "MM".

- There is significant mean difference in **Passive ROM Flexion**scores due to Group B "MM" (t(14) = 6.232, p-value = 0.000 < 0.05). The mean difference in Passive ROM Flexion scores due to this treatment is 17.47 with the standard deviation of 10.86. From this result, we conclude that there is significant mean **increase** in Passive ROM Flexion scores due to Group B "MM".

- There is significant mean difference in **Passive ROM Extension** scores due to Group B "MM" (t(14) = 9.112, p-value = 0.000 < 0.05). The mean difference in Passive ROM Extension scores due to this treatment is 6.40 with the standard deviation of 2.72. From this result, we conclude that there is significant mean **reduction, so there will be increase** in Passive ROM Extension scores due to Group B "MM".
- There is significant mean difference in **Muscle Power** scores due to Group B "MM" (t(14) = 2.646, p-value = 0.019 < 0.05). The mean difference in Muscle Power scores due to this treatment is 0.33 with the standard deviation of 0.49. From this result, we conclude that there is significant mean **increase** in Muscle Power due to Group B "MM".

- There is significant mean difference in **WOMAC percent** due to Group B "MM" (t(14) = 15.983, p-value = 0.000 < 0.05). The mean difference in WOMAC percent due to this treatment is 48.96 with the standard deviation of 11.86. From this result, we conclude that there is significant mean **reduction** in **WOMAC rate** due to Group B "MM".

5 . Comparison of Group A (MMCE) with Group B (MM) in terms of mean change (from Pre to Post test) in all standard measures (TABLE 8)

Hypotheses:

H_0: There is no significant difference between two treatments (MMCE and MM) in terms of mean change (from Pre to Post test) in all standard measures

H_1: There is significant difference between two treatments (MMCE and MM) in terms of mean change (from Pre to Post test) in all standard measures

Let the level of significance be $\alpha = 0.05$

Test to be applied: Independent Samples t-test

The **output** of this test is presented below:

Comparison Between Group A (MMCE) with Group B (MM) in terms of mean change (from Pre to Post test) in all standard measures

Table 8

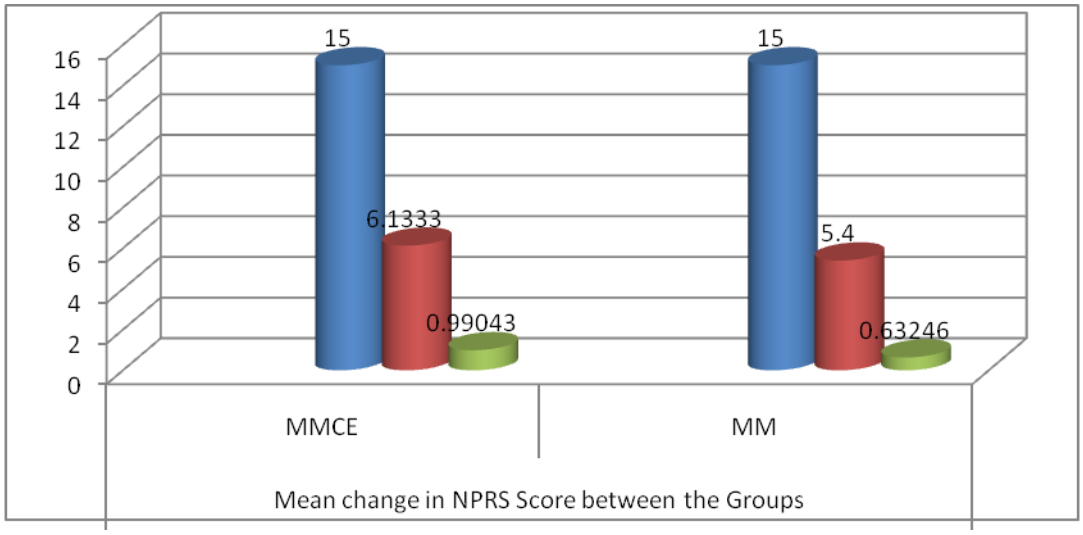
Group statistics				
	Treatment	N	Mean	Std. Deviation
NPRS(PRE) - NPRS(POST)	MMCE	15	6.1333	.99043
	MM	15	5.4000	.63246
AR_FLEX(POST) - AR_FLEX(PRE)	MMCE	15	19.8667	8.83877
	MM	15	18.0667	10.37488
AR_EXT (PRE) - AR_EXT(POST)	MMCE	15	5.3333	3.49830
	MM	15	7.0000	2.87849
PR_FLEX(POST) - PR_FLEX(PRE)	MMCE	15	17.7333	7.43992
	MM	15	17.4667	10.85533
PR_EXT(PRE) - PR_EXT(POST)	MMCE	15	4.8667	3.99762
	MM	15	6.4000	2.72029
Muscle Power(POST) – Muscle Power(PRE)	MMCE	15	1.9333	.70373
	MM	15	.3333	.48795
WOMAC%(PRE) - WOMAC%(POST)	MMCE	15	51.3887	7.01682
	MM	15	48.9587	11.86329

Table 9		Levene's Test for Equality of Variances		t-test for equality of means			
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference
NPRS(PRE) – NPRS(POST)	Equal variances assumed	.899	.351	**2.417**	**28**	**.022**	.73333
	Equal variances not assumed			2.417	23.790	.024	.73333
AR_FLEX(POST) - AR_FLEX(PRE)	Equal variances assumed	1.015	.322	**.511**	**28**	**.613**	1.80000
	Equal variances not assumed			.511	27.311	.613	1.80000
AR_EXT(PRE) - AR_EXT(POST)	Equal variances assumed	.184	.671	**-1.425**	**28**	**.165**	-1.66667
	Equal variances not assumed			-1.425	26.999	.166	-1.66667
PR_FLEX(POST) - PR_FLEX(PRE)	Equal variances assumed	3.200	.084	**.078**	**28**	**.938**	.26667
	Equal variances not assumed			.078	24.775	.938	.26667
PR_EXT(PRE) - PR_EXT(POST)	Equal variances assumed	1.498	.231	**-1.228**	**28**	**.230**	-1.53333
	Equal variances not assumed			-1.228	24.676	.231	-1.53333
Muscle Power(POST) – Muscle Power(PRE)	Equal variances assumed	.167	.686	**7.236**	**28**	**.000**	1.60000
	Equal variances not assumed			7.236	24.934	.000	1.60000
WOMAC%(PRE) - WOMAC%(POST)	Equal variances assumed	.881	.356	**.683**	**28**	**.500**	2.43000
	Equal variances not assumed			.683	22.727	.502	2.43000

From the above output, we have

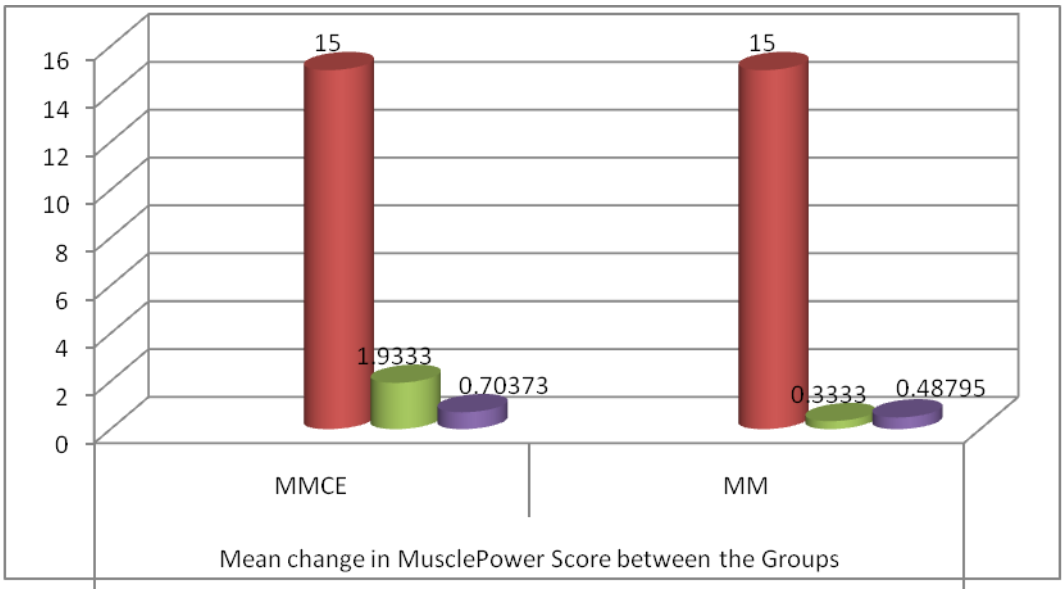
Result that shows significant difference:

- There is significant difference between two treatments (MMCE and MM) (Table 9) in terms of mean **reduction** in **NPRS** scores ($t(28) = 2.417$, $p = 0.022 < 0.05$). Going by the mean values, we conclude that the mean reduction in NPRS scores due to the treatment MMCE ($M = 6.133$ & $SD = 0.99$) is greater than that of the treatment MC ($M = 5.40$ & $SD = 0.63$) (Table 8).



Graph 1

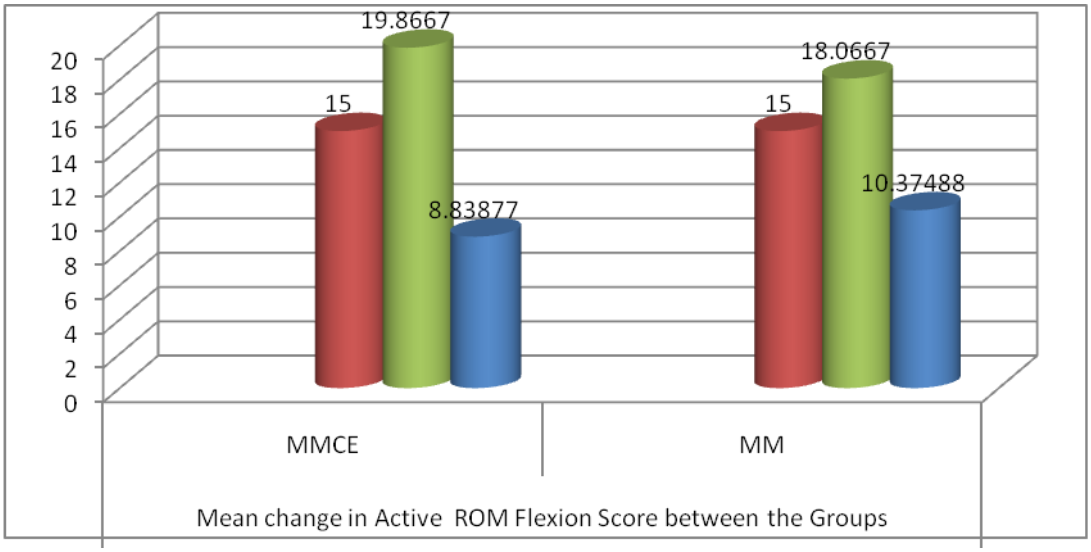
- There is significant difference between two treatments (MMCE and MM) (Table 9) in terms of mean **increase** in **Muscle Power** ($t(28) = 7.236$, $p = 0.000 < 0.05$). Going by the mean values, we conclude that the mean reduction in Muscle Power due to the treatment MMCE ($M = 1.93$ & $SD = 0.70$) is greater than that of the treatment MC ($M = 0.33$ & $SD = 0.49$) (Table 8).



Graph 2

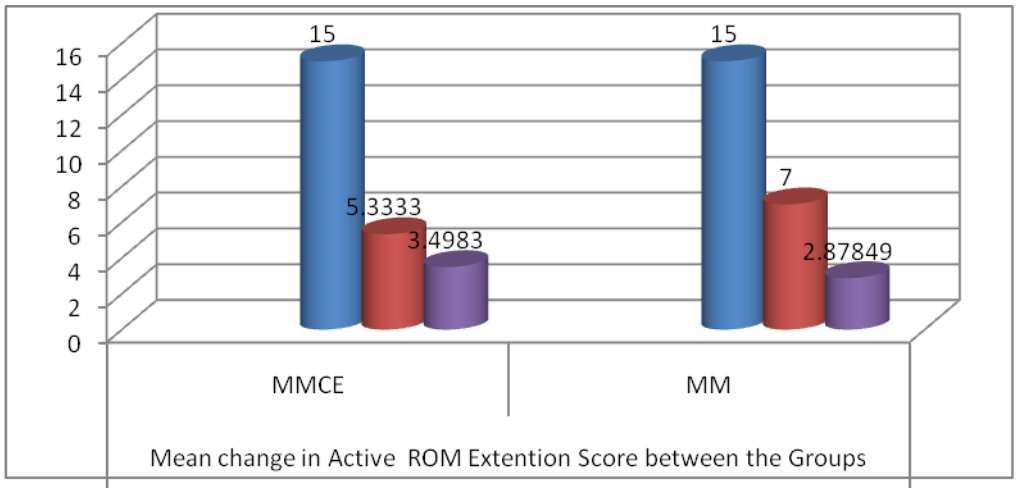
Result that shows insignificant difference:

- The difference between two treatments (MMCE and MM) (Table 9) in terms of mean **increase** in **Active ROM Flexion** scores is **insignificant** (t(28) = 0.511, p = 0.613 > 0.05).



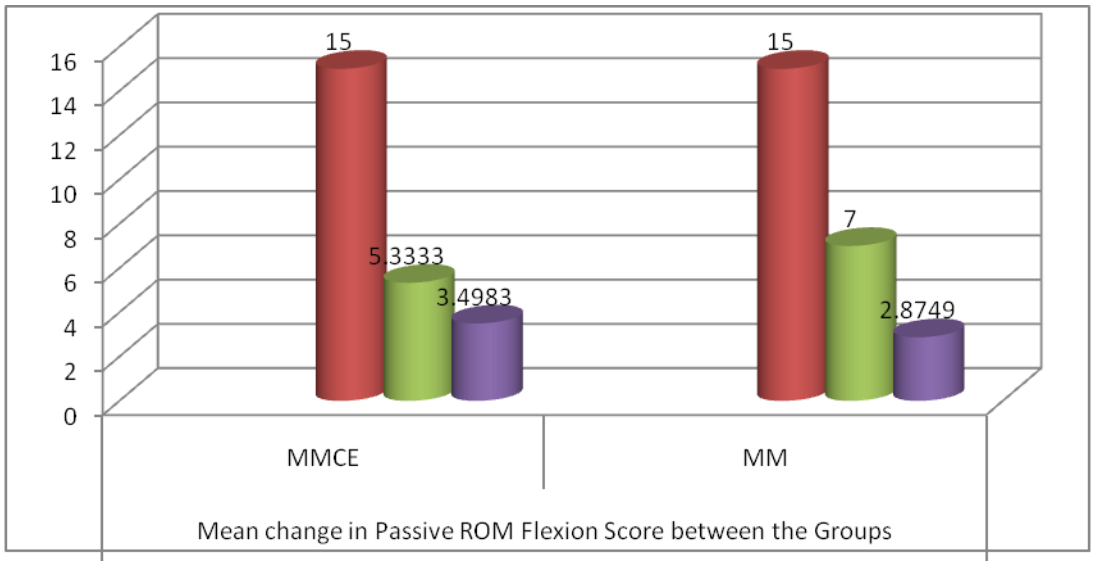
Graph 3

- The difference between two treatments (MMCE and MM) (Table 9) in terms of mean **reduction** in **Active ROM Extension** scores is **insignificant** ($t(28) = -1.425$, $p = 0.165 > 0.05$) .



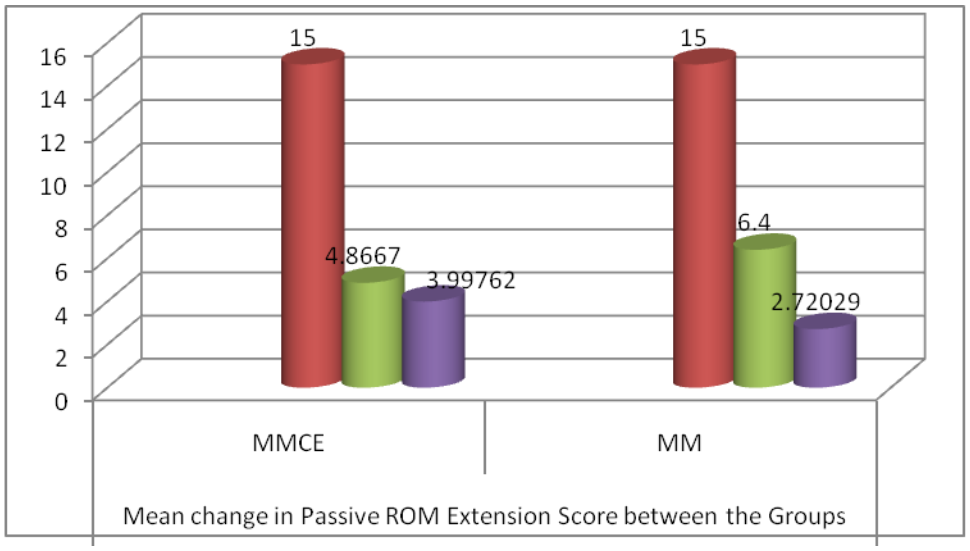
Graph 4

- The difference between two treatments (MMCE and MM) (Table 9) in terms of mean **increase** in **Passive ROM Flexion** scores is **insignificant** ($t(28) = 0.078$, $p = 0.938 > 0.05$).



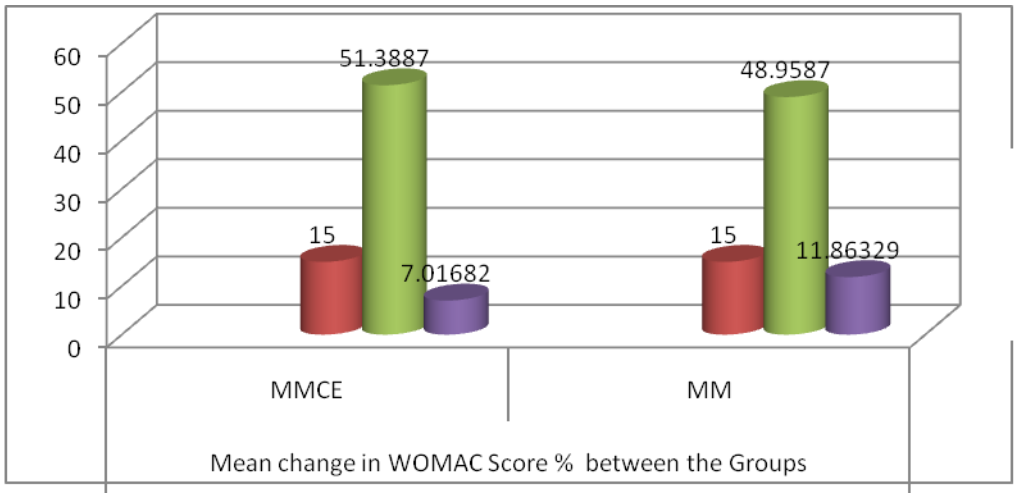
Graph 5

- The difference between two treatments (MMCE and MM) (Table 9) in terms of mean **reduction** in **Passive ROM Extension** scores is **insignificant** (t(28) =1.228,p = 0.230 > 0.05) .



Graph 6

- The difference between two treatments (MMCE and MM) (Table 9) in terms of mean **reduction** in **WOMAC%** scores is **insignificant** (t(28) = 0.683 p = 0.500 > 0.05).



Graph 7

8. DISCUSSION:

The present study intended to compare the effectiveness of Maitland mobilization with clinical exercise versus Maitland mobilization alone in patients with severe tibio femoral Osteoarthritis in reducing pain, improving ROM, muscle power and functional status.

The sample of 30 subjects have been randomized into two groups in 1:1 ratio that is 50% of subjects received Maitland mobilization with clinical exercise and the remaining 50% of subjects received Maitland mobilization alone. Participants received treatment 12 sessions of treatment for 4 weeks duration.

In Group A, received Maitland mobilization with clinical exercise shows effectiveness on pain Based on statistical analysis using **Paired sample t test results**, **NPRS**[p-value = 0.000 < 0.05, mean = 6.13 & SD= 0.99], This may be due to activation of central and peripheral pain inhibitory system and chemical changes in peripheral nociceptors and also altering the neuro physiological mechanism and kinesiological mechanism either alone or in combination.

Similar findings on greater symptomatic relief of pain in combination with manual therapy and supervised exercise previously reported by **Deyle et al 2005** [(36)]and exercise also effective in reducing pain stated by **Greshman Fisher et al**[(59)].

In this study comparing the pre and post test score in Group A for **Muscle power of quadriceps** [p-value = 0.000 < 0.05, mean = 1.93, SD = 0.704], shows more effective in improving muscle power, Osteoarthritis include joint damage causes pain and restricted mobility, resulting in muscle weakness so in this Group clinical exercise includes strengthening program improves the muscle power. Some of the studies also used strengthening exercise to improve muscle power and they proved that muscle power is increased **Neil et al** 2010 and **Hurler & Scott et al** 1998 studies also shows that progressive strengthening exercise improve quadriceps strength [(41)]

Comparing results of pre and post test in Group A shows significant improvement mean difference in **Active ROM Flexion** [p-value = 0.000 < 0.05, mean = 19.87 & SD = 8.84], In this study clinical exercise including closed kinematic chain is used, previous study done by **Ettinger W H Jr** showed improvement in physical activity using closed kinematic chain

exercise in improving active ROM and also improve muscle power. This statement supports our study in increasing active ROM flexion which shows there is improvement in flexor group muscle [58]

In this study comparing the pre and post test score in Group A shows significant improvement mean difference in **Active ROM Extension**[p-value = 0.000 < 0.05, mean = 5.53, SD = 3.49],manual therapy and clinical exercise decreases pain and increased in muscle power results in increase in active Range Of Motion extension. Thus this study supports the view of **Halim Yilmaz et al 2013** shows that exercise program includes quadriceps and hamstring muscle work improves ROM and physical function and another research **Penninx B W et all 2002** showed that aerobic exercise program, resistance exercise program improve ADL which could be due to increased range of motion. [68]

When comparing the pre and post test score **Passive ROM flexion**[p-value = 0.000 < 0.05, mean = 17.73, SD = 7.44]shows significant improvement in mean difference, one of the study done by **Samson et al** shows that Maitland mobilization and Therab and exercise improves the knee joint range of motion particularly in passive ROM flexion and passive ROM extension.

In this study comparing the pre and post test score shows significant improvement mean difference in **Passive ROM Extension**[p-value = 0.000 < 0.05, Mean = 4.87, SD = 3.998]. Some of the studies show significant increase ROM (p=0.000) by using knee joint mobilization in **Fish, Denham et al** 2008[56].

In Group A **WOMAC %**[p-value = 0.000 < 0.05, mean = 51.39, SD =7.02], It also shows that Maitland mobilization with clinical exercise is effective in improving functional activities. One of the study done by **Gail D Deyle et al** 2005 shows that physical therapy and supervised clinical exercise group obtained successful outcome as measured by significant reduction in WOMAC score [36] and another study done by **Petrella, Bartha et al** 2005 using strengthening exercise program improved the WOMAC score[57].

Thus this study supports the view of **Ottowa Panel Evidence-Based Clinical Practice Guidelines for Therapeutic Exercises and Manual Therapy in the management of Osteoarthritis** recommends the use of therapeutic exercise. It concluded that therapeutic exercise is beneficial for reducing pain, improving muscle strength, ROM & improving quality of life[43]

In group B, received Maitland mobilization alone shows effectiveness on pain. Based on statistical analysis using **Paired sample t test results**, **NPRS**[p-value = 0.000 < 0.05, mean = 5.40& SD= 0.632], some of the studies shows that Manipulation included analgesic effects has been demonstrated in a number of studies in human subjects by **Vernon et al 1990, vicenzino et al 1996** and **Skyba et al 2003** study show that analgesic effect following knee joint mobilization was primarily due to enhancement of the descending pain inhibitory pathway in the spinal cord which utilize serotonergic c5 –HTA and noradrenergic receptor (Alpha)[(34)].**Wright et al (2004)** Suggests that gentle repetitive movements of the joint provides hypoalgesia effects. These causes reflect changes in local cellular changes[(35)].

In Group B comparing the pre and post test score shows significant improvement in mean difference on **Muscle power**,[p-value = 0.019 < 0.05, mean = 0.33, SD = 0.49],due to decrease in NPRS results in increase in muscle power, through increasing the physical function, Thus this study supports manual therapy improves the physical function done by **J Haxby Abbott et al 2009[(37)].**

In Group B **Active ROM Flexion** [p-value = 0.000 < 0.05, mean = 18.07 & SD = 10.37], Maitland mobilization induced hypoalgesia is effective in reducing pain by **Penny Moss et al 2004** this could leads to increase the physical activities result indirectly increase in active ROM flexion[(29)] and another study shows standard deviation of active flexion is 7.22 to 4.90 progressed in active flexion by using Maitland Mobilization with TENS by **Samson et al.**

When comparing the pre and post test score in Group B shows significantly improvement in mean difference on **Active ROM Extension**[p-value = 0.000 < 0.05, mean = 7.0, SD = 2.88], as such we discussed above there will be increase in muscle power of quadriceps which is having main role in extension of knee joint it can increase the active ROM extension and **Samson et al** showed standard deviation 4.54 to 2.46 progressed the active ROM extension by using Maitland mobilization.

In this Group B comparing the pre and post test score shows significant improvement in mean difference on **Passive ROM Flexion**[p-value = 0.000 < 0.05, mean = 17.47, SD = 10.86] shows improved in significant mean difference, this could be due to active ROM shows improvement this results in increase in passive ROM. This study supports that **Samson et al** showed that increase in the passive ROM flexion by using Maitland mobilization with TENS and this study also supports the **Sara Maher et al 2010** shows improvement on passive ROM flexion followed by tibiofemoral mobilization[(28)].

When comparing the pre and post test score shows significant improvement in mean difference on **Passive ROM Extension**[p-value = 0.000 < 0.05, Mean = 6.40, SD = 2.72]some of the studies showed significant improvement in passive ROM extension by **Samson et al** by using Maitland mobilization.

WOMAC %[p-value = 0.000 < 0.05, mean = 48.96, SD =11.86].Maitland mobilization is effective in reducing pain through hypoalgesic effect and it can results in improvement of physical function by **Penny Moss et al 2006** and **Samson et al**[29].

It shows that Maitland mobilization alone also effective in reducing pain, increase in ROM and improving functional activities.

On comparison of both groups i.e group A & B, the intergroup comparison using **Independent sample t test results**, **NPRS**[p = 0.022 < 0.05,Group A (M = 6.133 & SD = 0.99) is greater than that of Group B (M = 5.40 & SD = 0.63)],**Pollard H, Chiro GD** et al have studied on the effect of a manual therapy knee protocol on osteoarthritis knee pain, they investigated that, a short term manual therapy knee protocol significantly reduced pain [55] and also **Tucker M, Brantingham J** et al 2003 have shown that manual therapy has significant improvement in NRS, VAS. **Nor Azlin M N et al** proved that joint mobilization decrease pain and other studies shows that combination of manual therapy[26] and supervised clinical exercise is having more effect on reducing pain than that of Maitland mobilization alone [**Gail Deyle et al**] [31]

Comparing Group A and Group B on **Muscle power**[p = 0.000 < 0.05],Group A (M = 1.93 & SD = 0.70) is greater than that of the treatment Group B (M = 0.33 & SD = 0.49). It shows that there significant reduction in pain and improvement in muscle power in group A than group B. It is due to group A include Clinical Exercise consists of strengthening program and some of the study shows that mobilization indirectly increase muscle power, **Moss et al 2003** studied that AP mobilization of tibia on femur shows significant decrease on pain and increases physical function[29].

By comparing the both Group we concluded that Group A and Group B is both having equal effects on **Active ROM Flexion**[p=0.613>0.05]**, Active ROM Extension**[p=0.165>0.05], **Passive ROM Flexion**[p=0.938>0.05], **Passive ROM Extension**[p=0.452>0.05], **WOMAC %**[p=0.500>0.05], this is may be due to less repetition of exercise and also may be due to short duration of study. In future study we can make long duration of study on Maitland

mobilization and clinical exercise by altering the repetition of exercise, to analyze the effects on active ROM and passive ROM of knee in tibiofemoral osteoarthritis.

Despite limitation of review, it suggest that additional exercise may have significantly better effect compared to Maitland Mobilization alone in terms of pain relief and improve muscle power.

Since on comparison, on the whole it shows that Maitland mobilization with clinical exercise is significantly effective in reducing pain, improving ROM, Muscle power and functional activities than Maitland mobilization alone.

9. LIMITATION & RECOMMENDATION:

LIMITATION

- Sample size is small
- No control group
- Short duration of the study and no long term follow up of patients

RECOMMENDATIONS:

- A Large sample size can be taken
- Study can be done with comparing other modalities and also using control group.
- Longer study duration and follow up can be done to assess long term benefits
- Difference between male and female can be studied/dominant & non dominant side

10. CONCLUSION :

Going by the results of the analysis, we see that there is significant mean difference in all standard measures due to both the treatments "Maitland Mobilization with Clinical Exercise (MMCE)" and "Maitland Mobilization alone (MM)". This results clearly indicates that both the treatments are effective in reducing pain, improving ROM, muscle power and functional activities. However, by comparing (i.e., testing) the effectiveness of each treatment with respect to all standard measures, we see that the treatment "Maitland Mobilization with Clinical Exercise" is more effective than "Maitland Mobilization" in terms of reducing **NPRS** and increasing **Muscle Power**. But both the treatments are appearing to be equally effective in terms of the remaining 8 standard measures (Active ROM Flexion, Active ROM Extension, Passive ROM Flexion, Passive ROM Extension, and WOMAC%).

On the whole, we conclude that the treatment "Maitland Mobilization with Clinical Exercise" is little more effective than the treatment "Maitland Mobilization alone" in certain standard measures such as NPRS and Muscle Power.

11. REFERENCES:

1) **Lone AR, Wafai ZA, Buth BA, Wani T, Koul PA, Khan SH**, Analgesic efficacy of transcutaneous electrical nerve stimulation compared with diclofenac sodium osteoarthritis of the knee.Physiotherapy,2003;89(8):478-485

2) **Phipps WJ, Cassmeyer VL, Sands JK, Lehman NM**. Medicalsurgical nursing: concepts and clinical practice. 4th ed. St. Louis:Mosby; 1994.

3)**Peat G, Mc Carney R, Croft P**, Knee pain in osteoarthritis in older adult, Review ofScommunity burden and current use primary health care, *Ann rheum dis.* 2001;60;91-97

4) **Lawrence JS, Bremner JM, Bier F**. Osteo-arthrosis: prevalence the population and relationship between symptoms and x-ray changes. Ann Rheum Dis 1966;25:1-24

Burckhardt CS. Chronic pain.NursClin North Am 1990;25:863-7

5)**Ahlbacks,**osteoarthritis of the knee. A radiographic investigation 1968

6) **Tidy's**, Physiotherapy,1996:13th edition.

7)**OliveriSA,FelsonDT,Reed JI**, In cadence of symptomatic hand, hip and knee osteoarthritis among patient in health maintenance organization RHE Arthritis1995;123-135

8) **Michael Doherty**,*Osteoarthritis;*1994:11

9) **Sharma L, Hayes KW, Felson DT, et al**. Does laxity alter the relationship between strength and physical function in knee osteoarthritis. Arthritis Rheum 1999;42:25-32.

10) **Hurley MV**. The role of muscle weakness in the pathogenesis of osteoarthritis.RheumDisclin North Am 1999;25:283-98.

11) **Maitland GD**, *vertebral manipulation*,5th edition,Sydney,buttersworth,1986;9.

12) **Maitland G**.2005 Maitland's peripheral manipulation in Hengeveld , E& Banks, K 4th edition Edinburgh E elseiver ltd.

13) **VincezinoB,Paungmali, A.Buratowski S and wright A** 2001 Specific Manipulative Therapy for chronic lateral epicondulalgic produce uniquely characteristic hypoalgesia.

14)**Moss P slukawright A R,leeper** initial effect of knee joint mobilizartion on osteoarthritis hyperlgosia Man Ther 2007:72:10918.

15) **Puett DW, Griffin MR**. Published trials of nonmedicinal and noninvasivetherapies for hip and knee osteoarthritis. Ann Intern Med. 1994;121:133-40.

16) **Lane NE, Buckwalter JA**. Exercise: a cause of osteoarthritis? Rheum Dis ClinNorth Am. 1993;19:617-33.

17) **Daly MP, Berman BM**. Rehabilitation of the elderly patient with arthritis.ClinGeriatr Med. 1993;9:783-801.

18) **Nesher G, Moore TL**. Clinical presentation and treatment of arthritis in theaged.ClinGeriatr Med. 1994;10:659-75.

19) **Ytterberg SR, Mahowald ML, Krug HE**. Exercise for arthritis. BaillieresClinRheumatol. 1994;8:161-89.

20)**Hall KD, Hayes KW, Falconer J**. Differential strength decline in patientswith osteoarthritis of the knee: revision of a hypothesis. Arthritis CareRes. 1993;6:89-96, doi: 10.1002/art.1790060208.

21)**Tan J, Balci N, Sepici V, Gener FA**. Isokinetic and isometric strength inosteoarthrosis of the knee.A comparative study with healthy women.Am J Phys Med Rehabil. 1995;74:364-9, doi: 10.1097/00002060-199509000-00008

22)**Fransen M, Crosbie J, Edmonds J**. Physical therapy is effective forpatients with osteoarthritis of the knee: a randomized controlled clinicaltrial. J Rheumatol. 2001;28:156-64.

23) **Huang MH, Lin YS, Yang RC, Lee CL.** A comparison of varioustherapeutic exercises on the functional status of patients with kneeosteoarthritis.Semin Arthritis Rheum. 2003;32:398-406, doi: 10.1053/sarh.2003.50021.

24) **Deyle GD, Henderson NE, Matekel RL et.** al , effectiveness of manual physical therapy inosteoarthritis of the knee, *Annals of internal medicine*, 2000;132(3):173-181

25)**Ianmarshall.**Division of pediatric Endocrinology 2006 june06 [online] available

26**) Nor Azlin,**et al Effects of passive joint mobilization on patients with knee osteoarthritis.UKM Journal article repository, Sain'smalaysiana, 40 (12) pp.1461-1465.

27)**G.kFitzegarld**, Therapeutic exercise for knee. European journal of physical and rehabilitation medicine, Europa medicalphysio 2005june 4(2):163-71

28) **Sara Maher** examined the effect of tibio-femoral traction Mobilization on passive knee flexion motion impairment and pain. Journal of manual and manipulative therapy 2010 vol.8 no.1

29) **Penny Moss**, the initial effect of knee joint mobilization on osteoarthritis hyperalgesia. Journal of manual and manipulation, 12(2007):109-118.

30) **Maria Alexander Ferraria-velanta**, validity of four pain intensity rating scale, International association for the study of pain. 152(2011) 2399-2404

31) **Deyle GD,Henderson** effectiveness of manual therapy and exercise in osteoarthritis of the knee. Ann. Internal medicine 2000:132:173-181.

32) **Marlene Fransen** physical therapy is effective for patient with osteoarthritis of knee. Journal of Rheumatology 2001: 28 :156-164.

33) **Mariette J Jansen** strength training alone, exercise therapy alone and exercise therapy with passive manual mobilisation each reduce pain and disability in people with knee osteoarthritis Journal of physiotherapy 2011 :57: 11-20.

34) **D A Skyba** et al joint manipulation reduce pain by activation of monamine receptors but not opiod (or) Gaba receptors in the spinal cord. International association for the study of pain 2003 : Nov : 106(1-2) :159-168.

35) **Wright A,** Hypoalgesic post- manipulation therapy: review of apotential neurophysiological mechanism. Manual Therapy 1995:111-116.

36) **Gail D Deyle et al** physical therapy treatment effectiveness for Osteoarthritis of knee: A randomized comparison of supervised clinical exercise and manual therapy procedure versus a home exercise. PHYS THER. 2005;85:1301-1317.

37**) J Haxby Abott et al** exercise therapy, manual therapy, or both, for osteoarthritis of the hip or knee: A factorial randomised controlled trail protocol. Trails journal FEB 2009,10: 11.

38) **Marlene fransen, Sara Mc Connell**, Exercise for osteoarthritis of the knee : Cochrane Database of sysmtematic reiews 2008.

39) **Kim L. Bennell , Rana S . Hinman** , A review of the clinical evidence for exercise in osteoarthritis of the hip and knee , Journal of Science and Medicine in Sport 14 (2011) 4-9.

40) **Robert Topp et al** , The effect of dynamic versus Isometric resistance training on pain and functioning among adults with osteoarthritis of the knee:Arch Phys Med Rehabil Vol 83 , September 2002.

41) **Neil A.Segal et al** , effect of quadriceps strength and proprioception on risk for knee osteoarthritis:Official Journal of the American College of Sports Medicine 2081-88:2010.

42) **M E van Baar et al** , Effectiveness of exercise in patients with osteoarthritis of hip or knee: nine months follow up : Ann Rheum Dis 2001 ; 60:1123-30.

43) **LucieBrousseau** et al Ottawa panel evidence-based clinical practise guidelines for therapeutic exercise and manual therapy in the management of osteoarthritis PHYS THER. 2005; 85:907-971.

44) **Brian T. Maurer,**Osteoarthritis of the Knee: Isokinetic Quadriceps Exercise Versus an Educational Intervention:Arch Phys Med Rehabil Vol 80, October 1999:1293-99.

45) **Ferrerz MB**, et al

46) **Gillian A . Howker et a**l Measures of adult pain . Arthritis care and research vol -63 , 240-252,2011.

47) **Erin E.Krebs MD,MPH**: Timothy MD,MPH et al Accuracy of the pain numeric rating scale as a screening test in primary care. Article from Journal of general internal medicine , Pubmed.

48) **Maria Alexandra Ferreira-Valente** et al , Validity of four pain intensity rating scales :pain 152 (2011)2399-2404.

49) **Ellen Flaherty et al (2012)**, Pain Assessment for older adults from the hertford institute for geriatric nursing, new York university, college of nursing issue nov 7.

50)**American thoracic society**pain evalution on lower extrimity

51) **Jules M Rothisitcin** Goniometric reliability in clinical setting: elbow and knee measurements PHYS THER, 1983; 63: 1611-1615.

52) **Prem P Gogia** Reliability and validity of goniometric measurements at the knee. PHYS THER 1987; 67:192-195

53) **K.G.Auw Yang**, validation of the short form womac function scale for the evaluation of osteoarthritis of the knee. Journal of Bone and Joint Surgery January VOL 89-13 No.1 Jan 2007.

54) **N.Bellamy** et al

55)**Pollard et al, Chiro GD et al**. The effect of a manual therapyknee protocol on osteoarthritis knee pain: a randomized controlled trial. J Can Chiropr Assoc 2008;52(4):229-42.

56) Fish Denham et al A Randomized Clinical Trial to Determine the Effect of Combining a Topical Capsaicin Cream and Knee-Joint Mobilization in the Treatment of Osteoarthritis of the Knee. Journal of the American Chiropractic Association . Aug2008, Vol. 45 Issue 6, p8-23**.**

57)**Pettrella RJ, Bartha C**. Home based exercise therapy for olders persons with knee osteoarthritis: a randomised clincial trial. J Rheumatol 2000;27:2215–21.

58) **Ettinger WH, Burns R, Messier SP, Applegate W, Rejeski WJ, Morgan T, et al**. A randomised control trial comparing aerobic exercise and resistance exercise with a health education program in older adults with knee osteoarthritis. JAMA 1997;277.

59) **Fisher NM, Gresham GE, Abrams M, Hicks J, Horrigan D, Pendergast DR.**Quantitative effects of physical therapy on muscular and functional performance in subjects with osteoarthritis of the knees. Arch Phys Med Rehab 1993;74:840–7.

60) **A.Mahajan ,S.Verma , V. Tandon** Osteoarthritis an update postgraduate department of medicine; dept. of pharmacology and therapeutics: Govt. medical college, jammu (j&k) india – JAPI.vol.53.july 2005.

61) **R.S. Hinman, s. mocket, K.L. Bennell, B.R. Metcalf, K.M. crossley (2002)** Rheumatology (oxford) Dec;41(12):1388-94.University Of Melbourne, Australia. Balance impairments in individuals with symptomatic knee osteoarthritis: a comparison with matched controls using clinical tests.

62) Henry Pollard The effect of a manual therapy knee protocol on osteoarthritic knee pain:a randomised controlled trial J Can Chiropr Assoc 2008; 52(4)

63) **Hurley MV, Rees J, Newham DJ** quadriceps function, proprioceptive activity and functional performance in healthy young, middle aged and eiderly subjects. Age ageing 1998; 27:55-62

64) Varsha C. Naik, JebaChitra , SubhashKhatri: Effectiveness of Maitland versus mulligan mobilization technique following post surgical management of Colles' - fracture – rct. Indian Journal of Physiotherapy and Occupational Therapy. Vol. 1, No. 4 (2007-10 - 2007-12)

65) Paul A van den Dolder and David L Roberts: Six sessions of manual therapy increase knee flexion and improve activity in people with anterior knee pain: a randomised controlled trial. Australian journal of physiotherapy 2006 Vol. 52

66) Salaffif, leardiniG et al, osteoarthritis cartilage, 2003(8): 551-560.

67) Cynthia C norkin, Joyce white, Guide to Goniometry, 2nd edition

68) **Penninx BW**[1], **Rejeski WJ**, Pandya J, Miller ME, Di Bari M, Applegate WB, Pahor M.; J Gerontol B Psychol Sci Soc Sci. 2002 Mar;57(2):P124-32.

ANNEXURE

12. ANNEXURE :

12.1 PATIENTS CONSENT FORM :

Informed Consent for Participants in Research study Involving Human Subjects

Title of Research: ***To Study the Effectiveness Of Maitland Mobilization and Clinical Exercise Vs Maitland Mobilization Alone In Chronic Tibiofemoral Arthritis***

Investigator: Saravanan. T.R

Purpose of This Research: You are invited to participate in a study on the comparison of effectiveness of Maitland Mobilization and Clinical Exercise Vs Maitland Mobilization Alone In Chronic Tibiofemoral Arthritis. From the information collected and studied in this study we hope to learn more about the effectiveness of Maitland Mobilization and Clinical Exercise Vs Maitland Mobilization Alone In Chronic Tibiofemoral Arthritis.

Procedures: With your permission we would like to collect health information about you, including information about your general health and then we will evaluate your foot.

Only researchers will have access to the final data, and you can refuse to be part of the study. You can also stop at any point during the study. Your results will never be shared with anyone other than the researchers.

Benefits: You may receive direct benefit from this study. We cannot guarantee that you will receive any benefits from this study.

Extent of Anonymity and Confidentiality:

At no time will the researchers release the results of this study to anyone other than individuals working on this study without your written consent.

It is possible that the Institutional Review Board (IRB) may view this study's collected data for auditing purposes. The IRB is responsible for the oversight of the protection of human subject's involved in research.

Compensation: You will not be paid to participate in this study.

Freedom to Withdraw: Your decision whether or not to participate in this study will not affect medical care. If you read this form and have decided to participate in this study, please understand

your participation is voluntary and you have the right to withdraw your consent or discontinue your participation at any time without penalty. Your identity will not be disclosed in any published and written material resulting from the study.

Subject's Responsibilities:

I voluntarily agree to participate in this study. I have the following responsibilities:

- Report to my test sessions on time.
- Report to each test session as scheduled.
- Complete the testing as described to me to by the investigator the best of my ability.
- Be honest about my pain scale to the investigators at the time of testing.
- To be honest about my medical history.

Subject's Permission:

I have read the Consent Form and the conditions of this study. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent.

_____ Date_____

Subject signature

Should I have any pertinent questions about this research or its conduct, and research subjects' rights, and whom to contact in the event of a research related injury to the subject, I may contact:

Investigators:

Mr. T.R. SARAVANAN **trstrs77@gmail.com**

Guide :

Mr. Prabhakar. S **jayacpt202@gmail.com**

Co- Guide :

Mr. V.S. Saravanan **sharavananphysio@gmail.com**

IRB Chairman :

Mr. V. Balchandar **jayacpt202@gmail.com**

12.2 PT EVALUATION FOR TIBIOFEMORAL ARTHRITIS:-

DEMOGRAPHIC DATA :

- **Name :**
- **Age :**
- **Sex :**
- **Occupation :**
- **Address :**
- **Ph.No :**
- **Side Affected :**

CHIEF COMPLAINTS:

HISTORY :

Past medical history :

- History of any diseases like diabetes and hypertension : Yes / No
- History of any previous dislocation / fracture in Knee : Yes / No
- History of any previous injury in knee : Yes / No
- History of any degenerative joint diseases : Yes / No
- History of any previous surgery : Yes / No
- History of any treatment taken previously : Yes / No
- History of any medications taken previously : Yes / No

Present medical history :

- Duration of present problem :
- Any present medical / surgical / PT treatment :
- Any improvement following the treatment : Yes / No
- Any advice given by the physician :

Personal history :

- Smoking : Yes / No
- Alcohol : Yes / No
- Tobacco chewing : Yes / No
- Personality type :
- Family history :

Occupational history :

- Type of work :
- Duration of work :
- Working atmosphere :

Social history :

- Role of members in family :
- Economic status of family :

OBJECTIVE ASSESSMENT:

ON OBSERVATION :

- Built of the patient : Ectomorph / Mesomorph / Endomorph
- Attitude of the limb :
- Any marked swelling in and around knee joint : Yes / No
- Any muscle spasm in and around knee joint : Yes / No
- Any marked bony deformity : Yes / No
- Any marked bony prominence : Yes / No
- Any marked redness : Yes / No
- Any marked bony angulation : Yes / No
- Any trophic changes in skin and nail : Yes / No
- Any open wounds : Yes / No
- Any surgical scar : Yes / No
- Using any of assistive devices : Yes / No

ON PALPATION:

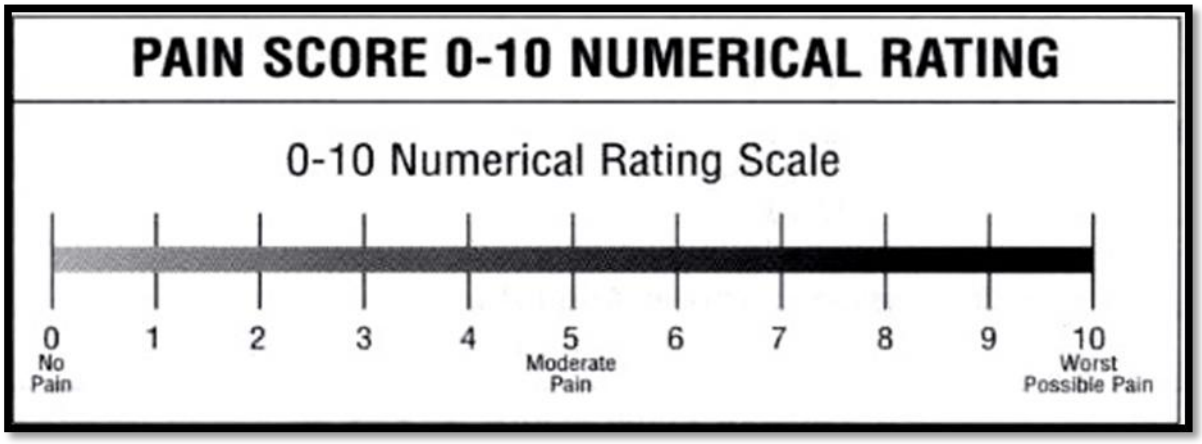
- Warmth over the knee joint : Present / Absent
- Tenderness during movement of knee joint : Present / Absent
- Swelling in and around knee joint : Present / Absent
- Muscle spasm in and around knee joint : Present / Absent
- Any abnormal bony margins : Present / Absent
- odema : Pitting / Non pitting

ON EXAMINATION :

Pain evaluation :

- Site of pain : Around knee joint
- Side of pain : Right / Left side
- Duration of pain : Acute / Chronic
- Onset of pain : Sudden onset / Gradual onset
- Nature of pain : Constant / Intermittent
- Aggravating factors : Standing / walking / stair climbing / squatting / during ADL activities
- Relieving factor : Rest / Medication / physiotherapy
- Radiating pain : Present / Absent

NPRS:



Reflex evaluation :

0= no response
1=Trace/decrease response
2=Normal
3=Exaggerated/ brisk
4= Sustained

REFLEX	NERVE ROOT	GRADE
Knee Jerk		

RANGE OF MOTION EXAMINATION:

JOINT NAME	MOVEMENT	PRE TEST				POST TEST			
		ACTIVE ROM		PASSIVE ROM		ACTIVE ROM		PASSIVE ROM	
		RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT
KNEE	FLEXION								

MUSCLE POWER:

MRC GRADING

Muscle name	Pre test												Post test											
	Right						Left						Right						Left					
Quadriceps	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5

SENSORY EXAMINATION:

Superficial sensation	:	Present / Absent
Light touch	:	Present / Absent
Pain	:	Present / Absent
Hot/Cold temperature	:	Present / Absent
Deep sensation	:	Present / Absent
Vibratory sense	:	Present / Absent
Kinaesthetic sensation	:	Present / Absent

GAIT EXAMINATION:

Heel strike	:
Foot flat	:
Cadence	:
Step length	:
Stride length	:

GAIT TYPE:

Trendelenburg gait	:	Yes / No
Lordotic gait	:	Yes / No
Antalgic gait	:	Yes / No
Lurchman gait	:	Yes / No

SPECIAL TEST:

PATELLA GRIND TEST	:	Positive / Negative
ABDUCTION STRESS TEST	:	Positive / Negative
ANTERIOR DRAWER TEST	:	Positive / Negative
LACHMAN'S TEST	:	Positive / Negative

INVESTIGATION:

X-RAY:

MRI / CT SCAN:

12.5 MASTERCHART