

**EFFECTIVENESS OF MULLIGAN'S MWM ON PAIN, RANGE
OF MOTION AND FUNCTIONAL ACTIVITIES IN PATIENTS
WITH KNEE OSTEOARTHRITIS**

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Bachelor of Science in Physiotherapy (B. Sc. PT)

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We the undersigned certify that we have carefully read and recommended to the Faculty of Medicine, University of Dhaka, for the acceptance of this dissertation entitled

EFFECTIVENESS OF MULLIGAN’S MWM ON PAIN, RANGE OF MOTION AND FUNCTIONAL ACTIVITIES IN PATIENTS WITH KNEE OSTEOARTHRITIS

Submitted by **Tasnem Bentay Ali**, for partial fulfillment of the requirements for the degree of Bachelor of Science in Physiotherapy (B. Sc. PT)

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DECLARATION

I declare that the work presented here is my own. All sources used have been cited appropriately. Any mistakes or inaccuracies are my own. I also declare that for any publication, presentation or dissemination of information of the study, I bound to take written consent of my supervisor and Head of physiotherapy Department, Bangladesh Health Professions Institute (BHPI).

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Acronyms

BHPI	Bangladesh Health Professions Institute
CRP	Centre for the Rehabilitation of the Paralysed
MWM	Movement with Mobilization
MS	Musculo-skeletal
NSAID's	Non-Steroidal Anti-inflammatory Drugs
OA	Osteoarthritis
PT	Physiotherapy
RCT	Randomized Control trail
IRR	Infra-red radiation
ROM	Range of Motion
VAS	Visual Analogue Scale
WHO	World Health Organization
WOMAC	Western Ontario McMaster University Osteoarthritis Index

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Abstract

Objective: To compare pain intensity at resting, sitting, standing, squatting, activities of daily living, walking, and stair up & down, Range of Motion (ROM) in sitting & standing position and functional activities before and after Mulligan's MWM with conventional physiotherapy and conventional Physiotherapy alone in patients with knee Osteoarthritis. *Methodology:* 14 patients with knee Osteoarthritis were randomly selected from musculo-skeletal outpatient physiotherapy unit, CRP, Savar. Then 7 patients with knee Osteoarthritis were randomly assigned to Mulligan's MWM with conventional physiotherapy group and 7 patients to the only conventional physiotherapy group for this randomized control trial study. The study was a single blinded study which has been conducted at musculoskeletal outpatient physiotherapy unit, CRP, Savar. Trial group was given Mulligan's MWM and conventional physical therapy (exercise and IRR) and control group was given conventional physiotherapy (exercise and IRR) only. Both the group received the treatment for a period of 6 days. Visual Analogue Scale (VAS) was used to measure pain intensity in resting, sitting, standing, squatting, functional activities, walking, and stair up & down. Western Ontario McMaster University Osteoarthritis Index (WOMAC) score for functional activities & goniometer for ROM. Pain and WOMAC score was analyzed by Mann-Whitney U test. Unrelated "t" test was used to compare the ROM. *Results:* Results showed that, relative improvement occur in trial group than in control group. Pain scores on VAS at resting, sitting, standing, walking, squatting, activities of daily living & stair up & down. WOMAC score measurement for functional activities was relatively reduced in trial group on both group comparisons. Range of motion was relatively reduced, but that's not statistically significant. *Conclusion:* Conventional physiotherapy is effective in improving pain and functional activities but Mulligan MWM has an added effect on reducing pain and improves ROM & functional activities.

Key words: Knee Osteoarthritis, Conventional physiotherapy, Mulligan's MWM.

1.1 Background

Osteoarthritis (OA) is one of the most common arthritis & musculoskeletal problem in worldwide & approximately 10% of the world's population have symptomatic OA who are 60 years or older (E. Sambandam et al., 2011). Osteoarthritis is a chronic degenerative disorder with multifactorial etiology characterized by loss of articular cartilage, hypertrophy of bone at the margins, subchondral sclerosis and range of biochemical and morphological alteration of the synovial membrane and joint capsule (Harris et al., 2014).

Degenerative disorder is not a single disease but also represents the various disorders of joints such as joint failure (E. Sambandam et al., 2011). Generally degenerative disorder is a disease of the elderly, but our recent local survey showed it to be very common in both males (53.3%) and females (60.9%) and the young individuals may be affected (Al-Arfaj et al., 2002).

Osteoarthritis is one of the most common musculoskeletal disorders in the world which affect 2,693 of every 100,000 women and 1770 of every 100,000 men (Murphy et al., 2008).

Before 50 years of age, the prevalence of OA in most joints is higher in men than in women. After about 50 years of age women are more affected with the hand, feet, spine, & weight bearing joint such as hip & knee than men and greater severity of OA (Srikanth et al., 2005).

Knee osteoarthritis is one of musculoskeletal condition affecting older people and is associated with most common symptoms of pain, inflammation, instability, decreased range of motion & lowering the quality of life (Rinkle et al., 2010).

Knee osteoarthritis is the most common cause of joint disorder & its prevalence increasing with age. The point of prevalence of knee OA in Australian population is 5-10% & India population is 22% to 39% (P. Malgaonkar et al., 2014). The

prevalence of knee osteoarthritis in the Netherlands in 2007 was 14.3 per 1000 for men and 23.8 per 1000 for women (Jansen et al., 2011). It affects more than 21 million people in the US with 36% of elderly aged 70 or older having some degree of radiographic knee OA (D'Ambrosia, 2005).

In Bangladesh, there is no real statistics that how many patients are affected by osteoarthritis. But, one statistics give a general indication to the prevalence of osteoarthritis and that is 10,392,681 people are affected by osteoarthritis in 2004 (Paul, 2003).

Knee OA is the strongest predictor of disability among 10 diseases for several activities such as stair climbing, walking, housekeeping etc. & the risk factors of knee OA including with age, gender, obesity, varus/vulgus malalignment, previous knee injury, occupation, heredity and others (Brouwer et al., 2007).

Vigorous levels of activity appeared to increase the risk of OA recent study reported that daily walking of more than 10,000 steps per day may be associated with worsening of certain MRI features (Dore et al., 2012).

The patients of knee OA primarily complains of joint pain, morning stiffness, muscle weakness, loss of range of motion, instability and loss of functional ability such as walking, squatting, sit to stand, climbing stairs (Anita et al., 2006). But the progression of the disease is usually slow leading to joint failure with pain and disability (Litwic et al., 2013). Knee OA is a main source of chronic disability (Colbert et al., 2013). It causes mark limitation in daily living activity (ADLs) of the patients (Marmon et al., 2013).

Both drug & non drug treatment are used to treat knee OA, pain reduction and symptom improvement may be achieved by drug treatments but the drug treatment have side effect & drug overdose (NAM et al., 2013). Physical therapies such as electrotherapy, hyperthermia, phototherapy, exercise therapy and manual therapy these are include of non-drug treatments (NAM et al., 2013).

The aim of physical therapy for knee OA is to reduce pain, preserve joint physiology and maintain or recover normal activity of the joint (Mishel et al., 2013).

Many studies investigated the effectiveness of physical therapy, manual therapy, shock wave therapy, kinesio taping usages in subjects with knee OA. Mulligan's mobilization with movement (MWM) is a manual therapy treatment technique that is used in the spine, upper & lower extremity for management of various musculoskeletal conditions (NAM et al., 2013).

Mulligan's movement with mobilization is a manual therapy technique in which the therapist applied pain free accessory joint gliding force at right angle or parallel to a joint while a concurrent movement of the joint is actively performed by the patient (P. Malgaonkar et al., 2014).

Manual therapy techniques such as MWM improve joint proprioceptive inputes (Lalit et al., 2012). It is found that Mulligan's MWM technique is more effective in reducing pain, joint stiffness and improving range of motion, walking distance & finally the quality of life in patients with knee osteoarthritis (P.Malgaonkar et al., 2014).

1.2 Rational

From many studies it is found that many people are suffering from knee OA in Bangladesh. It is a matter of regret that most of them are deprived from proper physiotherapy treatment. They are just getting electrotherapy modalities. But outdoor department of CRP is trying to provide appropriate management of knee osteoarthritis based on evidence. The manual therapy that are most frequently employed to deal with this clinical condition including Mulligan's MWM. Mulligan's MWM reduce knee pain better than other physical therapy & electrotherapy modalities and to reduce joint stiffness, increase ROM & functional activities in patient with knee OA.

The aim of the study is to find out the effectiveness of Mulligan's MWM technique for the subject with knee OA. The subjects with knee OA exhibit significant deficits in knee kinematics including walking, squatting, sit to stand, housekeeping & climbing stairs. For reducing pain & increasing ROM and functional activity it is suggested that patellar mobilization, isometric contraction, strengthening exercise & electrotherapy modalities IRR (Infra-red radiation) was the most effective interventions. In the field of research in physiotherapy, hasn't encoded any research on effectiveness of Mulligan's MWM exercise in subjects with knee OA. There are some achievements in overall Physiotherapy intervention in knee OA but experts suggests that Mulligan's MWM is one of the important interventions for knee OA.

The purpose of this study is to compare the effectiveness of Mulligan's MWM with conventional physiotherapy and conventional physiotherapy alone for the patient with knee OA. There was some research articles published about physiotherapy intervention for patient with knee OA, but the effectiveness of Mulligan's MWM technique for the patients with knee OA is not so focused among them. So, in this study "Effectiveness of Mulligan's MWM exercise in Combination with Conventional Physiotherapy for the patients with knee OA" will give the evidence of effectiveness of Mulligan's MWM exercise in subjects with knee OA. However, research helps to improve the knowledge of health professionals, as well as develops the profession. The results of the study may help the physiotherapists to give evidence based treatment in patient with knee OA, which will be beneficial for both the patient with knee OA and for developing the field of physiotherapy profession.

1.3 Aim

The aim of this study is to compare the Effectiveness of Mulligan's MWM technique in Combination with Conventional Physiotherapy for knee OA.

1.4 Objectives

1.4.1 General objective

- To evaluate the effectiveness of Mulligan's MWM with conventional physiotherapy & conventional physiotherapy alone to reduce pain in knee OA.

1.4.2 Specific objective

- To determine the level of pain before & after applying Mulligan's MWM with conventional physiotherapy & conventional physiotherapy alone in subjects with knee OA.
- To assess Improvement of Range of Movement (ROM) before & after applying Mulligan's MWM with conventional physiotherapy & conventional physiotherapy alone in subject with knee OA.
- To find out how much activity limitation before & after applying Mulligan's MWM with conventional physiotherapy & conventional physiotherapy alone in subjects with knee OA.

1.5 Hypothesis

Mulligan's MWM exercise with conventional physiotherapy is more effective than conventional physiotherapy alone for the treatment of subject with knee OA.

1.6 Null hypothesis

Mulligan's MWM exercise with conventional physiotherapy is no more effective than conventional physiotherapy alone for the treatment of subject with knee OA.

1.7 List of variables

1.7.1 Dependent variable

Knee Osteoarthritis.

1.7.2 Independent variable

Conventional physiotherapy & Mulligan's MWM exercise in subject with knee OA.

1.8 Operational definition

1.8.1 Osteoarthritis (OA)

Osteoarthritis is a chronic degenerative joint disorder with multifactorial etiology characterized by loss of articular cartilage & hypertrophy of bone at the margins. Knee OA is one of the most common joint diseases in the elderly & is associated with disability.

1.8.2 Conventional physiotherapy

Physiotherapeutic interventions that are widely accepted and commonly practiced by medical community. The researcher formulated a list of evidence based physiotherapy interventions of knee OA and provided those to the physiotherapist to mark the interventions commonly used as conventional physiotherapy for knee OA. After finishing the pilot study, researcher became able to find out the conventional physiotherapy interventions used for knee OA and their frequency of use, with the consent of eight clinical physiotherapists & an educational booklet. Patellar mobilization, knee joint mobilization, isometric contraction of quadriceps muscle, stretching exercise, gapping exercise, strengthening exercise of quadriceps, hamstring, hip abductor & adductor group of muscle, squeezing, soft tissue mobilization, loose body manipulation & Infra-red radiation was the most commonly used interventions, Oral NSAIDs were the second most commonly used intervention and corticosteroid injection were the partially used interventions.

1.8.3 Mulligan's MWM

Mulligan's MWM is a manual therapy technique in which therapist applied a manual glide force on the tibia & patient performed a concurrent active movement.

Osteoarthritis can be defined as a condition characterized by loss of cartilage of focal areas within the synovial joints, associated with hypertrophy of bone (osteophytes, subchondral bone sclerosis) and thickening of the capsule (Zhang et al., 2008). And involvement of other structures, including the ligament, meniscus, capsule, synovial membrane and periarticular muscles (Cooper et al., 2013). Worldwide, OA is one of the leading causes of disability, particularly in the elderly population and is most prevalent at the hip and knee (NAM et al., 2013). It also has an effect on the individual's function, quality of life, occupation, mood, relationships, and leisure activities (Marmon et al., 2013).

The prevalence of OA varies from country to country widely in all over the world (Pas et al., 2013).

Worldwide estimates indicate that symptomatic knee OA occurs in 9.6% of men and 18% of women aged > 60 years or older (P. Malgaonkar et al., 2014). In the Framingham study the prevalence of radiographic knee OA in adult's age ≥ 45 was 19.2% and 27.8% in the Johnston County Osteoarthritis project (Zhang & Jordan, 2008).

Osteoarthritis commonly affects the hands, feet, spine and large weight bearing joints such as the hip and knees & those who were only overweight had more than twice the chance of developing knee OA compared with their normal weight counterparts (Blagojevic et al., 2010).

Lower limb is the most common site for OA & patient with knee osteoarthritis complain pain and difficulty with everyday activities such as prolonged sitting, ascending and descending stairs, squatting, kneeling, rising from a chair and getting in and out of a car (Anita et al., 2006).

The complaint rate increase with age, up to 53.4% in the age group > 65 years & the major disability was inability to squatting (3.1%). Indian women had the highest rate

of pain (28.4%), while Chinese men & women pain rate ratio was 9.9% & 23.8% (Veerapen et al, 2007).

The exact causes of Primary knee osteoarthritis are not known. The following factors such as age, obesity, genetics, occupation, prolonged standing, sports, and metabolic disorders are suspected to cause of primary knee OA (Gosset et al., 2012). Another study shows the following factors such as crystals in joint fluid or cartilage, high bone mineral density, injury to the joint, peripheral neuropathy, joint hyper mobility are responsible for primary knee OA(Hinton et al, 2002).

The exact causes of secondary knee osteoarthritis are as valgus and varus deformities of the knee-rheumatoid arthritis, infection, TB, hyperparathyroidism, over use of intra articular steroid therapy (Ebenezer, 2003). Repeated minor trauma may lead to micro fractures and subsequent osteoarthritis & occupational factor is to be important in the development of secondary OA. Hemophilia, acromegaly and hyperthyroidism all predispose joints to secondary OA (Porter, 2003).

Risk factors of osteoarthritis including Age, Obesity, Trauma, Genetics, Sex hormones, Muscle weakness, Mal-alignment, Infection, Crystal deposition, Acromegaly, Previous rheumatoid arthritis & Repetitive joint use or excessive load (McWilliams et al., 2011).

According to American college of Rheumatology, knee OA are clinically diagnosed. These are crepitus on active joint motion, morning stiffness < 30 mins, bony enlargement of knee on examination, no palpable warmth, age > 40 years. Above mentioned criteria any of 3 should be present along with knee pain (G Peat et al., 2006).

To treat the condition of degenerative osteoarthritis both drug-based & a variety of non-drug treatment are used, pain reduction and symptom improvement may be achieved by drug treatments but the drug treatment have side effect & drug overdose (NAM et al., 2013). Non drug treatments including physiotherapy are effective to reduce pain in knee OA. Electrotherapy, hyperthermia, phototherapy, exercise therapy and manual therapy these are included in physiotherapy (NAM et al., 2013). For the

management of knee OA two recent systematic reviews demonstrated the usefulness of manual therapy and exercise program (French et al, 2011).

Mulligan technique is a kind of manual therapy technique for spinal or upper and lower extremity pain. Mulligan's concept of movement with mobilization (MWM) is a contemporary form of joint mobilization, in which the therapist applied pain-free accessory gliding force combined with active movement performed by patient (Jansen et al., 2011). By providing mulligan's MWM immediate relief pain & improved function of patients in several musculoskeletal disorders (Teys et al., 2008).

The aim of the Mulligan's MWM technique is to restore a painful and limited movement to a painless and full range functional movement immediately (Mishel et al., 2013). Mulligan's MWM can be applied in either no-weight-bearing or weight-bearing position & with or without a belt. A study indicated that both the non-weight-bearing and weight-bearing Mulligan's MWM treatment techniques significantly improved range of motion (Vicenzino, 2006). Several clinical studies investigated the efficacy of Mulligan's MWM treatment techniques especially for spine & lower extremities (NAM et al., 2013).

A true experimental design was conducted to compare the effect of a combination of shock wave therapy with exercise program, Mulligan's MWM with exercise program & exercise program alone in subject with knee OA. Forty five male & female patients with unilateral & bilateral knee OA were recruited. Their age was between 40 to 65 years. Of these subjects, 45 were randomized into three equal groups. Patients in group (A) received shock wave therapy with exercise program (strengthening for quadriceps, hamstring, hip adductors and extensors and stretching of the hamstrings and cuff muscles). Patients in group (B) received Mulligan's MWM with the same exercise program and group (C) received the exercise program alone. Each patient was assessed just before and after the treatment period. The three group received treatment 3 times per week for 4 weeks. Pain intensity was assessed by using the visual analogue scale WOMAC is used to evaluate pain, functional capacity and stiffness. Range of motion was measured by goniometer. Both shockwave therapy and Mulligan's MWM are effective in relieving knee pain and functional disability (Mishel et al., 2013).

A study was done about a relationship between the Mulligan's MWM & the varus kinesio taping in patients with knee OA. 40 subjects with knee osteoarthritis were randomized 20 subjects each into mobilization and taping group. Mobilization group was treated with Mulligan's MWM & Taping group was treated with therapeutic kinesio taping thrice a week for 2 weeks. At first Mulligan's MWM technique was performed in lying or non-weight-bearing position then the weight-bearing position. 3 set of 10 repetitions with one minute rest in between each set for six sessions with two days interval. In kinesio taping the K tape was applied from origin to insertion for the facilitation of quadriceps muscle & superior Y technique was done. Pain intensity was assessed by using the visual analogue scale, range of motion was measured by goniometer & WOMAC is used to evaluate functional capacity. Both group received treatment 3 times per week for 2 weeks. After 6 sessions of therapy the study conclude that both Mulligan's MWM & kinesio taping techniques are effective but Mulligan's MWM are more effective than kinesio taping technique (P. Malgaonkar et al., 2014).

A true experimental study was conducted about a relationship among the Mulligan's MWM, Maitland's mobilization & exercise program in patient with knee OA. 90 patients with knee osteoarthritis were carried out. Subjects were divided into 3 groups. Group A received Maitland's mobilization technique with exercise program, Group B received Mulligan's MWM with exercise program, Group C received only exercise program. In Maitland mobilization grade 2 & 3 mobilization were given in tibio-femoral, patella femoral joint. In Mulligan's MWM 3 set of 3 repetitions with one minute rest in between each set were given in both non weight-bearing & weight-bearing position. And in exercise program were included multiple angle isometrics, terminal arc knee extension, mini squats, partial lunges, one-leg balances, cross-body leg swings etc. 10 repetition per session. Both groups were received 3 sessions of treatment & 1 day interval per session therapy. Outcome was measured by VAS, WOMAC & goniometer. After 3 sessions of therapy it is concluded that Mulligan's MWM are more effective than Maitland's mobilization & exercise program alone (Lalit et al., 2012).

A study was done between the effectiveness of mulligan's MWM plus traditional physiotherapy program & traditional physiotherapy program on pain, disability, and

range of motion in patients with knee osteoarthritis. Thirty patients with knee OA participated in the study with ages ranged from 30-60 years. They were randomly assigned into two groups. Group (A) consisted of fifteen patients who received a traditional physiotherapy program. Group (B) consisted of fifteen patients who received traditional physical therapy program plus Mulligan's MWM. Treatment for both groups was three times a week for four weeks. The assessment was conducted at the beginning of first session and at the end of last session. Pain intensity was measured by the visual analogue scale & ROM of knee joint was assessed using the goniometer. Final result concluded that Mulligan's MWM with traditional physiotherapy program is more effective than only traditional physiotherapy program (Abdel et al., 2014).

Among four studies, four studies investigated the effectiveness of Mulligan's MWM treatment techniques with exercise program on knee OA. So, Mulligan's MWM can be used as exercise program on knee OA that is evidence base.

This research is a quantitative evaluation of the comparison between the exercise programs combined with Mulligan's MWM and exercise programs along for pain, ROM and functional activity management of the patients with knee OA. VAS and Goniometer was used as measurement tools for measuring the pain intensity & ROM in several functional positions & WOMAC was used for measuring the functional disability.

3.1 Study design

The study was conducted by Randomized Control Trail (RCT).

14 patients were selected by simple random sampling from musculoskeletal outpatient physiotherapy unit. The study was single blinded study which was conducted at musculoskeletal outpatient physiotherapy unit CRP, savar.

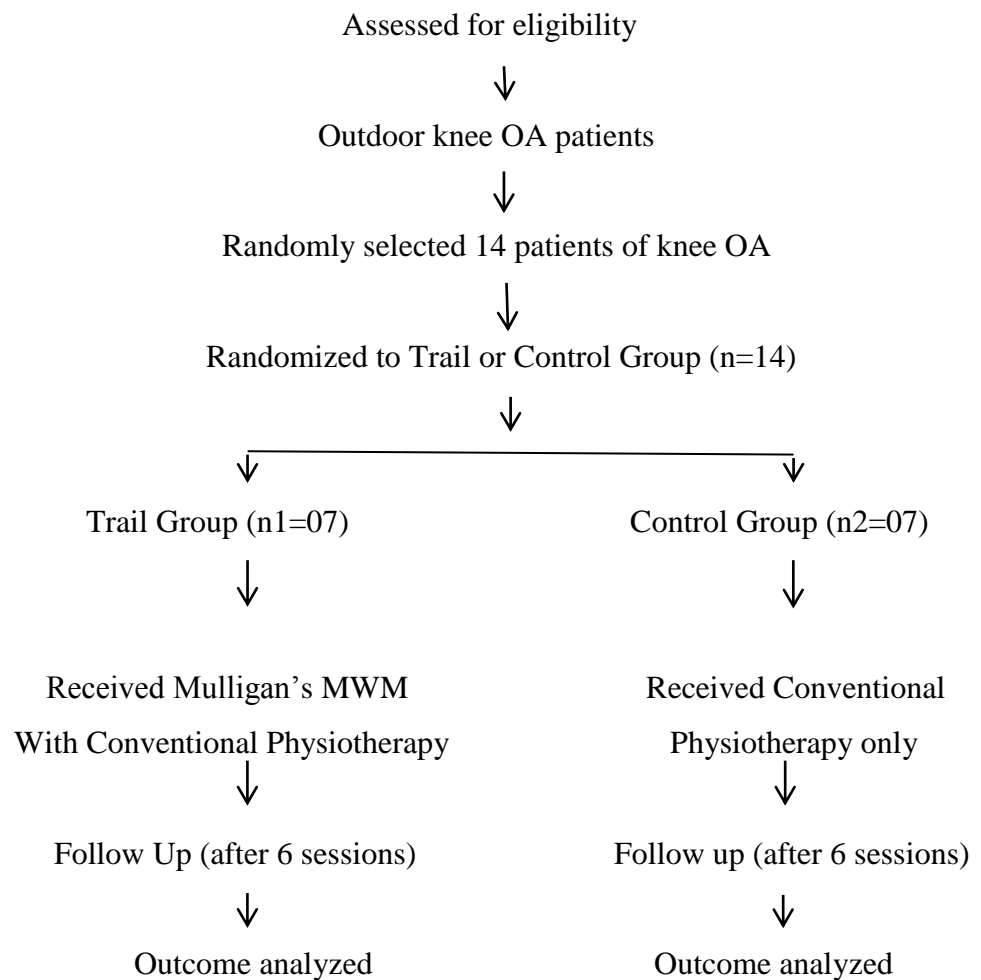
A pretest (before intervention) and posttest (after intervention) was administered with each subject of both groups to compare the pain effects before and after the treatment.

The design could be shown by-

R o x o (experimental group)

R o o (control group)

Flowchart of the phases of randomized controlled trial



A flowchart for a randomized controlled trial of a treatment program including conventional physiotherapy with Mulligan's MWM for patient with knee OA.

3.2 Study area

My study area was musculoskeletal outpatient physiotherapy unit, CRP, Savar, Dhaka- 1343.

3.3 Study population

The patients of knee OA in Bangladesh was my study population.

3.4 Sample selection

Subjects, who met the inclusion criteria, were taken as sample in this study by simple random sampling. Fourteen patients with knee OA were selected from musculoskeletal outpatient physiotherapy unit CRP, Savar. When the samples were collected, the researcher randomly assigned the participants into experimental and control group, because it improves internal validity of experimental research. The samples were given numerical number C1, C2, C3 etc for the control and E1, E2, E3 etc for experimental group. The study was a single blinded study. Total 14 samples included in this study, among them 07 patients were selected for the experimental group (received Mulligan's MWM with conventional physiotherapy) and other 07 patients were selected for control group (conventional physiotherapy only)

3.5 Inclusion criteria

- Age group equal or more than 50 years: This age group is more common for becoming knee OA (P. Malgaonkar et al., 2014).
- Both sexes are included: Knee OA is degenerative joint disease which can occur both sexes that are found on research (Mishel et al., 2013).
- Willing to participate (Takasaki et al., 2012).
- Unilateral or bilateral knee OA: Can affect one or both limb (Mishel et al., 2013).
- Crepitus on active joint motion (P. Malgaonkar et al., 2014).
- Knee pain: This is the most common symptom that occur after having knee OA (Lalit et al., 2012).
- Stiffness (Peat et al., 2006)
- Reduce ROM of knee joint (Lalit et al., 2012).

3.6 Exclusion criteria

- Subjects who were mentally unstable.
- Patients with any history of trauma to knees (Lalit et al., 2012).
- Any other major neurological,cardiovascular illness causing lower extremity dysfunction like Parkinson's disease,Cerebrovascular accidents etc.

3.7 Sample size

The equation of sample size calculation given below-

$$n = \left\{ \frac{Z \left(1 - \frac{\alpha}{2} \right)}{d} \right\}^2 \times pq$$

Here,

$$Z \left(1 - \frac{\alpha}{2} \right) = 1.96$$

$$P = 0.37$$

$$q = 1 - p$$

$$= 1 - 0.37$$

$$= 0.63$$

$$d = 0.05$$

According to this equation the sample should be more than 358 people but due to lack of opportunity the study was conducted with 14 patients attending at musculoskeletal department of physiotherapy in CRP.

3.8 Method of data collection

3.8.1 Data collection tools

A written questionnaire, pen, paper, WOMAC score, VAS and a Goniometer were used as data collection tools in this study.

3.8.2 WOMAC score

In the field of osteoarthritis research The Western Ontario McMaster University Osteoarthritis Index (WOMAC) was developed as an osteoarthritis specific measures of disability. It comprises three components: pain, stiffness, physical function, which can be reported separately or as an overall index. It is recommended that, the use of WOMAC as a primary measure of efficacy in osteoarthritis trials (P. Malgaonkar et al., 2014).

3.9 Measurement tool

3.9.1 Visual Analogue Scale (VAS)-In this study researcher used visual analogue scale for measuring the intensity of pain. The VAS is a simple and accurate way of subjectively assessing pain along a continuous visual spectrum. VAS consists of a

straight line on which the individual being assessed marks the level of pain. The ends of the straight line are the extreme limits of pain with 0 representing no pain and 10 representing the worst pain ever experienced. The visual analogue scale (VAS) is a tool widely used to measure pain and a change in the visual analogue scale score represents a relative change in the magnitude of pain sensation (NAM et al., 2013).

3.9.2 Goniometer In this study researcher used Goniometer for measuring the Range of Movement (ROM) of knee flexion and extension. The Goniometer is a simple and accurate way of objective assessment of ROM (Lalit et al., 2012).

3.10 Data collection procedure

The study procedure was conducted through assessing the patient, initial recording, treatment and final recording. After screening the patient at department, the patients were assessed by qualified physiotherapist. Six sessions of treatment was provided for every subject.

Fourteen subjects were chosen for data collection according to the inclusion criteria. The researcher divide all participants into two groups and coded C1 (7) for control group and E1 (7) for experimental group. Experimental group received conventional physiotherapy with Mulligan's MWM for knee OA and control group received only conventional physiotherapy.

Data was gathered through a pre-test, intervention and post-test and the data was collected by using a written questionnaire form which was formatted by the researcher. Pretest was performed before beginning the treatment and the intensity of pain, ROM of knee joint & functional activities were noted with visual analogue scale, goniometer & WOMAC score. The same procedure was performed to take post-test at the end of six session of treatment. Researcher gave the assessment form to each subject before starting treatment and after six session of treatment and instructed to put mark on the line of visual analogue scale & WOMAC score according to their intensity of pain. The researcher collected the data both in experimental and control group in front of the qualified physiotherapist in order to reduce the biasness. At the end of the study, specific test was performed for statistical analysis.

3.11 Intervention

3.11.1 Conventional Physiotherapy

The researcher formulated a list of evidence based physiotherapy interventions of knee OA and provided those to the physiotherapist to mark the interventions commonly used as conventional physiotherapy for knee OA. After finishing the pilot study, researcher became able to find out the conventional physiotherapy interventions used for knee OA and their frequency of use, with the consent of eight clinical physiotherapists. Patellar mobilization, knee joint mobilization, isometric contraction of quadriceps muscles, strengthening exercise of quadriceps, hamstring, hip abductor & adductor group of muscles, stretching exercise, gapping, soft tissue mobilization, loose body manipulation & Infra-red-radiation were the most commonly used interventions, the frequency of use are 100%. Oral NSAID were the second most commonly used interventions and corticosteroid injection were the partially used interventions.

3.11.2 Conventional Physiotherapy along with Mulligan's MWM

A common intervention program was executed for both groups as conventional physiotherapy, it includes- Patellar mobilization, knee joint mobilization, isometric contraction of quadriceps muscles, strengthening exercise of quadriceps, hamstring, hip abductor & adductor group of muscles, stretching exercise, gapping, soft tissue mobilization, loose body manipulation & Infra-redradiation which are the most frequently used interventions. In this study, the experimental group was treated with Mulligan's MWM in addition with conventional physiotherapy. Clinical physiotherapist applied the Mulligan's MWM and the conventional physiotherapy. Each group got 6 sessions of treatment. There is more evidence of exact set & repetition for Mulligan's MWM exercise. These are 3 sets of 3 repetitions, 2 sets of 10 repetitions and 3 sets of 10 repetitions. But in practice expert opinion suggests that 3 sets of 6 repetitions are minimal enough for patients with knee OA to get more effectiveness. In this study the experimental group applied 2 sets of 10 repetitions that is evidence base.

3.12 Ethical consideration

Follow the Bangladesh Medical Research Council guide line & WHO research guide line. Research proposal was submitted for approval to the administrative bodies of ethical committee of BHPI. Again before beginning the data collection, researcher was obtained the permission from the concerned authorities ensuring the safety of the participants. In order to eliminate ethical claims, the participants were set free to receive treatment for other purposes as usual. Each participant was informed about the study before beginning and given written consent. The researcher obtained consent to participate from every subject. A signed informed consent form was received from each participant. The participants were informed that they have the right to meet with outdoor doctor if they think that the treatment is not enough to control the condition or if the condition become worsen. The participants were also informed that they were completely free to decline answering any question during the study and were free to withdraw their consent and terminate participation at any time. Withdrawal of participation from the study would not affect their treatment in the physiotherapy department and they would still get the same facilities. Every subject had the opportunity to discuss their problem with the senior authority or administration of CRP and have any questioned answer to their satisfaction.

3.13 Data analysis

In order to ensure that the research have some values, the meaning of collected data has to be presented in ways that other research workers can understand. In other words the researcher has to make sense of the results. As the result came from an experiment in this research, data analysis was done with statistical analysis.

All participants were code according to group to maintain participant's confidentiality. All subjects of both experimental and control group score their pain intensity on visual analogue scale before starting treatment and after completing treatment. Reduction of pain intensity for both groups and improvement of ROM of different movements of knee are the differences between pre-test and post-test score.

Experimental studies with the different subject design where two groups are used and each tested in two different conditions and the data is interval or ratio should be analyzed with unrelated „t“ test. As it was experimental and had unmatched groups of different subjects, who was randomly assigned to conventional physiotherapy with

Mulligan’s MWM exercise and only conventional physiotherapy group and the measurement of the outcome came from ROM by Goniometer, with considering interval or ratio data, so the parametric unrelated „t“ test was used in this study to calculate the level of significance. Unrelated „t“ test and mean difference was calculated to test the hypothesis on the basis of following assumptions-

- Data were ratio
- Two different set of subjects in two conditions

The “t” formula-

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\left[\frac{\left(\sum x_1^2 - \frac{(\sum x_1)^2}{n_1} \right) + \left(\sum x_2^2 - \frac{(\sum x_2)^2}{n_2} \right)}{(n_1 - 1) + (n_2 - 1)} \right] \times \sqrt{\left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}$$

Where

\bar{x}_1 = mean of scores from treatment group.

\bar{x}_2 = mean of scores from control group.

$(x_1)^2$ = the square of the each individual score from treatment group totaled.

$(x_2)^2$ = the square of the each individual score from control group totaled.

$(\sum x_1)^2$ = the total of the individual score from treatment group squared.

$(\sum x_2)^2$ = the total of the individual score from control group squared.

n_1 = number of subjects from treatment group.

n_2 = number of subjects from control group.

3.14 Significant level

In order to find out the significance of the study, the researcher calculated the “p” value. The p values refer the probability of the results for experimental study. The word probability refers to the accuracy of the findings. A p value is called level of significance for an experiment and a p value of <0.05 was accepted as significant result for health service research. If the p value is equal or smaller than the significant levels, the results are said to be significant.

Calculating the degree of freedom from the formula:

$$\text{Degrees of freedom (df)} = (n_1 - 1) + (n_2 - 1) = (7 - 1) + (7 - 1) = 12$$

Df	.1	.05	.025	.01	.005	.0005
12	1.356	1.782	2.179	2.681	3.055	4.318

Table-1: Level of significance for one tailed hypothesis

3.15 Elimination of confounding variables

Confounding variable has an effect on the study variables which can affect the result of the study. There were some confounding variables in this study such as patient's age, history of taking recent physiotherapy intervention, oral NSAID, steroid injection or other treatment which could influence the result of the study. Researcher found no significant difference between the mean age of two groups and the mean age of control group was 61 years and mean age of trial group was 58 years, so there was no effect of age which can influence the result. To control the confounding variables, researcher set the inclusion criteria as to include only those subjects who have no history of taking recent physiotherapy intervention, oral NSAID, steroid injection or other treatment.

Fourteen patients with knee OA were taken for this study. Seven patients with Mulligan's MWM with conventional physiotherapy treatment group (trial group) and another seven with conventional physiotherapy treatment group (control group). Their pain intensity with VAS scale in resting, sitting, standing, walking, squatting, functional activities & stair up & down session, functional activities level with WOMAC score and range of motion was measure both trial and control group (before and after the treatment session).

Age of the participants

The study was conducted on 14 participants of knee osteoarthritis patients. Out of the participant the mean age of the participants was 58 years at trial group and 61 years at control group. The minimum age range is 50 years and maximum 80 years (Table-1).

Trial group		Control group	
Subjects	Age(years)	Subjects	Age (years)
T1	75	C1	80
T2	55	C2	62
T3	55	C3	52
T4	59	C4	65
T5	50	C5	52
T6	50	C6	55
T7	62	C7	61
Mean Age	58	Mean Age	61

Table- 1: Mean age of the participants of trial and control group.

Sex of the participants

Among 14 patients with knee OA 43% (n=6) were male and about 57% (n=8) were female.

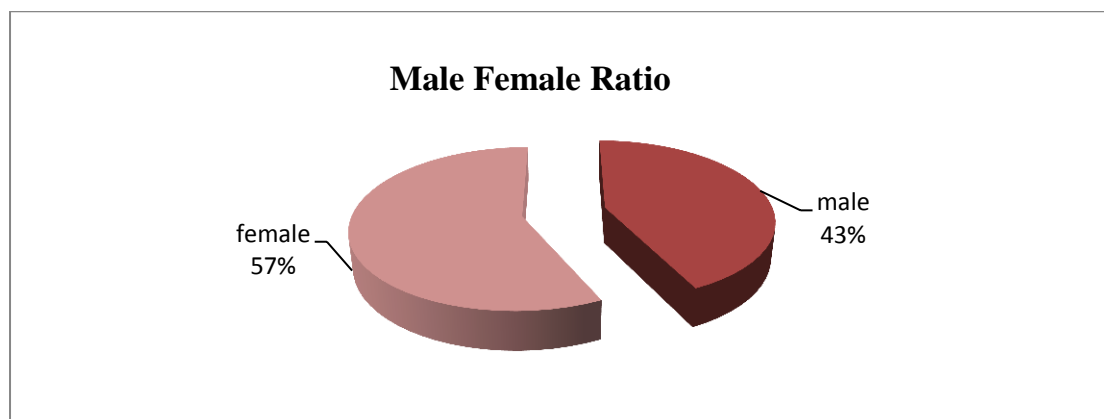


Figure-1: Gender Distribution

Comparison of changes of pain on VAS scale at resting position between both groups

In this study, day 1 pretest score of pain on VAS was 4.429 in trial group, 4.143 among control group. On day 6 post test scores after treatment showed that pain on VAS had relatively reduced in all groups (Table-2 & Figure-2).

Trial group			Control group		
Subjects	Day 1 Pre	Day 6 post	Subjects	Day 1 Pre	Day 6post
T1	9	5	C1	0	0
T2	8	4	C2	1	1
T3	3	2	C3	6	5
T4	2	2	C4	2	2
T5	3	1	C5	8	6
T6	3	2	C6	5	5
T7	3	1	C7	7	4
Mean	4.429	2.429	Mean	4.143	3.286

Table-2: Comparison of pain on VAS scale at resting position between trial and control groups.

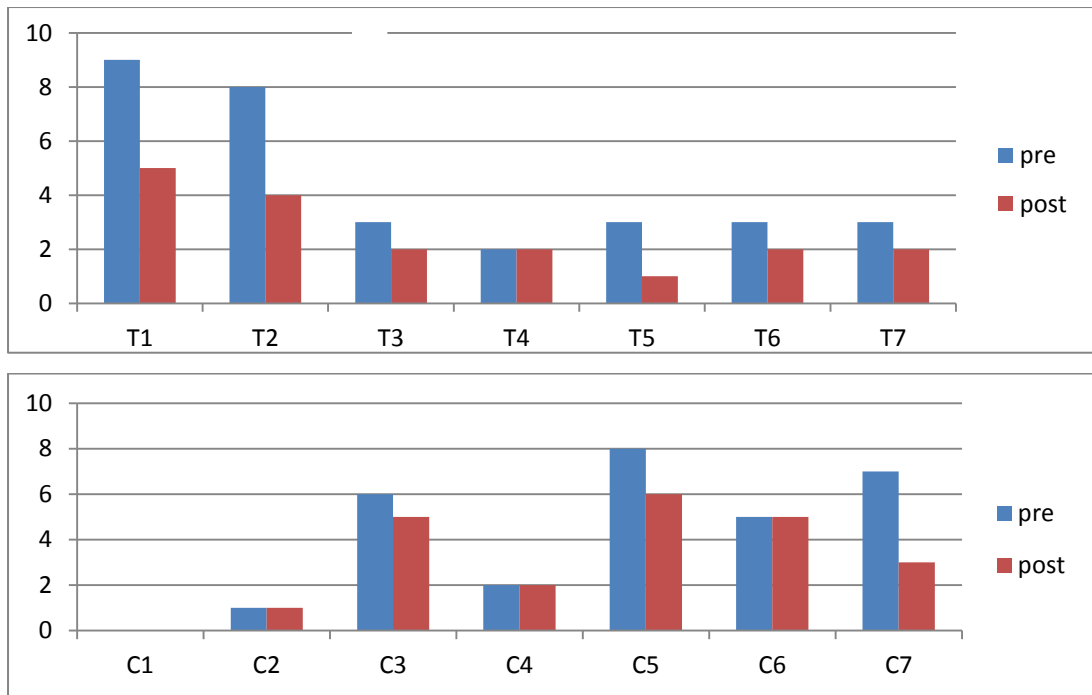


Figure-2: Reduction of Pain at resting position.

Comparison of changes of pain on VAS scale at sitting position between both groups

In this study, day 1 pretest score of pain on VAS was 4.429 in trial group, 4 among control group. On day 6 post test scores after treatment showed that pain on VAS had relatively reduced in all groups (Table-3 & Figure-3).

Trial group			Control group		
Subjects	Day 1 Pre	Day 6 post	Subjects	Day 1 Pre	Day 6 post
T1	9	5	C1	2	2
T2	7	4	C2	1	1
T3	3	2	C3	6	5
T4	3	2	C4	0	0
T5	3	2	C5	5	5
T6	2	2	C6	8	5
T7	4	2	C7	6	5
Mean	4.429	2.714	Mean	4	3.286

Table-3: Comparison of pain on VAS scale at sitting position between trial and control groups.

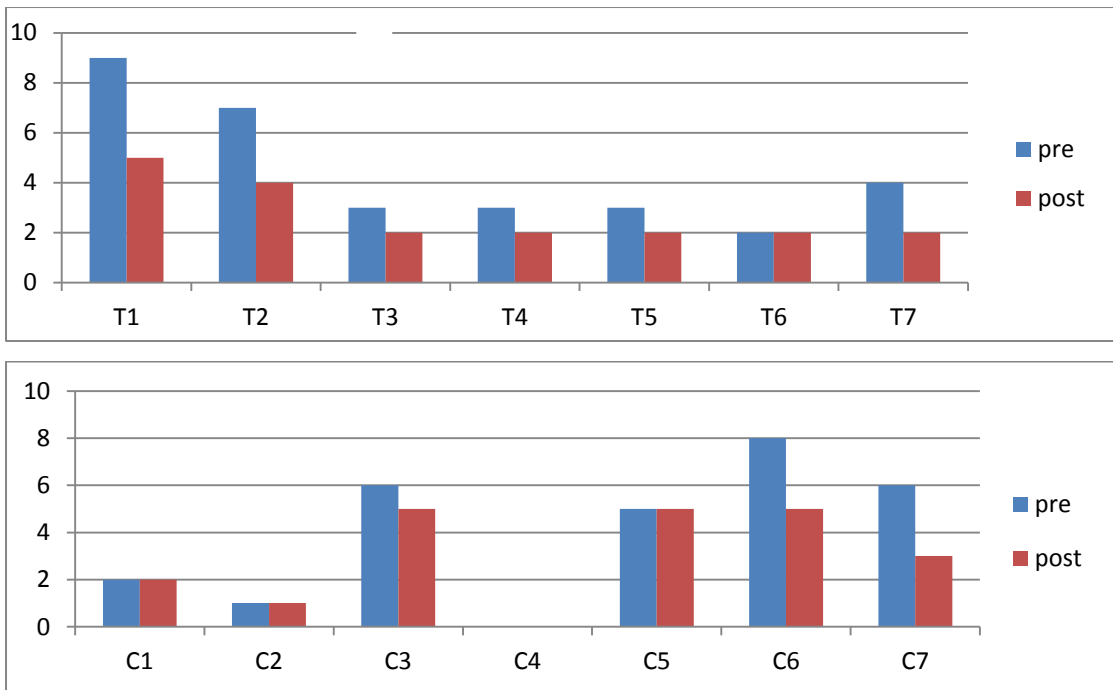


Figure-3: Reduction of Pain at sitting position.

Comparison of changes of pain on VAS scale at standing position between both groups

In this study, day 1 pretest score of pain on VAS was 6.286 in trial group, 6.286 among control group. On day 6 post test scores after treatment showed that pain on VAS had relatively reduced in all groups (Table-4 & Figure-4).

Trial group			Control group		
Subjects	Day 1 Pre	Day 6 post	Subjects	Day 1 Pre	Day 6 post
T1	9	6	C1	3	3
T2	8	5	C2	4	4
T3	5	4	C3	10	9
T4	5	3	C4	4	3
T5	6	3	C5	8	7
T6	5	3	C6	8	7
T7	6	4	C7	7	5
Mean	6.286	4	Mean	6.286	5.429

Table-4: Comparison of pain on VAS scale at standing position between trial and control groups.

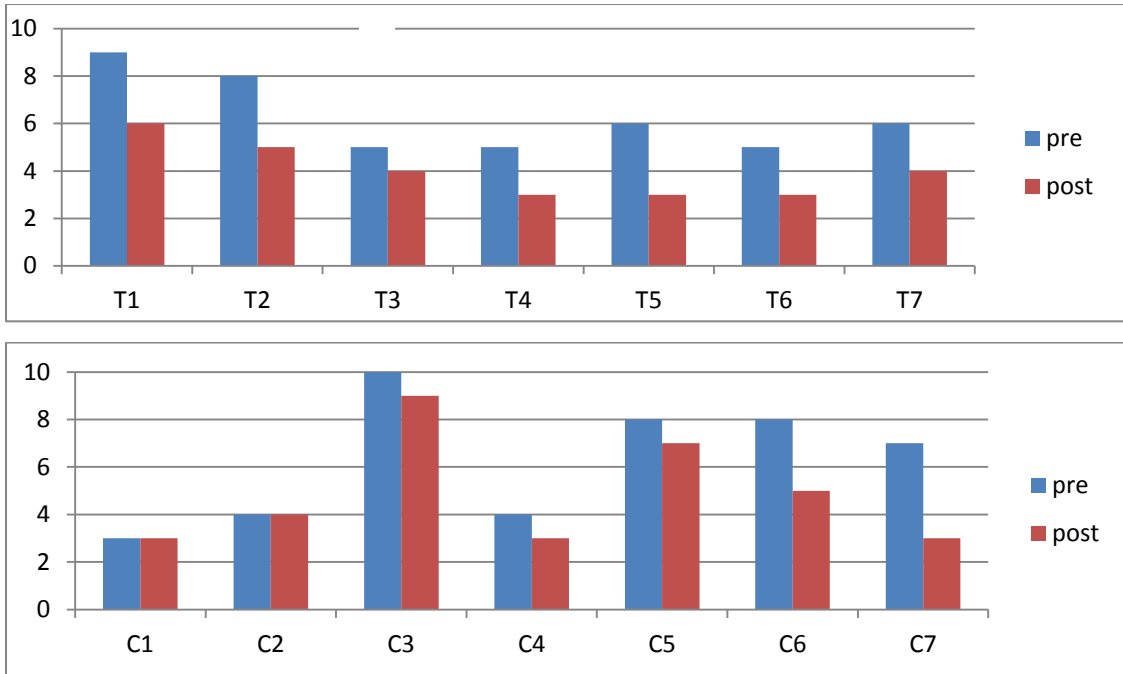


Figure-4: Reduction of Pain at standing position.

Comparison of changes of pain on VAS scale during walking between both groups

In this study, day 1 pretest score of pain on VAS was 7.572 in trial group, 6.857 among control group. On day 6 post test scores after treatment showed that pain on VAS had relatively reduced in all groups (Table-5 & Figure-5).

Trial group			Control group		
Subjects	Day 1 Pre	Day 6 post	Subjects	Day 1 Pre	Day 6 post
T1	9	6	C1	3	3
T2	8	5	C2	3	3
T3	6	4	C3	10	10
T4	7	5	C4	6	5
T5	7	4	C5	8	8
T6	8	5	C6	9	8
T7	8	5	C7	9	7
Mean	7.572	4.857	Mean	6.857	6.429

Table-5: Comparison of pain on VAS scale during walking between trial and control groups.

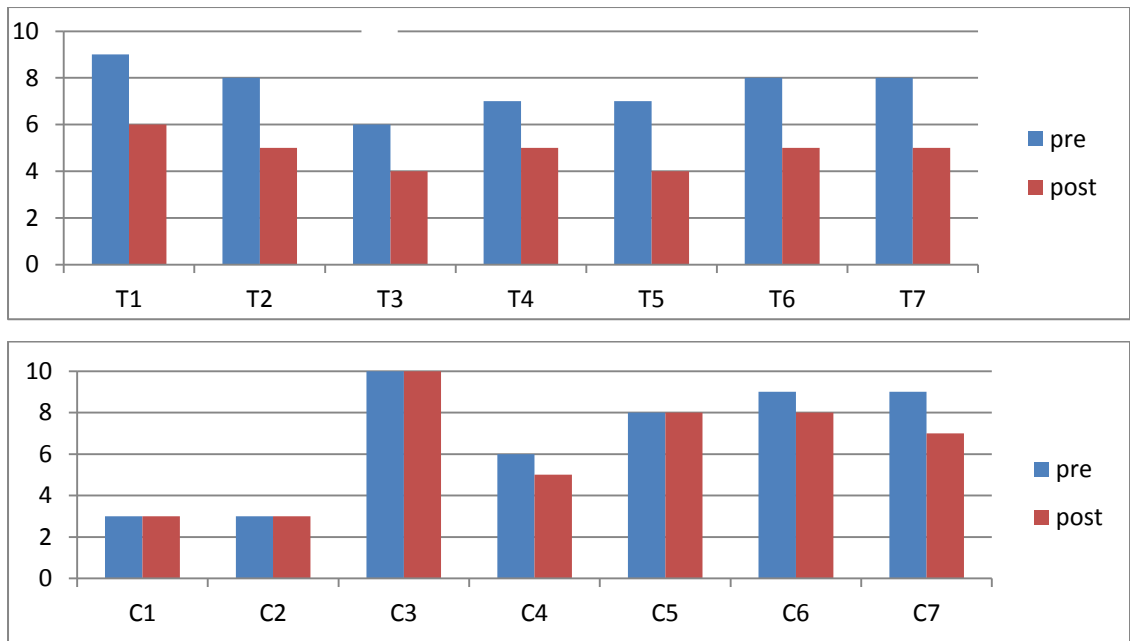


Figure-5: Reduction of Pain during walking.

Comparison of changes of pain on VAS scale at squatting position between both groups

In this study, day 1 pretest score of pain on VAS was 7.429 in trial group, 6.714 among control group. On day 6 post test scores after treatment showed that pain on VAS had relatively reduced in all groups (Table-6 & Figure-6).

Trial group			Control group		
Subjects	Day 1 Pre	Day 6 post	Subjects	Day 1 Pre	Day 6 post
T1	9	6	C1	5	4
T2	9	5	C2	5	4
T3	4	4	C3	10	10
T4	8	5	C4	0	0
T5	7	5	C5	9	8
T6	7	5	C6	9	9
T7	8	5	C7	9	8
Mean	7.429	5	Mean	6.714	6.143

Table-6: Comparison of pain on VAS scale at squatting position between trial and control groups.

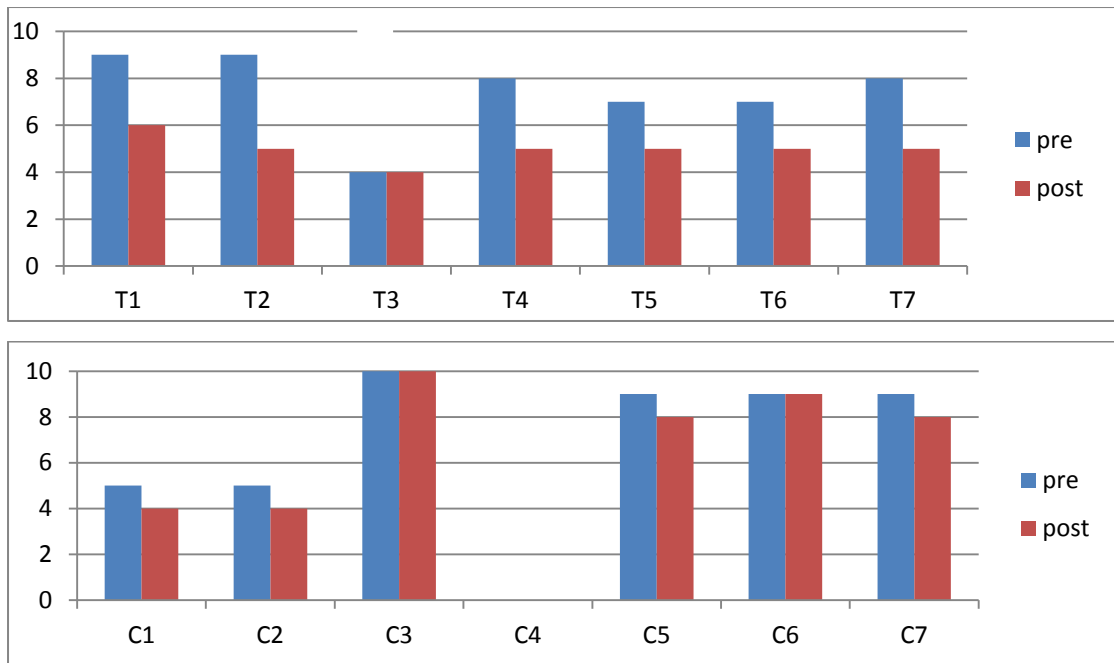


Figure-6: Reduction of Pain at squatting position.

Comparison of changes of pain on VAS scale during activities of daily living between both groups

In this study, day 1 pretest score of pain on VAS was 5.857 in trial group, 7.429 among control group. On day 6 post test scores after treatment showed that pain on VAS had relatively reduced in all groups (Table-7 & Figure-7).

Trial group			Control group		
Subjects	Day 1 Pre	Day 6 post	Subjects	Day 1 Pre	Day 6 post
T1	8	6	C1	5	5
T2	9	4	C2	5	5
T3	5	4	C3	10	9
T4	4	4	C4	8	7
T5	5	3	C5	8	7
T6	4	3	C6	8	8
T7	6	3	C7	8	6
Mean	5.857	3.857	Mean	7.429	6.714

Table-7: Comparison of pain on VAS scale during activities of daily living between trial and control groups.

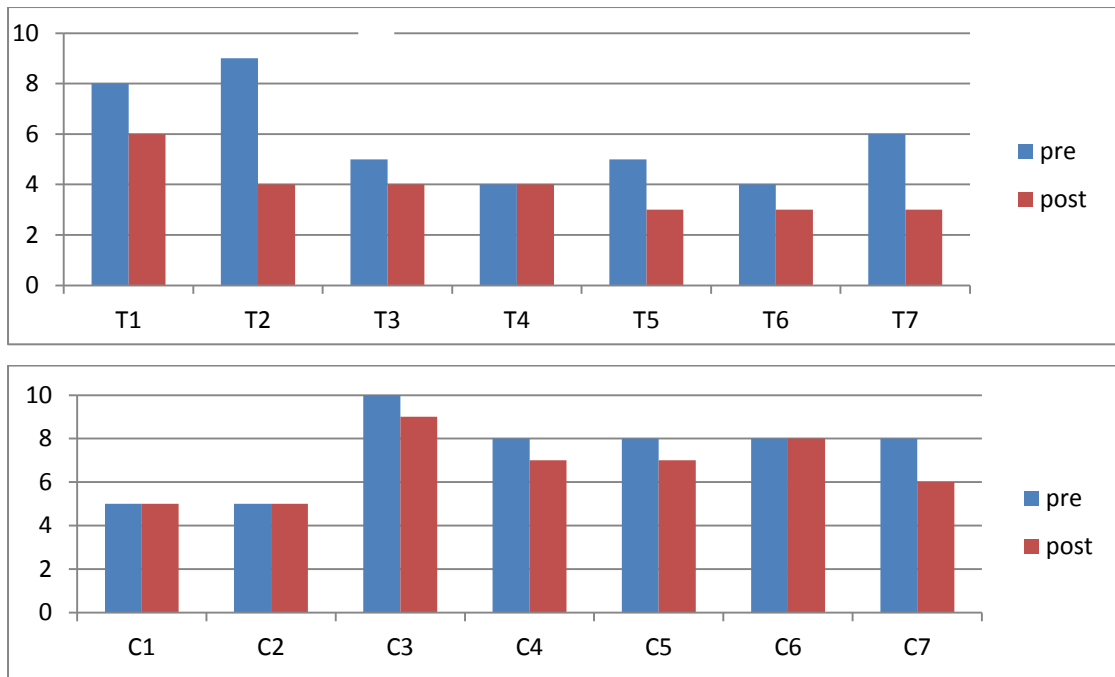


Figure-7: Reduction of Pain during ADL

Comparison of changes of pain on VAS scale during stair up & down between both groups

In this study, day 1 pretest score of pain on VAS was 8.429 in trial group, 8.572 among control group. On day 6 post test scores after treatment showed that pain on VAS had relatively reduced in all groups (Table-8 & Figure-8).

Trial group			Control group		
Subjects	Day 1 Pre	Day 6 post	Subjects	Day 1 Pre	Day 6 post
T1	9	7	C1	5	4
T2	8	4	C2	5	5
T3	10	7	C3	10	9
T4	8	5	C4	10	10
T5	8	5	C5	10	9
T6	8	6	C6	10	9
T7	8	5	C7	10	8
Mean	8.429	5.572	Mean	8.572	7.714

Table-8: Comparison of pain on VAS scale during stair up & down between trial and control groups.

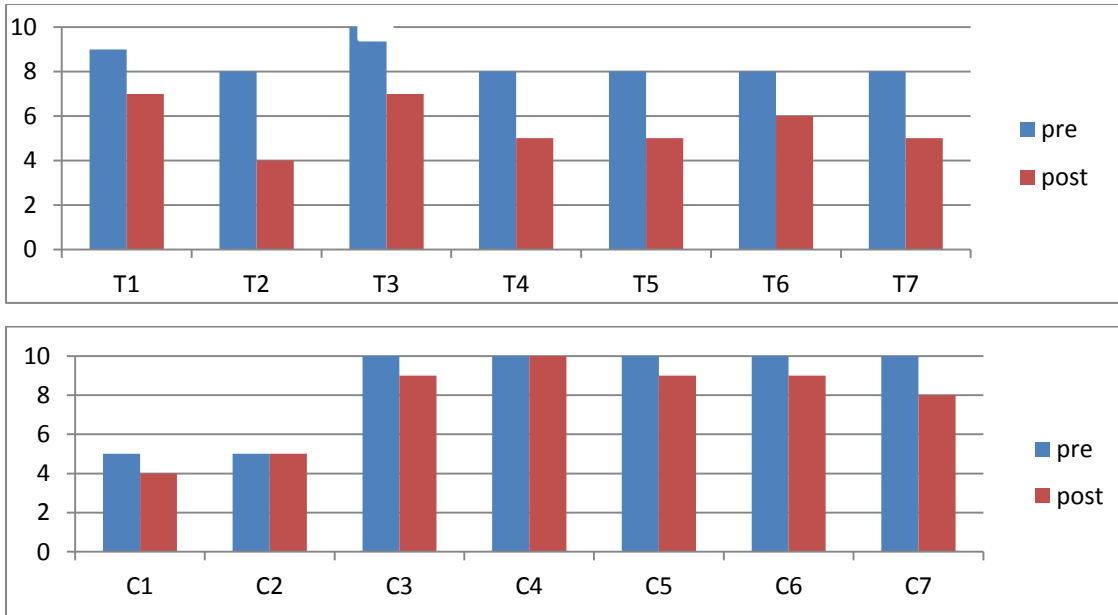


Figure-8: Reduction of Pain during stair up & down.

Name of the variables	Experimental Group (Mean Pain reduction)	Control group (Mean Pain reduction)
Pain at resting position	2	0.857
Pain at sitting position	1.715	0.714
Pain at standing position	2.286	0.857
Pain during walking	2.715	0.428
Pain at squatting position	2.429	0.571
Pain during ADLs	2	0.715
Pain during stair up & down	2.857	0.858

Table 9: Comparison of mean difference of pain reduction in both groups.

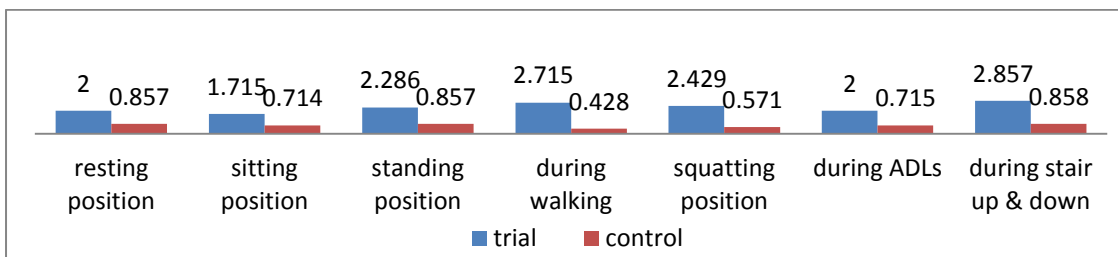


Figure-9: Mean difference of pain reduction.

Variables in the study statistically significance at the following level of significance:

No	Variables	Observed 'U' value	Observed P value	
1	Pain at resting position	27.5	<0.05=11	Not Significant
2	Pain at sitting position	27.5	<0.05=11	Not Significant
3	Pain at standing position	10.5	<0.05=11	Significant
4	Pain during walking	16	<0.05=11	Not Significant
5	Pain at squatting position	27	<0.05=11	Not Significant
6	Pain during activities of daily living	2.5	<0.05=11	Significant
7	Pain during stair up & down	10	<0.05=11	Significant

Table 10: Level of significance in different variable of pain

Improvement of ROM

Mean difference of Improvement of Range of motion between pre-test and post-test in conventional physiotherapy with Mulligan's MWM and only conventional physiotherapy group.

Name of the variables	Conventional physiotherapy with Mulligan's MWM for trial group	Only conventional physiotherapy for control group
Knee flexion Position	15.72	12.86
Knee extension position	2.143	0.714

Table 11: Mean difference of Improvement of ROM between pre-test and post-test in trial and control group.

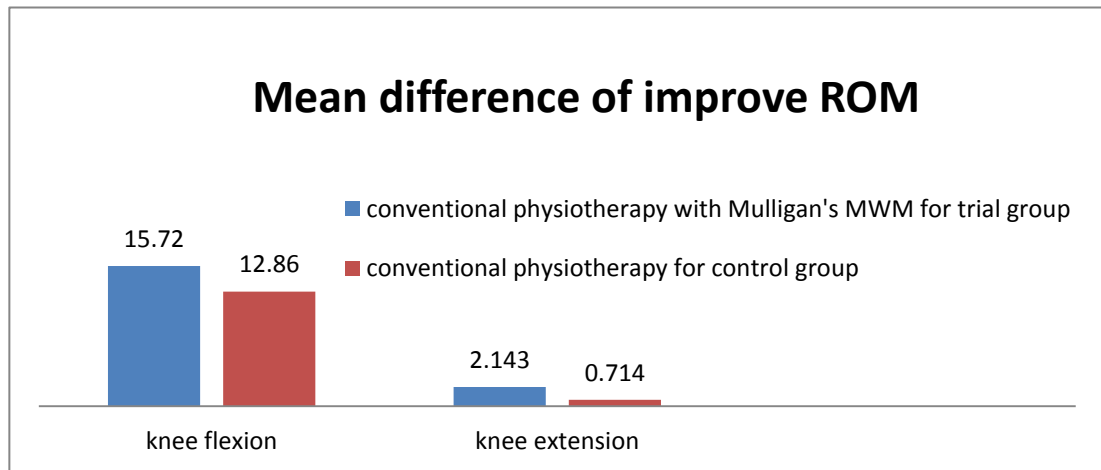


Figure 10: Mean difference of Improvement of ROM between pre-test and post- test in trial and control group.

Variables in the study statistically significance at the following level of significance:

No	Variables	Observed 't' value	Observed P value	
1.	ROM in knee flexion	1.044	<.10	Not Significant
2.	ROM in knee extension	1.153	<.10	Not Significant

Table 12: Level of significance in different variable.

Comparison of changes in WOMAC score between both groups

In this study, day 1 pretest WOMAC score was 47.27% in trial group, 47.69% among control group. On day 6 post test scores after treatment showed that WOMAC score had relatively reduced in all groups (Table-13 &Figure-11). In trial group 27.69 % and 41.59 % in control group respectively reduced. Between groups comparison reduction was more in trial than in control group.

Trial group			Control group		
Subjects	Day 1 Pre	Day 6 post	Subjects	Day 1 Pre	Day 6 post
T1	52.94	32.35	C1	38.24	36.76
T2	45.59	26.47	C2	38.24	32.35
T3	60.30	29.41	C3	57.35	50
T4	41.18	26.47	C4	38.24	36.77
T5	41.18	23.53	C5	54.41	44.12
T6	42.65	27.94	C6	54.41	45.59
T7	47.06	27.94	C7	54.41	42.65
Mean	47.27	27.69	Mean	47.69	41.59
Mean difference		19.58	Mean difference		6.1

Table-13: Comparison of WOMAC scores between trial and control group.

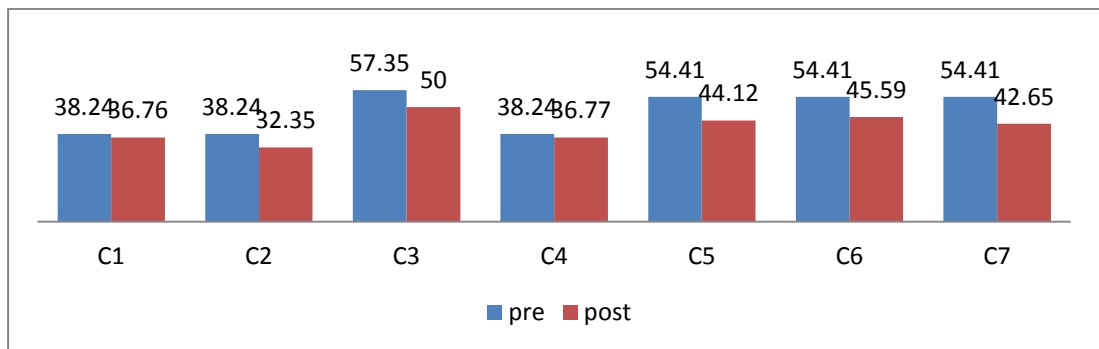


Figure-11: Functional activities in WOMAC score in both groups.

Variables in the study statistically significance at the following level of significance:

No	Variables	Observed 'U' value	Observed P value	
1.	Functional Activities	0.5	<0.05=11	Significant

Table 14: Level of significance in different variable

The purpose of this study was to evaluate the effectiveness of Mulligan's MWM with conventional physiotherapy compare to only conventional physiotherapy for knee OA. In this experimental study 14 patients with knee OA were randomly assigned to the experimental group and to the control group. Among these 14 patients, 7 patients were included in the experimental group who received Mulligan's MWM with conventional physiotherapy and the rest of the 7 patients were included in the control group, who received conventional physiotherapy only. Each group attended for 6 sessions of treatment within two weeks in the physiotherapy outdoor department of CRP Savar in order to demonstrate the improvement. The outcome was measured by using visual analogue scale for pain intensity in different functional position, goniometer for measuring ROM & WOMAC score for functional activities.

The researcher found significant improvement of pain, ROM & functional activities. In Experimental group, different variable of pain at standing, during ADLs and stair up & down result was statistically significant. And pain at resting, sitting, squatting & during walking result was not statistically significant.

ROM in different functional position result was not statistically significant, but the improvement was better in trial group then in control group.

Functional activities score was statistically significant.

In 2013, A study was conducted with 45 patient with knee OA. They were randomly assigned into 3 equal groups. Group A received shock wave therapy, Group B received Mulligan's MWM & Group C received exercise program. Treatment received 3 times per week for 4 weeks. Patients were evaluated pre and post treatment for knee pain by the VAS, ROM by goniometer & functional disability using WOMAC scale. After the end of the treatment Mulligan's MWM & shock wave therapy group's improvement was better & significant then only exercise group. Pain intensity, functional disability & ROM there was no significant difference between

SWT and MWM with $t=0.484$ at $P<0.5$, $t=1.109$ at $p<0.5$ & $t=9.470$ at $p<0.05$ was statistically significant (Mishel S.S et al., 2013).

By a single blinded randomized controlled trial was to investigate the effects of Mulligan's MWM versus kinesio taping on pain and disability for subject with knee OA. 40 subjects with knee OA equally randomized into two groups. One group treated with Mulligan's MWM & another group treated with patellar taping. Patients were evaluated pre and post treatment for knee pain by the VAS & functional disability using WOMAC scale. At the end of treatment improvement was better in Mulligan's MWM group than taping group. Pain intensity & functional disability score in mobilization group was 11.733 & 15.532 statistically significant (P. Malgaonkar et al., 2014).

In this Research, Researcher found improvement of Pain, ROM & functional activities score in both conventional physiotherapy and Mulligan's MWM group. But the comparison of both groups improvement was better in Mulligan's MWM group than in conventional physiotherapy group.

5.1 Limitations

The study was conducted with 14 patients of knee OA, which was a very small number of samples in both groups and was not sufficient enough for the study to generalize the wider population of this condition. Researcher only explored the effect of Mulligan's MWM exercise for knee OA after 6 weeks, so the long term effect of Mulligan's MWM for knee OA was not explored in this study. The research carried out in CRP Savar such a small environment, so it was difficult to keep confidential the aims of the study for blinding procedure. Therefore, single blind method was used in this study. There was no available research done in this area in Bangladesh. So, relevant information about knee OA patient with specific intervention for Bangladesh was very limited in this study. There was no follow up session after the end of the treatment which improved or maintenance the outcome.

6.1 Conclusion

The study consisted of 14 participants divided randomly and equally into two groups. Trial group consisted of those who received Mulligan's MWM with conventional physiotherapy, while control group consisted of those who received only conventional physiotherapy. All participants underwent an extensive medical history, physical and orthopedic examinations, from which their diagnosis of knee OA was made. All participants received 6 sessions of treatment, than follow up and evaluation was made.

The results of the study suggest that, pain at standing, ADLs & stair up &down in VAS scale was statistically significant & resting, sitting, walking & squatting was not statistically significant. WOMAC score for functional activities was statistically significant. And ROM measurement was not statistically significant. But in comparison, trial group mean percentage was improved on pain at resting, sitting, walking & squatting on VAS and ROM in comparison to control group.

Ultimately, the performance of Mulligan's MWM with conventional physiotherapy was more effective, regardless only conventional physiotherapy. From this research the researcher wishes to explore the effectiveness of Mulligan's MWM along with conventional physiotherapy to reduce the features of patient with knee OA which will be helpful to facilitate their rehabilitation and to enhance functional activities.

Knee OA is a degenerative disease that just not affects a specific joint but the entire complex of the knee. The manifestations are not only pain but also limitation in movements and restriction to activities of daily living. From this research, researcher also concluded the specific variables and comparison of their improvement rates. This will aid the professionals to decide the specific evidence based protocol for applying interventions in knee OA.

6.2 Recommendations

For future studies, the following recommendations may be made:

A larger sample size may improve the statistical significance of some of the results. A longer time frame and long-term follow-up examination (1 month after the study) may prove valuable in showing the long-term effect of the treatment, as was done in the study (P.Malgaonkar et al., 2014). Double blinding procedure should maintain to reduce biasness.

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APPENDIX 1
CONSENT FORM (English)

Assalamu-alaikum/ Namasker. My name is TasnemBintay Ali, student of BSc in physiotherapy at Bangladesh Health Professions Institute (BHPI), CRP. I am conducting a study for partial fulfillment of Bachelor of Science in Physiotherapy degree, titled, “Effectiveness of Mulligan’s MWM in Combination with Conventional Physiotherapy for knee OA”.

Through this research, I will see the efficacy of Mulligan’s MWM along with existing physiotherapy for the case of knee OA. For this regard, I would need to collect data from the patient having knee OA.

Considering the area of research, you have met the inclusion criteria and i would like to invite you as a subject of my study. If you participate in this study, I will evaluate for a particular intervention (Effectiveness of Mulligan’s MWM in Combination with Conventional Physiotherapy) for knee OA. The interventions that would be given are safe and will not cause any harm.

I want to meet you a few couple of sessions during your as usual therapy. Your participation will be voluntary. You have the right to withdraw consent and discontinue participation at any time.

If you have any query about the study or your right as a participant, you may contact with, researcher TasnemBentay Ali or Mohammad Anwar Hossain, Associate Professor, Department of Physiotherapy, CRP, Savar, Dhaka-1343.

Do you have any questions before I start?

So may I have your consent to proceed with the interview?

Yes: No:

Signature of the Interviewer.....

Ihave read and understand the contents of the form. I agree to participant in the research without any force.

Signature of the participant

Signature of the witness.....

সম্মতিপত্র

আসসালামুআলাইকুম/ নমস্কারা আমার নাম তামিম বিস্তু আলী, বাংলাদেশ হেলথ ইপ্রফেশনস ইনস্টিটিউট এর ফিজিওথেরাপী চতুর্থ বর্ষের ছাত্রী। আমি এই গবেষণাটি ব্যাচেলর অব সায়েন্স ইন ফিজিওথেরাপী ডিগ্রির পরিপূর্ণতার জন্য করছি। আমার গবেষণার নাম -হাটুর পুরাতন সগিধ-প্রদাহ বা সগিধবাতে মুলিগানের মুভমেন্ট উইত মবিলাইজেশন এর কাযকারীতা।

এই গবেষণার মাধ্যমে আমি জানতে পারব - হাটুর পুরাতন সগিধ-প্রদাহ বা সগিধবাতে মুলিগানের মুভমেন্ট উইত মবিলাইজেশন এর কাযকারীতা। এই জন্য আমার হাটুর পুরাতন সগিধ-প্রদাহ বা সগিধবাতে রোগী থেকে প্রয়োজনীয় তথ্য জানতে হবে।

গবেষণার ক্ষেত্রে অনুযায়ী, আপনি এই গবেষণায় অন্তর্ভুক্তির যোগ্যতা অর্জন করেছেন। আমি আপনাকে এই গবেষণায় অংশ গ্রহনের আমন্ত্রন জানাচ্ছি, আমার একটি নির্দিষ্ট ফলাফলের চেষ্টা করছি - হাটুর পুরাতন সগিধ-প্রদাহ বা সগিধবাতে মুলিগানের মুভমেন্ট উইত মবিলাইজেশন এর কাযকারীতা ” যেসবচিকিৎসা পদ্ধতি আপনার উপর প্রয়োগ করা হবে তা সম্পূর্ণ নিরাপদ এবং নিশ্চিত যেকোন ক্ষতি সাধন করবেনা বিরত থাকতে পারেন।

আপনার যদি এ গবেষণা সম্পর্কে কোন জিজ্ঞাসা থাকে তবে অনুগ্রহপূর্বক যোগাযোগ করতবেন গবেষক তামিম বিস্তু আলী অথবা আনোয়ার হোসেন, সহযোগী অধ্যাপক ও ক্লিনিকাল প্রধান, ফিজিওথেরাপী বিভাগ, বিএইচপিআই, সিআরপি, সাভার, ঢাকা-১৩৪৩।

শুরু করার পূর্বে আপনার কি কোন প্রশ্ন আছে?

আমি কি শুরু করতে পারি?

হ্যাঁ

না

প্রশ্নকর্তার স্বাক্ষর

আমি এই সম্মতি পত্রটি পড়েছি ও বুঝেছি। আমি স্বেচ্ছায় এই গবেষণায় অন্তর্ভুক্ত হচ্ছি।

অংশগ্রহণকারীর স্বাক্ষর

১ নং সাক্ষীর স্বাক্ষর

২ নং সাক্ষীর স্বাক্ষর

APPENDIX 2

Research Title: Effectiveness of Mulligan's MWM on pain, ROM and functional activities in patients with knee osteoarthritis.

QUESTIONNAIRE

Code No:

PART:1

Name of the participant:	
Age:	
Sex:	
Address:	
Contact No:	
Education:	
Start time of intervention:	
End time of intervention:	
Consent taken:	a) Yes..... b) No.....

PART:2

These questionnaires are designed for Knee Osteoarthritis patient according to, “The Western Ontario and MacMaster Universities Osteoarthritis Index (WOMAC SCORE)” .There is some questions. Please put the circle (o) mark on answer which will most closely describe your condition. Here, 0 indicate none, 1 indicate slight, 2 indicate moderate, 3 indicate severe & 4 indicate extreme.

For activities of physical function:

Pretreatment session:

Descending stairs	0	1	2	3	4
Ascending stairs	0	1	2	3	4
Rising from sitting	0	1	2	3	4
Standing	0	1	2	3	4
Bending to floor/picking up an object	0	1	2	3	4
Walking on flat surface	0	1	2	3	4
Getting in /out of car	0	1	2	3	4
Going shopping	0	1	2	3	4
Putting on socks/stockings	0	1	2	3	4
Rising from bed	0	1	2	3	4
Taking off socks/stockings	0	1	2	3	4
Lying in bed (turning over, maintaining knee position)	0	1	2	3	4
Getting in /out of bath	0	1	2	3	4
Sitting	0	1	2	3	4
Getting on /off toilet	0	1	2	3	4

Heavy domestic duties(shoveling, scrubbing floors, etc)	0	1	2	3	4
Light domestic duties(cooking, dusting)	0	1	2	3	4

Total score: _____/68= _____%

Range of motion is measured by goniometer:

Pretreatment session:

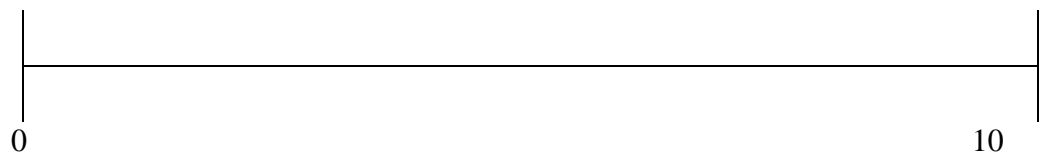
1. Passive ROM of flexion of affected knee (Measured by examiner)
Pre- treatment Degrees.
2. Passive ROM of extension of affected knee (Measured by examiner)
Pre- treatment Degrees.

VAS scale (0=no pain, 10=severe pain) for measuring the intensity of pain

Pretreatment session:

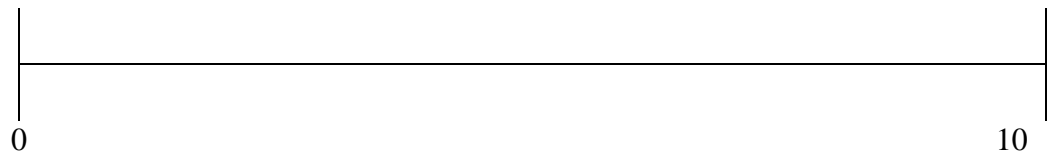
1. How severe is your pain at resting position?

Pre



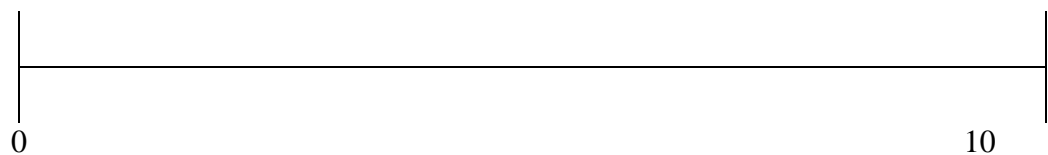
2. How severe is your pain at sitting position?

Pre



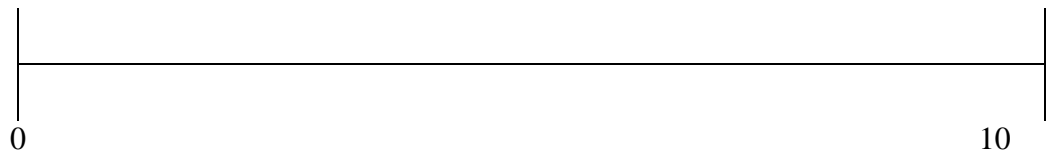
3. How severe is your pain at standing position?

Pre



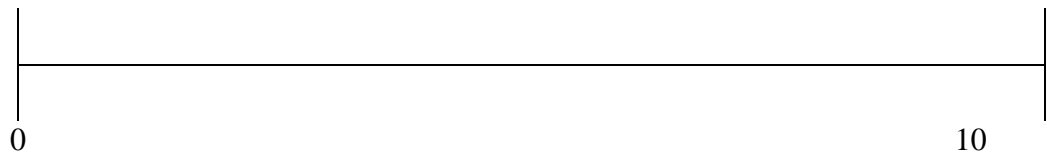
4. How severe is your pain during walking?

Pre



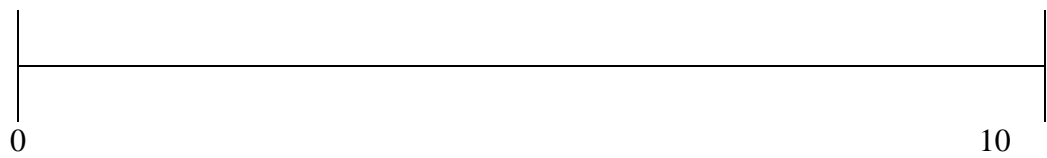
5. How severe is your pain at squatting position?

Pre



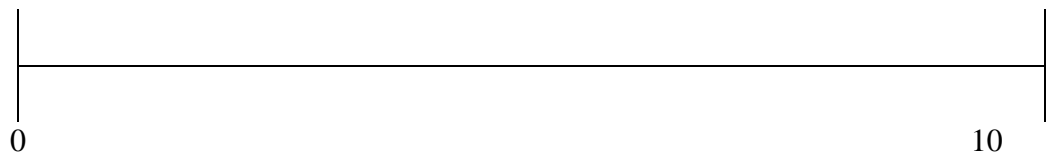
6. How severe is your pain during activities of daily living?

Pre



7. How severe is your pain during stair up & down?

Pre



Shenouda et al., (2013)

TasnemBentay Ali

4th professional B.SC.in physiotherapy

Researcher

গবেষণার শিরোনাম: হাঁটু অস্টিও আর্থ্রাইটিস রোগীদের মধ্যে ব্যথা, রম এবং কার্যকরী কার্য ক্রমে মূলিগানের
মুভমেন্ট উইত মবিলাইজেশন এর কার্যকারীতা।

প্রশ্নাবলী (চিকিৎসার আগে)

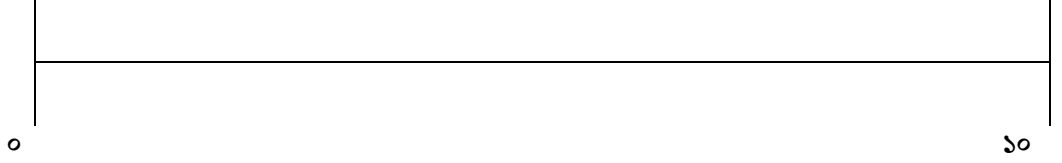
কোডনং:

অংশ: ১	
অংশগ্রহণকারীর নাম:	
বয়স:	
লিঙ্গ:	
ঠিকানা :	
ফোন নাম্বারঃ	
শিক্ষা:	
হস্তক্ষেপের সময় শুরু:	
হস্তক্ষেপের সময় শেষ:	
অনুমতি গ্রহণ :	ক) হ্যাঁ খ)কোন

ব্যথার তীব্রতা পরিমাপের জন্য ভ্যালু অ্যাডেড সার্ভিস স্কেল (০ = কোন ব্যথা নাই, ১০ = তীব্রব্যথা)

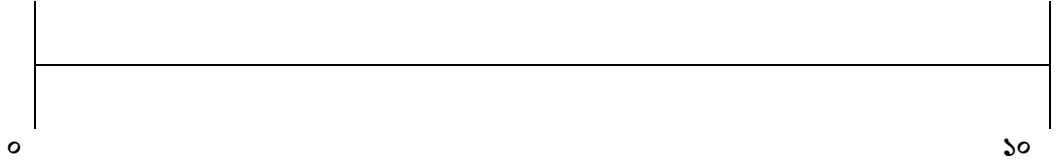
১। বিশ্রামের অবস্থায় আপনার ব্যথার পরিমাণ কত?

চিকিৎসার পূর্বে



২। বসে থাকা অবস্থায় আপনার ব্যথার পরিমাণ কত?

চিকিৎসার পূর্বে



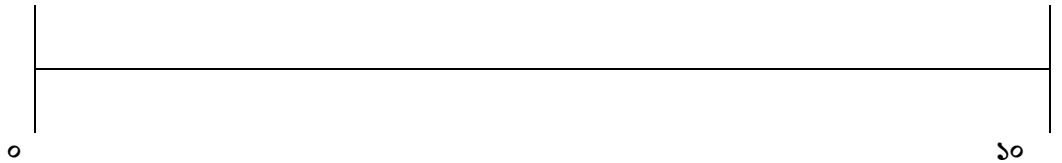
৩। দাঁড়ানো অবস্থায় আপনার ব্যথার পরিমাণ কত?

চিকিৎসার পূর্বে



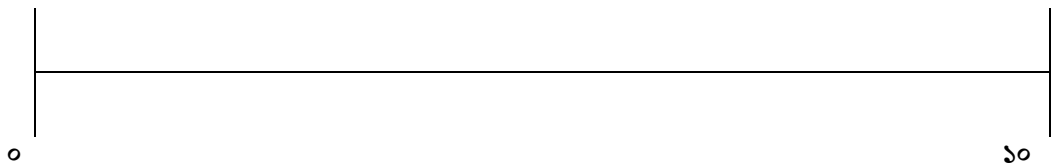
৪। হাটার সময় আপনার ব্যথার পরিমাণ কত?

চিকিৎসার পূর্বে



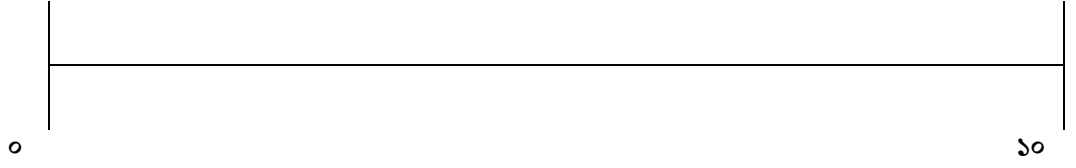
৫। টয়লেটের পজিসনে বসতে আপনার কত ব্যথা হয়?

চিকিৎসার পূর্বে



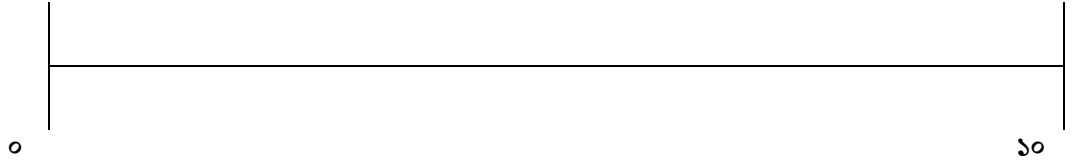
৬। প্রতিদিনের দৈনিক কাজ করার সময় আপনার ব্যথার পরিমাণ কত?

চিকিৎসার পূর্বে



৭। সিঁড়ি দিয়ে উপরে উঠতে নামতে আপনার কত ব্যথা হয়?

চিকিৎসার পূর্বে



গনিও মিটার দিয়ে ROM পরিমাপ করাঃ

চিকিৎসা দেওয়ার আগে=

WOMAC SCORE দিয়ে শারীরিক ফাংশন কার্যক্রম পরিমাপ করাঃ

চিকিৎসা দেওয়ার আগে=

সিঁড়ি দিয়ে উপরে	০	১	২	৩	৪
সিঁড়ি দিয়ে নামার	০	১	২	৩	৪
বসা থেকে রাইজিং	০	১	২	৩	৪
দাঁড়ানো	০	১	২	৩	৪
তল নমন একটি বস্তুর গোছগাছ	০	১	২	৩	৪
সমতল উপরহাঁটা	০	১	২	৩	৪
গাড়ীতে ডুকা ও বের হওয়া	০	১	২	৩	৪
কেনাকাটা করা	০	১	২	৩	৪
নির্বাণ মোজা / স্টকিংস	০	১	২	৩	৪
বিছানা থেকে উঠে	০	১	২	৩	৪
মোজা বন্ধ গ্রহণ / স্টকিংস	০	১	২	৩	৪

বিছানায় শয়ন (হাঁটু অবস্থান					
বজায় রাখার উপর বাঁক)	০	১	২	৩	৪
স্নান ডুকা ও বের হওয়া	০	১	২	৩	৪
বসা	০	১	২	৩	৪
টয়লেট শুরু ও শেষ	০	১	২	৩	৪
ভারি গার্হস্থ্য দায়িত্ব (ইত্যাদি ,					
মেঝে ক্রাবিং	০	১	২	৩	৪
হাঙ্কা গার্হস্থ্য দায়িত্ব ((রান্না, কাড়া					
)	০	১	২	৩	৪

মোট স্কোর : _____/৬৮= _____%

APPENDIX-3

Mann-Whitney U test:

This test is used for the analysis of the result of experimental study which has two different un-matched groups of subjects. The Mann-Whitney U test is a non-parametric test that simply compares the result obtained from each group to see if they differ significantly. This test can only be used with ordinal or interval/ ratio data.

The formula of Mann-Whitney U test:

$$U = n_1n_2 + \frac{n_x(n_x+1)}{2} - T_x$$

Where, n_1 = the number of the subjects in trail group

n_2 = the number of the subject in control group.

T_x = the larger rank total.

n_x = the number of the subjects of the group with larger rank total.

The end results after six sessions of intervention of VAS scale pain at resting position between trail group and control group are shown in the table.

Subject	Trail group	Rank	Subject	Control group	Rank
T1	5	10.5	C1	0	
T2	5	10.5	C2	1	2
T3	2	5.5	C3	5	10.5
T4	2	5.5	C4	2	5.5
T5	1	2	C5	6	13
T6	2	5.5	C6	5	10.5
T7	1	2	C7	4	8
Rank total =41.5			Rank total=49.5		

Table-14: U test calculation pain on VAS scale at resting position between trial and control groups.

Where,

$$n_1 = 7,$$

$$n_2 = 7,$$

$$T_x = 49.5,$$

$$n_x = 7$$

Now U formula is,

$$U = n_1 n_2 + \frac{n_x(n_x+1)}{2} - T_x$$

$$U = 7 \times 7 + \frac{7(7+1)}{2} - 49.5$$

$$= 49 + 28 - 49.5$$

$$= 27.5$$

U value was 27.5. The critical value of U at $p \leq 0.05$ was 11. Therefore, the result was not significant at $p \leq 0.05$ at one tailed hypothesis. So, the difference was not statistically significant.

The end results after six sessions of intervention of VAS scale pain at sitting position between trail group and control group are shown in the table.

Subject	Trail group	Rank	Subject	Control group	Rank
T1	5	11	C1	2	4.5
T2	4	8	C2	1	1
T3	2	4.5	C3	5	11
T4	2	4.5	C4	0	
T5	2	4.5	C5	5	11
T6	2	4.5	C6	5	11
T7	2	4.5	C7	5	11
Rank total =41.5			Rank total=49.5		

Table-15: U test calculation pain on VAS scale at sitting position between trial and control groups.

Where,

$$n_1 = 7,$$

$$n_2 = 7,$$

$$T_x = 49.5,$$

$$n_x = 7$$

Now U formula is,

$$U = n_1 n_2 + \frac{n_x(n_x+1)}{2} - T_x$$

$$U = 7 \times 7 + \frac{7(7+1)}{2} - 49.5$$

$$= 49 + 28 - 49.5$$

$$= 27.5$$

U value was 27.5. The critical value of U at $p \leq 0.05$ was 11. Therefore, the result was not significant at $p \leq 0.05$ at one tailed hypothesis. So, the difference was not statistically significant.

The end results after six sessions of intervention of VAS scale pain at standing position between trail group and control group are shown in the table.

Subject	Trail group	Rank	Subject	Control group	Rank
T1	6	11	C1	5	8
T2	5	9.5	C2	4	7
T3	4	7	C3	9	14
T4	3	3	C4	3	3
T5	3	3	C5	7	12
T6	3	3	C6	7	12
T7	4	7	C7	7	12
Rank total =43.5			Rank total=66.5		

Table-16: U test calculation pain on VAS scale at standing position between trial and control groups.

Where,

$$n_1 = 7,$$

$$n_2 = 7,$$

$$T_x = 66.5,$$

$$n_x = 7$$

Now U formula is,

$$U = n_1 n_2 + \frac{n_x(n_x+1)}{2} - T_x$$

$$U = 7 \times 7 + \frac{7(7+1)}{2} - 66.5$$

$$= 49 + 28 - 66.5$$

$$= 10.5$$

U value was 10.5. The critical value of U at $p \leq 0.05$ was 11. Therefore, the result was significant at $p \leq 0.05$ at one tailed hypothesis. So, the difference was statistically significant.

The end results after six sessions of intervention of VAS scale pain during walking between trail group and control group are shown in the table.

Subject	Trail group	Rank	Subject	Control group	Rank
T1	6	10	C1	3	1
T2	5	7	C2	4	3
T3	4	3	C3	10	14
T4	5	7	C4	5	7
T5	4	3	C5	8	12.5
T6	5	7	C6	8	12.5
T7	5	7	C7	7	11
Rank total =44			Rank total=61		

Table-17: U test calculation pain on VAS scale during walking between trial and control groups.

Where,

$$n_1 = 7,$$

$$n_2 = 7,$$

$$T_x = 61,$$

$$n_x = 7$$

Now U formula is,

$$U = n_1 n_2 + \frac{n_x(n_x+1)}{2} - T_x$$

$$U = 7 \times 7 + \frac{7(7+1)}{2} - 61$$

$$= 49 + 28 - 61$$

$$= 16$$

U value was 16. The critical value of U at $p \leq 0.05$ was 11. Therefore, the result was not significant at $p \leq 0.05$ at one tailed hypothesis. So, the difference was not statistically significant.

The end results after six sessions of intervention of VAS scale pain at squatting position between trail group and control group are shown in the table.

Subject	Trail group	Rank	Subject	Control group	Rank
T1	6	9	C1	4	2
T2	5	6	C2	4	2
T3	4	2	C3	10	13
T4	5	6	C4	0	
T5	5	6	C5	8	10.5
T6	5	6	C6	9	12
T7	5	6	C7	8	10.5
Rank total =41			Rank total=50		

Table-18: U test calculation pain on VAS scale at squatting position between trial and control groups.

Where,

$$n_1 = 7,$$

$$n_2 = 7,$$

$$T_x = 50,$$

$$n_x = 7$$

Now U formula is,

$$U = n_1 n_2 + \frac{n_x(n_x+1)}{2} - T_x$$

$$U = 7 \times 7 + \frac{7(7+1)}{2} - 50$$

$$= 49 + 28 - 50$$

$$= 27$$

U value was 27. The critical value of U at $p \leq 0.05$ was 11. Therefore, the result was not significant at $p \leq 0.05$ at one tailed hypothesis. So, the difference was not statistically significant.

The end results after six sessions of intervention of VAS scale pain during activities of daily living between trail group and control group are shown in the table.

Subject	Trail group	Rank	Subject	Control group	Rank
T1	6	9.5	C1	5	7.5
T2	4	5	C2	5	7.5
T3	4	5	C3	9	14
T4	4	5	C4	7	11.5
T5	3	2	C5	7	11.5
T6	3	2	C6	8	13
T7	3	2	C7	6	9.5
Rank total =30.5			Rank total=74.5		

Table-19: U test calculation pain on VAS scale during activities of daily living between trial and control groups.

Where,

$$n_1 = 7,$$

$$n_2 = 7,$$

$$T_x = 74.5,$$

$$n_x = 7$$

Now U formula is,

$$U = n_1 n_2 + \frac{n_x(n_x+1)}{2} - T_x$$

$$U = 7 \times 7 + \frac{7(7+1)}{2} - 74.5$$

$$= 49 + 28 - 74.5$$

$$= 2.5$$

U value was 2.5. The critical value of U at $p \leq 0.05$ was 11. Therefore, the result was significant at $p \leq 0.05$ at one tailed hypothesis. So, the difference was statistically significant.

The end results after six sessions of intervention of VAS scale pain during stair up & down between trail group and control group are shown in the table.

Subject	Trail group	Rank	Subject	Control group	Rank
T1	7	8.5	C1	4	1.5
T2	4	1.5	C2	5	4.5
T3	7	8.5	C3	9	12
T4	5	4.5	C4	10	14
T5	5	4.5	C5	9	12
T6	6	7	C6	9	12
T7	5	4.5	C7	8	10
Rank total =39			Rank total=66		

Table-20: U test calculation pain on VAS scale during stair up & down between trial and control groups.

Where,

$$n_1 = 7,$$

$$n_2 = 7,$$

$$T_x = 66,$$

$$n_x = 7$$

Now U formula is,

$$U = n_1 n_2 + \frac{n_x(n_x+1)}{2} - T_x$$

$$U = 7 \times 7 + \frac{7(7+1)}{2} - 66$$

$$= 49 + 28 - 66$$

$$= 10$$

U value was 10. The critical value of U at $p \leq 0.05$ was 11. Therefore, the result was significant at $p \leq 0.05$ at one tailed hypothesis. So, the difference was statistically significant.

Range of motion of knee flexion position: Improvement of ROM in knee flexion in OA, Mulligan's MWM with conventional physiotherapy treatment group and only conventional physiotherapy treatment group for Improvement of ROM in knee flexion were differences between pre-test and post-test pain scores.

Mulligan's MWM with conventional physiotherapy group			Only Conventional physiotherapy group		
Subjects	ROM in knee flexion (X_1)	X_1^2	Subjects	ROM in knee flexion (X_2)	X_2^2
T ₁	20	400	C ₁	10	100
T ₂	10	100	C ₂	10	100
T ₃	10	100	C ₃	20	400
T ₄	20	400	C ₄	10	100
T ₅	20	400	C ₅	20	400
T ₆	10	100	C ₆	10	100
T ₇	20	400	C ₇	10	100
	$\sum X_1=110$	$\sum X_1^2=1900$		$\sum X_2= 90$	$\sum X_2^2= 1300$

Table-21: t test calculation ROM in knee flexion position between both trial and control groups.

Where,

$$\bar{X}_1= 15.72$$

$$\sum X_1^2= 1900$$

$$(\sum X_1)^2= 12100$$

$$n_1=7$$

$$\bar{X}_2= 12.86$$

$$\sum X_2^2=1300$$

$$(\sum X_2)^2= 8100$$

$$n_2=7$$

Calculating the degree of freedom from the formula

$$\begin{aligned} df &= (n_1-1) + (n_2-1) \\ &= (7-1) + (7-1) = 12 \end{aligned}$$

Now 't' formula-

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\left(\sum x_1^2 - \frac{(\sum x_1)^2}{n_1}\right) + \left(\sum x_2^2 - \frac{(\sum x_2)^2}{n_2}\right)}{(n_1-1) + (n_2-1)} \times \sqrt{\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

$$t = \frac{15.72 - 12.86}{\sqrt{\frac{1900 - \frac{12100}{7} + 1300 - \frac{8100}{7}}{(7-1) + (7-1)} \times \sqrt{\left(\frac{1}{7} + \frac{1}{7}\right)}}$$

$$t = 1.044$$

Range of Movement in knee extension position: Improvement of ROM in knee extension in OA, Mulligan's MWM with conventional physiotherapy treatment group and only conventional physiotherapy treatment group for Improvement of ROM in knee flexion were differences between pre-test and post-test pain scores.

Mulligan's MWM with conventional physiotherapy group			Only Conventional physiotherapy Group		
Subjects	ROM in knee extension(X ₁)	X ₁ ²	Subjects	ROM in knee extension (X ₂)	X ₂ ²
T ₁	5	25	C ₁	0	0
T ₂	0	0	C ₂	5	25
T ₃	0	0	C ₃	0	0
T ₄	5	25	C ₄	0	0
T ₅	5	25	C ₅	0	0
T ₆	0	0	C ₆	0	0
T ₇	0	0	C ₇	0	0
	∑X ₁ =15	∑X ₁ ² =75		∑X ₂ = 5	∑X ₂ ² = 25

Table-22: t test calculation ROM in knee extension position between both trial and control groups.

Where,

$$\bar{X}_1 = 2.143$$

$$\sum X_1^2 = 75$$

$$(\sum X_1)^2 = 225$$

$$n_1 = 7$$

$$\bar{X}_2 = 0.714$$

$$\sum X_2^2 = 25$$

$$(\sum X_2)^2 = 25$$

$$n_2 = 7$$

Calculating the degree of freedom from the formula

$$\begin{aligned} df &= (n_1 - 1) + (n_2 - 1) \\ &= (7 - 1) + (7 - 1) = 12 \end{aligned}$$

Now 't' formula-

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\left[\frac{\left(\sum x_1^2 - \frac{(\sum x_1)^2}{n_1} \right) + \left(\sum x_2^2 - \frac{(\sum x_2)^2}{n_2} \right)}{(n_1 - 1) + (n_2 - 1)} \right] \times \sqrt{\left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}$$
$$t = \frac{2.143 - 0.714}{\sqrt{\left[\frac{75 - \frac{225}{7} + 25 - \frac{25}{7}}{(7-1) + (7-1)} \right] \times \sqrt{\left(\frac{1}{7} + \frac{1}{7} \right)}}$$

$$t = 1.153$$

The end results after six sessions of intervention of WOMAC score between trail and control group are shown in the table.

Subject	Trail group	Rank	Subject	Control group	Rank
T1	22	7.5	C1	25	9
T2	18	2.5	C2	22	7.5
T3	20	6	C3	34	14
T4	18	2.5	C4	27	10
T5	16	1	C5	30	12
T6	19	4.5	C6	31	13
T7	19	4.5	C7	29	11
		Rank total= 28.5			Rank total=76.5

Table-23: U test calculation on WOMAC scores between trial and control groups.

Where,

$$n_1 = 7,$$

$$n_2 = 7,$$

$$T_x = 76.5$$

$$n_x = 7$$

$$U = 7 \times 7 + \frac{7(7+1)}{2} - 76.5 = 0.5$$

The U value was 0.5. The critical value of U at $p \leq 0.05$ was 11. Therefore the result was significant at $p \leq 0.05$ at one tailed hypothesis. So, the difference was statistically significant.

March 04, 2015

Head

Department of Physiotherapy

Centre for the Rehabilitation of the Paralysed (CRP)

Chapain, Savar, Dhaka – 1343

Through: Head, Department of Physiotherapy, BHPI.

Subject: Seeking permission for data collection to conduct my research project.

Dear Sir,

With due respect and humble submission to state that I am TasnemBentay Ali, student of 4th Professional B.Sc. in Physiotherapy at Bangladesh Health Professions Institute (BHPI). The Ethical Committee has approved my research project titled on "Effectiveness of Mulligan MWM for the patients with Knee osteoarthritis." under the supervision of Mohammad Anwar Hossain, Associate Professor, Department of Physiotherapy. Conducting this research project is partial fulfilment of the requirement for the degree of B.Sc. in Physiotherapy. I want to collect research data for my research project from the qualified Physiotherapists working at CRP. So, I need permission for data collection from the Musculoskeletal Unit of Physiotherapy Department at CRP, Savar. I would like to assure that anything of my study will not be harmful for the participants.

I, therefore, pray and hope that you would be kind enough to grant my application and give me the permission for data collection and oblige thereby.

Sincerely yours,

Tasnem Bentay Ali

Tasnem Bentay Ali
4th Professional B. Sc. in Physiotherapy,
Roll-08, Session: 2009-2010,
Bangladesh Health Professions Institute (BHPI)
(An academic Institute of CRP)
CRP-Chapine,Savar, Dhaka - 1343.

Forwarded for Approval
16/03/15
Approved
Please contact with M. Kamal
CRP as a circular part of
the data collection
16/3/15