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Long term effect of mulligan movement with mobilization on range of motion and physical functions in subjects with knee osteoarthritis

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Abstract
Background: Osteoarthritis of knee is a degenerative joint disease which is most commonly seen in the people of above 45 years in both genders. It happened due to wear and tear changes in the knee joint and formation of osteophytes in knee joint.
Objective: To find out the Long-term effect of Mulligan movement with mobilization on range of motion and physical function in subjects with knee osteoarthritis.
Methods: 40 patients with osteoarthritis of knee were allocated into two groups (20 participants in each group) the outcome measure used was WOMAC questionnaire and Goniometer for range of motion. Subjects of group A were treated with Mulligan mobilization whereas subjects with group B were treated with Isometrics and stretching. For both the experimental group the techniques were performed thrice a week for the duration of 8 weeks and follow up will be done after 4 weeks.
Results: The results demonstrated that significant effect of Mulligan mobilization with movement for the subjects of group A when compared with those of group B at the end of 8 weeks.
Conclusion: Although the study supports the experimental hypothesis that long term effect of Mulligan mobilization with movement is much more effective than stretches.

Keywords: Osteoarthritis**,** mulligan mobilization, mulligan belt, goniometer

1. Introduction
Osteoarthritis (OA) also known as degenerative joint disease, is associated with degradation of articular cartilage, subsequently affecting the underlying bone causing osteophyte formation at the joint margins (Altmann *et al*., 1991; Larmer *et al*., 2014) [1].
Osteoarthritis is the most common form of arthritis in the knee. It is a degenerative, "wear-and-tear" type of arthritis that occurs most often in people 50 years of age and older, but may occur in younger people, too. In osteoarthritis, the cartilage in the knee joint gradually wears away. As the cartilage wears away, it becomes frayed and rough, and the protective space between the bones decreases. This can result in bone rubbing on bone and produce painful bone spurs. Osteoarthritis develops slowly and the pain it causes worsens over time [2].
Knee osteoarthritis is the second most common rheumatologic problem and is most frequent joint disease with prevalence of 22% to 39% in India. According to the Johnston county project, a long-term study from university of North Carolina, the lifetime risk of developing osteoarthritis of the hip is 25% and osteoarthritis of knee is about 46% [3].
The pathogenesis of OA involves a degradation of cartilage and remodelling of bone due to an active response of chondrocytes in the articular cartilage and the inflammatory cells in the surrounding tissues. The release of enzymes from these cells break down collagen and proteoglycans, destroying the articular cartilage. The exposure of the underlying subchondral bone results in sclerosis, followed by reactive remodelling changes that lead to the formation of osteophytes and bone cysts. Osteoarthritis has a multifactorial a etiology and can be primary (with no obvious cause) or secondary (due to trauma, infiltrative disease or connective tissue diseases). Risk factors for primary OA include obesity, advancing age, female gender, and manual labour occupations [4].
Knee osteoarthritis (OA) is a major public health issue because it causes chronic pain, reduces physical function and diminishes quality of life.

Ageing of the population and increased global prevalence of obesity are anticipated to dramatically increase the prevalence of knee OA and its associated impairments. No cure for knee OA is known, but exercise therapy is among the dominant non-pharmacological interventions recommended by international guidelines.

The causes of OA knee are multifactorial, that are Age, Gender, Hereditary, Weight, Repetitive stress injuries, Athletics, Other illnesses [5].

Several studies has shown knee arthritis usually progress with ageing population. Higher rate of knee arthritis is most common among the elderly population of age in between 60s and 70s [6].

Osteoarthritis (OA) is divided into five stages. Stage 0 is assigned to a normal, healthy knee. The highest stage, 4, is assigned to severe OA. OA that has become this advanced is likely to cause significant pain and disrupt joint movement. Stage 0: Normal knee, Stage 1: Person with stage 1 OA is showing very minor bone spur growth. Bone spurs are bony growths that often develop where bones meet each other in the joint. Someone with stage 1 OA will usually not experience any pain or discomfort as a result of the very minor wear on the components of the joint. Stage 2 OA of the knee is considered a “Mild” stage of the condition. Stage 3 OA is classified as “Moderate” OA. In this stage, the cartilage between bones shows obvious damage, and the space between the bones begins to narrow. People with stage 3 OA of the knee are likely to experience frequent pain when walking, running, bending, or kneeling. Stage 4 OA is considered “Severe” [7].

Osteoarthritis is a complex chronic disorder of the entire knee joint, with multiple potential risk factors. While the main characteristic of osteoarthritis is loss of articular (joint) cartilage, it is now appreciated that osteoarthritis is a total joint disease [8].

Common OA symptoms are pain, morning stiffness, reduced range of motion, joint instability, swelling, muscle weakness and fatigue. This directly affects patients’ social interactions, mental functioning, and sleep quality, and patients with KOA report among the lowest health-related quality of life (HrQoL) compared with patients suffering other chronic diseases [9].

According to data from 2013 to 2017, at least 29 million Indians have OA5, 25. Over the next few decades, substantial rises are expected in the incidence, health impact, and economic consequences of OA, largely due to the aging of the population and the second reason is obesity epidemic6-7. Older age and Excess body weight and other systemic diseases are well-recognized risk factors for the development of OA, especially knee OA. The burden of knee OA alone is particularly high and is on the rise [10].

Moreover, muscle weakness in knee OA usually results in joint stiffness and decreasing ROM that involves daily activities. Quadriceps muscle impairment in knee OA is well documented in the literature. Patients with knee OA experience chronic form of pain and show a declining ability to use their joints, which consequently weakens the muscles. Hence, these destabilise the joints and reduce the physical functions of patients; further, the motions required for the patients’ daily activities become restricted [11].

Osteoarthritis (OA) is one of the leading causes of musculoskeletal pain and disability worldwide,1 with knee OA affecting up to one-third of people aged over 60 years.2 Overall, most individuals with knee OA have chronic pain,3 which is a multidimensional experience that influences their quality of life (QoL) [12].

It involves progressive softening and loss of articular cartilage, subchondral bone sclerosis, cyst formation and the development of osteophytes. OA of the knee accounts for more dependence in walking, stair climbing and other lower-extremity tasks that any other disease [13].

It is a complex, multifactorial disease with many different phenotypes [14].

Osteoarthritis of the knee is a leading cause of disability. Current management is typically limited to the treatment of symptoms until late stages of arthritis lead to knee replacement [15].

While several risk factors have been identified, the causes of knee osteoarthritis are not well established. Age, obesity, and being overweight (body mass index, >26), work-related activities, playing sports at high levels, and malalignment of the knee joint are the most prominent risk factors [16].

The clinical diagnosis of OA of the knee is typically based on presentation, including insidious onset of weight-bearing knee pain that is exacerbated by use of the joint and relieved by rest, and that tends to worsen over the course of the day. Radiographic evidence of OA may precede symptomatic OA but may not correlate with symptom severity. Radiologic severity can be estimated and expressed using the Kellgren and Lawrence (K-L) criteria. However, a number of versions of the criteria exist: At less severe grades, correlation with symptoms is poor, whereas at more severe grades, agreement tends to be higher. The primary impact of these different versions of the criteria may be the challenge that they create in trying to assess, compare, and pool the findings of research studies [17].

Some longitudinal studies have even used different criteria at different time points within the same study. Because of the variation in scores for radiographic finding under various versions of the criteria (especially for individuals with less-advanced disease), stratification is important. Some evidence suggests that among individuals with knee pain, magnetic resonance imaging (MRI) demonstrates physical signs of osteoarthritic changes in the knee before they are visible radiographically [18].

There is progressive softening and disintegration of articular cartilage accompanied by a growth of osteophytes, cyst formation, and subchondral sclerosis [19].

Mulligan’s mobilisation with movement (MWM), the concept of Mobilizations with movement (MWM) of the extremities and SNAGS (sustained natural apophyseal glides) of the spine were first coined by Brian R. Mulligan. Mobilization with movement (MWM) is the concurrent application of sustained accessory mobilization applied by a therapist and an active physiological movement to end range applied by the patient. Passive end-of-range overpressure, or stretching, is then delivered without pain as a barrier. While applying "MWMS" as an assessment, it should consist of should PILL response to use the same as a Treatment P-Pain free, I-Instant result, LL-Long Lasting. If there is No PILL response, that technique should not be advocated. The second principle is Crocks.

C-Contra-indications (No Pill response is a contraindication)

R-Repetitions (Only three reps on the day one)

O-Over pressure [20]

Ramya V. Rao, Ganesh Balthillaya conclude that there is immediate effect of mulligan movement with mobilization in osteoarthritis of knee and it also gives a further scope for research to investigate mulligan movement with mobilization for longer duration. Hence, this study includes the population aging between 45-60 years. Several studies have shown that

there is immediate effect of mulligan movement with mobilization but there are no studies showing the long-term effect of mulligan mobilization with movement. Hence, the purpose of the study is to find out the long-term effect of mulligan movement with mobilization.

2. Materials and Methods

Source of data

- Padmashree Diagnostic Centre, Vijaya Nagar, Bangalore.
- Padmashree Clinic, Nagarbhavi, Bangalore.
- ESI, Rajajinagar, Bangalore.

Method of collection of data

- **Population:** Subjects with knee osteoarthritis.
- **Sampling:** Convenience sampling.
- **Sample size:** 40.
- **Type of study:** Pre-post experimental study.
- **Duration of study:** 6 months

Inclusion criteria

- Age: 45-60years
- Subject with willingness to comply with the study protocol.
- Both genders were included in the study.
- Subjects diagnosed with osteoarthritis by Orthopaedician
- Onset of duration greater than 3 months.
- Subjects with unilateral knee pain

Exclusion criteria

- Subjects with cardiovascular and neurological disease.
- Subject with fever and tumors.
- Subject with other knee pathology like tendinitis, bursitis etc.
- Surgery or arthroscopy within 3 months prior to inclusion.
- Severe burns or joints deformities making the patient unable to walk
- Intraarticular steroids therapy within last 6 months.
- Any valgus or Varus deformity at knee joint.
- BMI more or equal to 30kg/m^2.

Materials Required

- Mulligan's Belt.
- Couch.
- Paper.
- Pen.
- Towel / Pillow.
- WOMAC questionnaire.
- Goniometer.

Group A-Mulligan's mobilization with movement (20 subjects)

Group B (Control group)-Received stretching to (Hamstrings and calf muscles), isometrics (20 subjects) Goniometer was used to measure the Range of motion,

Group A (N=20)

Subjects in this group received Mulligan's mobilization with movement.

- To improve flexion angle, subjects received posterior glide of tibio-femoral joint.
- To improve or increase the extension the subjects received anterior glide of tibiofemoral joint.
- Patient position-supine lying
- Therapist position-walk standing position
- The therapist grasped the patient knee with his both hands and asked the patient to perform flexion and extension of knee and then the glides were given (medial rotation or lateral rotation) simultaneously.
- The treatment included 10 glides per set, 3 sets per session.
- MWM was given thrice a week for 8 weeks and follow up was done after 4 weeks.

Group B (N=20)

Subjects in this group received Stretches & Isometric (Hamstrings and calf) in supine position.

- Above mentioned exercises were given thrice a week for 8 weeks and follow up was done after 4 weeks.

Outcome measures

- WOMAC Questionnaire
- Range of motion

Statistics

The data on baseline characteristic and outcome measures were elicited and recorded. The data was analyzed through statistical software SPSS 21.0 version.

- The level of significance was 0.05. The Wilcoxon test was used to test the significance of WOMAC score in both the groups. The Mann-Whitney U test was used to test the significance of WOMAC score in between the groups. Paired t-test was used to test the significance of pre and post-test in both the groups Range of motion. Unpaired t-test was used to test the significance of Range of motion in between the groups. The MS-Excel and MS-Word Software were used to generate the tables and graphs suitably.

3. Results and Discussion

3.1 Results

The interventions in each group were individually effective in improving ROM and functional activities in subjects with knee OA. But, the interventions in group-A was better than the interventions in other groups among subjects with knee OA.

Table 1: Distribution of subjects according to gender in both the groups

Sl. No.	Gender	Groups	
		Group-A	Group-B
1.	Male	10	9
2.	Female	10	11
		Chi-Square value=0.1003, DF=1, P=.751, Result=NS	

Table 2: Distribution of subjects according to Age in both groups

Sl. No.	Variable	Group-A		Group-B		Unpaired T-Test
		Range	Mean ± SD	Range	Mean ± SD	
1	Age in years	45-60	52.2± 4.94	46-58	51.65± 3.61	T=0.40131, P=.690439

Table 3: Range, mean and SD on ROM and WOMAC in subjects with OA in Group A

Sl. No.	Variables	Pre-test		Post-test		Paired, T-Test and Wilcoxon test	P-Value
		Range	Mean ±SD	Range	Mean ± SD		
1	ROM	100-127	116.15±8.09	120-135	128.15±4.57	Paired, T-Value=19.47	.00008*
2	WOMAC	42.70-65.63	58.69±8.04	31.25-58.34	46.77±8.77	Z= 3.9199	.00008*

Note: * denote-Significant (p<0.05)

Table 5: Range, mean and SD on ROM and WOMAC in subjects with OA in GROUP-B

SL. No.	Variables	Pre-test		Post-test		Paired t-test and Wilcoxon test	P-Value
		Range	Mean ±SD	Range	Mean ±SD		
1	ROM	105-127	115.15±8.75	115-135	126.25±5.04	T=10.50	.00001*
2	WOMAC	42.70-63.54	53.36± 5.65	36.36-47.92	41.92±3.47	Z=-11.92	.00001*

Note: * denote-Significant (p<0.05)

Table 6: Comparison of post-tests in ROM and WOMAC in group A and group B

Sl. No.	Variables	Group-A		Group-B		Un Paired t-test and Man-Whitney test	P-Value
		Range	Mean ±SD	Range	Mean ±SD		
1	ROM	120-135	128.15±4.57	115-135	126.25±5.04	t value=0.91878	P=.182003*
2	WOMAC	31.25-58.34	46.77±8.77	36.36-47.92	41.92±3.75	Z=2.3509	P=.01139*

Note: * denote-Significant (p<0.05)

3.2 Discussion

The study was aimed to find out the "Long term effect of Mulligans mobilization with movement on functional activities in subjects with knee osteoarthritis".

In this study 40 subjects with osteoarthritis of knee between the age group of 45-60 years of both genders were taken after fulfilling the inclusion and exclusion criteria. The subjects were assigned into two groups randomly. 20 subjects were assigned into Group A and received Mulligan movement with mobilization for thrice in a week for the duration of 8 weeks. 20 subjects were assigned into Group B and received stretching with Isometrics of knee exercises for thrice in a week for the duration of 8 weeks.

All the baseline demographic variables were heterogeneous in nature in both the groups. Demographic variables included age, dominance which was homogeneous in nature. Assessment was taken prior to and after the session. In Group-A, subjects were treated with Mulligan movement with mobilization. Prior to the test ROM was from 100-127 with mean 116.15 and SD± 8.09. In post-test, it was found to be increased 120-135 with mean 128.15 and SD±4.57. The non-parametric test for comparison of dependent outcomes when ordinal, the Wilcoxon test was carried out and it was found to be significant at p<0.000.

On the other hand the WOMAC score, prior to the test was from 42.70-65.63 with mean 58.69 of and SD±8.04. In post-test, it was found to be decreased to 31.25-58.34 with mean of 46.77 and SD±8.77. The nonparametric test for comparison of dependent outcomes when ordinal, the Wilcoxon test was carried out and it was found to be significant at p<0.000.

In Group A the mean ROM have improved significantly. Possible explanation for increased ROM for subjects in Group A could be because of that joint mobilization not only initiates local physiological mechanisms but also involves central mechanisms such as facilitation of inhibitory pathways in the spinal cord or descending inhibitory pathways from higher levels in the brainstem [21].

Knee flexion ROM improved significantly immediately after intervention with MWM (Beselga *et al.*) reported immediate improvement of hip flexion and internal rotation ROM following a single treatment of MWM in patients with hip OA [22]. The present study demonstrated an immediate and short-term effect of knee MWM on motor activity, as indicated by significant improvements in knee flexor and extensor muscle strength. These improvements may be due to the reversal of reflex pain inhibition. Alteration in motor activity may also be an indication of a response that is mediated at the level of the central nervous system. MWM improved quadriceps muscle strength significantly in patients with knee OA [23].

In Group A the mean WOMAC have improved significantly. Possible explanation for greater reduction in pain was apparent that quadriceps muscle weakness occurs across a clinical spectrum of knee OA. While it is well established that quadriceps muscles in knee OA are weaker than healthy controls or contralateral knees. It is clear that weakness occurs across a disease spectrum. Conversely, observed that force differences between the moderate and severe radiographic groups were small and non-significant compared to the mild group. Brandt *et al* reported no difference in quadriceps strength between those with stable versus progressive radiographic knee OA over 2.5 years; however, it is possible that differences were masked because radiographic stratification provides limited information about muscle strength [24].

In Group-B, subjects were treated with stretching and isometric knee exercises. Prior to the test ROM was from 105-127 with mean 115.65 and SD± 8.75. The non-parametric test for comparison of dependent outcomes when ordinal, the Wilcoxon test was carried out and it was found to be significant at p<0.000.

On the other hand the WOMAC score, prior to the test was from 42.70-63.54 with mean 53.36 of and SD±5.65. In post-test, it was found to be decreased 36.36-47.92 with mean 41.92 and SD±3.47. The non-parametric test for comparison of dependent outcomes when ordinal, the Wilcoxon test was carried out and it was found to be significant at p<0.000. The mean difference in ROM score in group A was 128.15 with SD of±4.57 and mean difference was in ROM score in group B which was 126.75 with SD of±5.04 which was statistically significant.

It is hypothesized that stretching exercises was not much effective to increase ROM. Possible explanation would be systematic review of 32 studies of land-based exercise for knee OA concluded that platinum-level evidence supports land-based therapeutic exercise for at least short-term pain reduction, but long-term effects are unclear and pooled effect sizes are small. Unfortunately, this review did not consider the mode of intervention used both aerobic and strengthening

interventions were included, both Weight-Bearing (WB) and Non-Weight-Bearing (NWB) interventions were included, and none of the authors' comparisons attempted to note whether any particular mode was most effective for pain relief. The review did conclude that studies that provided an individual intervention produced greater pain relief however, no conclusions could be made regarding the most effective mode or dosage of exercise for knee OA pain (Cochrane 2009) [25]. While the reduction of pain and the improvement of physical function were achieved by stretching, the WOMAC Index scores did not change. This may be because the grade of OA was relatively low, which may represent a non-major limitation of functional activity. Moss *et al*. reported no improvement in WOMAC Index scores after the initial effect of stretching in patients with knee OA.

However, longer sessions of stretching or other manual therapy techniques in combination with exercise produced significant improvements in WOMAC Index scores in other studies [26]. However when comparing the mean WOMAC scores, group-A was more effective in reducing the WOMAC score than the group-B. In group A post mean score of WOMAC score with a mean of 41.92 with SD of 3.47. In group-B post mean score of WOMAC with a mean of 41.92 with SD of 3.75. In the present study Group A (MWM) have shown statistically significant improvement.

4. Conclusion

The study was aimed to find out clinical and statistical significance of Long-term effect of Mulligan mobilization with movement (MWM). Both the groups showed positive results which were clinically significant. After Statistical analysis it was evident that subjects who received Mulligan movement with mobilization performed better results with more improvement in the Range of motion (ROM) and The Western Ontario and McMaster Universities Arthritis Index score (WOMAC). Hence Mulligan movement with mobilization was found to be effective than Isometrics and stretching's. Therefore, the null hypothesis was rejected and the alternate hypothesis was accepted which stated that-There will be long term effect of Mulligan mobilization with movement on functional activities in subjects with knee osteoarthritis.

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