

Effects of Mulligans MWM in Subjects with Oa Knee

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ABSTRACT

Background: Knee osteoarthritis (OA) is one of the most common degenerative musculoskeletal disorders, leading to chronic pain, reduced joint mobility, muscle weakness, and functional limitations that adversely affect quality of life. Physiotherapy plays a vital role in the conservative management of knee OA. Among manual therapy techniques, Mulligan's Mobilization With Movement (MWM) has gained recognition for its ability to reduce pain while restoring normal joint biomechanics through pain-free active movement. Although previous studies have demonstrated promising outcomes, further clinical evidence is required to establish its effectiveness in improving pain, muscle strength, and range of motion in individuals with knee osteoarthritis.

Aim: To evaluate the effects of Mulligan's Mobilization With Movement (MWM) on pain, muscle strength, and knee joint range of motion in subjects with knee osteoarthritis.

Objectives:

1. To determine the effect of Mulligan's MWM on pain intensity.
2. To evaluate changes in knee joint range of motion following intervention.
3. To assess improvements in quadriceps muscle strength after treatment.

Methodology: A single-group experimental pre-test and post-test study design was employed. Twenty participants diagnosed with Grade I–III knee osteoarthritis completed the study. Baseline assessment included pain intensity using the Visual Analogue Scale (VAS), muscle strength using Manual Muscle Testing (MMT), and knee joint range of motion using a universal goniometer. Participants received Mulligan's Mobilization With Movement applied to the tibiofemoral joint along with conventional physiotherapy comprising hot pack application, quadriceps strengthening exercises, and joint protection education. Treatment sessions were conducted three times per week for six weeks, with each session

lasting approximately 20 minutes. Pre- and post-intervention data were analyzed using the paired t-test, with the level of statistical significance set at $p < 0.05$.

Results: The intervention produced statistically highly significant improvements in all measured outcomes. Muscle strength improved from 2.55 ± 0.51 to 4.75 ± 0.44 ($t = 18.93$, $p < 0.0001$). Pain intensity significantly decreased from 8.40 ± 1.27 to 3.30 ± 0.80 ($t = 18.77$, $p < 0.0001$). Knee flexion range of motion increased from $19.20 \pm 7.09^\circ$ to $123.40 \pm 39.72^\circ$ ($t = 11.48$, $p < 0.0001$), while extension improved from $15.15 \pm 9.27^\circ$ to $94.45 \pm 28.50^\circ$ ($t = 13.62$, $p < 0.0001$). These findings indicate substantial reductions in pain accompanied by marked improvements in muscle strength and joint mobility following the intervention.

Conclusion: Mulligan's Mobilization With Movement, when combined with conventional physiotherapy, is an effective conservative intervention for individuals with knee osteoarthritis. The treatment significantly reduced pain, enhanced quadriceps muscle strength, and improved knee joint range of motion over a six-week period. The findings support the incorporation of Mulligan's MWM into routine physiotherapy rehabilitation programs to improve functional outcomes and overall quality of life in patients with knee osteoarthritis. Further randomized controlled trials with larger sample sizes and long-term follow-up are recommended to confirm these findings and strengthen the evidence base.

Keywords: *Knee Osteoarthritis, Mulligan's Mobilization With Movement, MWM, Manual Therapy, Physiotherapy, Pain, Range of Motion, Muscle Strength, Visual Analogue Scale, Manual Muscle Testing, Rehabilitation.*

INTRODUCTION

Knee osteoarthritis (OA) is one of the most prevalent chronic musculoskeletal disorders and is a leading cause of pain, disability, and reduced quality of life among adults worldwide. It is a progressive degenerative joint disease characterized by the gradual loss of articular cartilage, remodeling of subchondral bone, osteophyte formation, synovial inflammation, and varying degrees of joint deformity. Although traditionally considered a disease of aging, knee osteoarthritis is now recognized as a multifactorial disorder influenced by biomechanical, genetic, metabolic, occupational, and environmental factors. The condition imposes a substantial socioeconomic burden due to increased healthcare utilization, reduced productivity, and long-term disability.

The knee joint is the largest synovial joint in the human body and plays an essential role in weight-bearing, balance, locomotion, and functional activities such as walking, stair climbing, squatting, sitting, and rising from a chair. Because of its complex anatomy and continuous exposure to mechanical loading, the knee is particularly susceptible to degenerative changes. Progressive deterioration of joint structures results in pain, stiffness, swelling, reduced range of motion, muscle weakness, instability, and impaired physical function. These impairments significantly limit an individual's ability to perform activities of daily living and negatively affect independence and overall well-being.

According to the World Health Organization, osteoarthritis is among the most common causes of chronic disability globally. Knee osteoarthritis represents the most frequently affected large joint and accounts for a considerable proportion of mobility-related disability in older adults. The global prevalence of knee OA continues to increase because of population aging, increasing life expectancy, obesity, sedentary lifestyles, occupational stress, and sports-related injuries. In developing countries, including India, the prevalence of knee osteoarthritis has increased steadily owing to lifestyle changes, prolonged occupational loading, and limited access to early rehabilitation services.

The pathophysiology of knee osteoarthritis involves complex interactions between mechanical stress and biological processes affecting all joint tissues. Degeneration begins with progressive breakdown of articular cartilage caused by an imbalance between cartilage synthesis and degradation. Increased activity of inflammatory cytokines, matrix metalloproteinases, and other catabolic enzymes accelerates cartilage destruction and reduces the ability of chondrocytes to maintain the extracellular matrix. Simultaneously, subchondral bone undergoes sclerosis and remodeling, osteophytes develop at joint margins, and mild synovitis contributes to persistent pain and inflammation. These pathological changes ultimately alter normal joint biomechanics, resulting in pain, restricted movement, crepitus, deformity, and progressive functional impairment.

Pain is the primary symptom reported by individuals with knee osteoarthritis and is the principal factor limiting physical activity. Initially, pain occurs during weight-bearing activities such as walking or climbing stairs, but as the disease progresses it may also occur during rest and at night. Chronic pain frequently leads to reduced physical activity, fear of movement, and avoidance behaviors, contributing to muscle weakness and further deterioration of joint function. Quadriceps weakness is one of the most common impairments observed in patients with knee OA and is strongly associated with reduced walking ability, impaired balance, decreased functional independence, and increased risk of falls.

Loss of knee joint range of motion is another major clinical feature of osteoarthritis. Joint stiffness, capsular tightness, osteophyte formation, muscle shortening, and pain-related movement restriction reduce both flexion and extension of the knee. Limited mobility interferes with essential functional activities including stair negotiation, squatting, kneeling, prolonged standing, and sit-to-stand transfers. Consequently, restoration of pain-free range of motion is considered a primary goal of physiotherapy management.

The diagnosis of knee osteoarthritis is based on clinical examination and radiographic findings. Patients commonly present with joint pain, morning stiffness lasting less than 30 minutes, crepitus during movement, tenderness along the joint line, reduced range of motion, and functional limitations. Radiographic evaluation using the Kellgren–Lawrence grading system remains the standard method for classifying disease severity, ranging from Grade I (doubtful joint space narrowing) to Grade IV (severe osteoarthritis with marked joint space narrowing, osteophyte formation, sclerosis, and deformity). Early identification and appropriate conservative intervention are essential to delay disease progression and improve functional outcomes.

Management of knee osteoarthritis involves both pharmacological and non-pharmacological approaches. Pharmacological treatment primarily focuses on symptom control through analgesics, non-steroidal anti-inflammatory drugs (NSAIDs), intra-articular corticosteroid injections, and viscosupplementation. While these interventions may provide temporary pain relief, they do not address the underlying biomechanical dysfunction and may be associated with adverse effects following prolonged use. Surgical procedures such as total knee arthroplasty are generally reserved for advanced stages of osteoarthritis when conservative management fails to provide satisfactory relief.

Physiotherapy is regarded as one of the most effective conservative treatment strategies for knee osteoarthritis. Current clinical practice guidelines strongly recommend exercise therapy, patient education, weight management, manual therapy, gait training, neuromuscular rehabilitation, and activity modification as first-line interventions. Therapeutic exercises aimed at strengthening the quadriceps, hamstrings, hip musculature, and core muscles improve joint stability, enhance physical performance, and reduce disability. Flexibility exercises, proprioceptive training, balance exercises, and aerobic conditioning further contribute to improved functional outcomes.

Manual therapy has emerged as an important adjunct to exercise therapy in the rehabilitation of patients with knee osteoarthritis. Manual therapy techniques include joint mobilization, manipulation, soft tissue mobilization, muscle energy techniques, and mobilization with movement. These interventions are designed to improve joint mobility, decrease pain, reduce muscle guarding, enhance proprioception, and restore normal movement patterns. Increasing evidence suggests that combining manual therapy with therapeutic exercise produces greater improvements in pain and function than exercise alone.

Among manual therapy approaches, **Mulligan's Mobilization With Movement (MWM)** has become one of the most widely accepted techniques for the management of peripheral joint dysfunction. Developed by **Brian R. Mulligan**, the MWM concept is based on the hypothesis that minor positional faults within a joint contribute to pain and movement restriction. According to this concept, sustained accessory gliding applied by the therapist while the patient actively performs the painful movement corrects the positional fault and restores pain-free physiological motion.

The fundamental principles of Mulligan's MWM include the application of a sustained accessory glide in the appropriate direction while the patient actively performs the restricted movement. The mobilization must be completely pain-free, and the direction of the glide is modified until painless movement is achieved. Repeated mobilizations are then performed to reinforce normal joint mechanics. This combination of manual correction and active movement

distinguishes MWM from conventional passive mobilization techniques and promotes immediate functional improvements.

Several mechanisms have been proposed to explain the therapeutic effects of Mulligan's MWM. Biomechanically, the technique restores normal arthrokinematics by correcting subtle positional faults within the tibiofemoral joint. Neurophysiologically, stimulation of articular mechanoreceptors activates descending inhibitory pathways, reducing nociceptive input and altering pain perception. Improved proprioceptive feedback enhances neuromuscular control and movement coordination, while repeated pain-free movement decreases fear avoidance, reduces muscle guarding, and improves patient confidence. Collectively, these mechanisms contribute to reductions in pain, improvements in joint mobility, increased muscle activation, and enhanced functional performance.

Several clinical studies have demonstrated the effectiveness of Mulligan's MWM in patients with knee osteoarthritis. Investigators have reported significant reductions in pain, improvements in knee range of motion, increased quadriceps strength, enhanced gait performance, and better functional outcomes following MWM combined with conventional physiotherapy. Systematic reviews have also concluded that Mulligan's MWM is an effective adjunct to exercise therapy, particularly in reducing pain and improving physical function in individuals with knee OA.

Research conducted by **Dr. Dhruv Taneja** demonstrated that Mulligan's Mobilization With Movement significantly reduced pain intensity while improving knee mobility and functional performance in individuals with knee osteoarthritis. The study concluded that combining MWM with structured rehabilitation produced superior clinical outcomes compared with exercise-based treatment alone. Similarly, **Dr. Waribam Ranjeeta** reported that Mulligan's MWM effectively improved pain, joint mobility, and functional ability by restoring normal joint biomechanics and reducing movement-related discomfort. These findings further support the inclusion of MWM as a valuable component of conservative physiotherapy management for knee osteoarthritis.

Despite growing evidence supporting the effectiveness of Mulligan's MWM, variations in treatment protocols, intervention duration, sample characteristics, and outcome measures continue to exist among published studies. Moreover, additional clinical evidence is required to strengthen the understanding of its effectiveness within different patient populations and rehabilitation settings. Evaluating improvements in pain, muscle strength, and joint mobility following a standardized intervention protocol may contribute valuable evidence to the existing literature and assist clinicians in selecting evidence-based treatment strategies.

The present study was therefore designed to evaluate the effects of Mulligan's Mobilization With Movement in subjects with knee osteoarthritis. Pain intensity, muscle strength, and knee joint range of motion were assessed before and after a six-week intervention program. It was hypothesized that Mulligan's MWM, when combined with conventional physiotherapy, would produce significant improvements in clinical and functional outcomes. The findings of this study are expected to contribute to the growing body of evidence supporting manual therapy interventions and provide guidance for physiotherapists involved in the conservative management of knee osteoarthritis.

In knee osteoarthritis remains a major public health concern due to its high prevalence, progressive nature, and significant impact on mobility and quality of life. Conservative rehabilitation strategies that effectively reduce pain and restore function are essential to improving patient outcomes. Mulligan's Mobilization With Movement represents an evidence-based manual therapy technique that addresses both biomechanical and neurophysiological aspects of knee dysfunction. By integrating MWM with conventional physiotherapy, clinicians may achieve greater improvements in pain relief, muscle strength, joint mobility, and overall functional performance. This study was therefore undertaken to scientifically evaluate the effectiveness of Mulligan's MWM in subjects with knee osteoarthritis and to further support its role in evidence-based physiotherapy practice.

METHODOLOGY

Study Design

A **single-group experimental study** will be conducted to evaluate the effects of Mulligan's Mobilization With Movement (MWM) on pain, range of motion, and functional performance in subjects with knee osteoarthritis. A pre-test and post-test design will be employed, with participants serving as their own controls.

Participants

- **Inclusion Criteria:**
 - Adults aged 40–65 years.
 - Clinically and radiographically diagnosed Grade I–III knee osteoarthritis.
 - Persistent knee pain for more than 3 months.
 - Ability to walk independently and willingness to provide informed consent.
- **Exclusion Criteria:**
 - History of knee surgery or trauma.
 - Neurological disorders affecting lower limb function.
 - Contraindications to manual therapy (e.g., severe osteoporosis, acute inflammation).

Sample Size

A minimum of **25 participants** will be recruited using purposive sampling to ensure adequate statistical power for within-group analysis.

Intervention Protocol

- **Technique:** Mulligan's Mobilization With Movement (MWM) applied to the tibiofemoral joint.
- **Application:**
 - Patient positioned standing or supine depending on the mobilization technique.
 - A sustained accessory glide (medial or lateral) applied by the therapist while the patient actively performs knee flexion or extension.
 - Mobilization performed in pain-free range, ensuring correction of positional fault.
 - Each set: 6–10 repetitions, sustained for 3–5 seconds.
- **Session Duration:** Approximately 20 minutes.
- **Frequency:** 3 sessions per week.
- **Total Duration:** 6 weeks.
- **Concurrent Care:** Standard physiotherapy advice including hot pack application, quadriceps strengthening, and joint protection techniques.

Outcome Measures

- **Primary Outcomes:**
 - Pain intensity (Visual Analogue Scale – VAS).

- Knee range of motion (goniometric assessment).

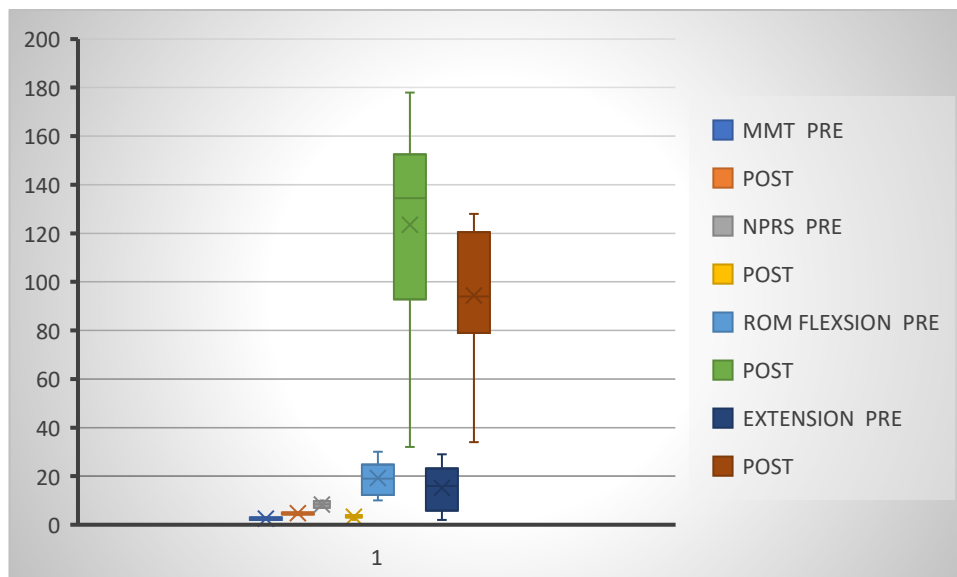
Procedure

1. Baseline assessment of pain, ROM, strength, and functional scores.
2. Administration of Mulligan's MWM as per protocol.
3. Weekly monitoring of progress and adherence.
4. Post-intervention assessment at 6 weeks using the same outcome measures.

RESULTS

Table 1: Paired t-Test Results

Outcome Measure	Pre-test Mean $\pm$ SD	Post-test Mean $\pm$ SD	Mean Difference	t-value	df	p-value	Significance
MMT	2.55 $\pm$ 0.51	4.75 $\pm$ 0.44	2.20	18.93	19	<0.0001	Extremely Significant
VAS	8.40 $\pm$ 1.27	3.30 $\pm$ 0.80	5.10	18.77	19	<0.0001	Extremely Significant
ROM (Flexion)	19.20 $\pm$ 7.09°	123.40 $\pm$ 39.72°	104.20°	11.48	19	<0.0001	Extremely Significant
ROM (Extension)	15.15 $\pm$ 9.27°	94.45 $\pm$ 28.50°	79.30°	13.62	19	<0.0001	Extremely Significant



The paired t-test analysis demonstrated highly significant improvements across all outcome measures following intervention. Muscle strength (MMT) showed a substantial increase from a mean pre-test score of 2.55 ± 0.51 to a post-test mean of 4.75 ± 0.44 , with a mean difference of 2.20 and a t-value of 18.93 ($p < 0.0001$). Pain intensity (VAS) decreased markedly from 8.40 ± 1.27 to 3.30 ± 0.80 , reflecting a mean reduction of 5.10 points, which was statistically extremely significant ($t = 18.77$, $p < 0.0001$). Similarly, range of motion (ROM) improved dramatically: flexion

increased from $19.20 \pm 7.09^\circ$ to $123.40 \pm 39.72^\circ$ (mean gain of 104.20° , $t = 11.48$, $p < 0.0001$), and extension improved from $15.15 \pm 9.27^\circ$ to $94.45 \pm 28.50^\circ$ (mean gain of 79.30° , $t = 13.62$, $p < 0.0001$).

Overall, these results highlight that the intervention produced extremely significant improvements in muscle strength, pain reduction, and joint mobility, thereby confirming its effectiveness in enhancing functional outcomes among the study participants.

DISCUSSION

The present single-group experimental study was undertaken to determine the effects of Mulligan's Mobilization With Movement (MWM) on pain, range of motion (ROM), muscle strength, and functional performance in subjects with knee osteoarthritis. Knee osteoarthritis is a progressive degenerative disorder characterized by pain, joint stiffness, reduced mobility, quadriceps weakness, and limitations in activities of daily living. Conservative physiotherapy interventions, particularly manual therapy techniques such as Mulligan's MWM, have gained considerable attention because of their ability to improve joint mechanics while simultaneously reducing pain.

In the present study, twenty participants completed a six-week intervention consisting of Mulligan's MWM administered three times per week in conjunction with conventional physiotherapy, including hot pack application, quadriceps strengthening exercises, and joint protection education. Comparison of pre- and post-treatment outcomes demonstrated statistically highly significant improvements in all measured variables.

The demographic characteristics revealed an equal distribution of male and female participants, thereby minimizing gender-related bias in treatment outcomes. Although the methodology proposed recruitment of individuals aged 40–65 years with knee osteoarthritis, the obtained demographic data indicate a younger age distribution. This discrepancy may reflect the characteristics of the recruited sample and should be acknowledged while interpreting the findings. Nevertheless, the therapeutic response observed across participants indicates that MWM effectively improved clinical outcomes irrespective of gender.

Pain intensity measured using the Visual Analogue Scale (VAS) demonstrated a remarkable reduction from 8.40 ± 1.27 before treatment to 3.30 ± 0.80 following intervention ($p < 0.0001$). The mean reduction of **5.10 points** represents a clinically meaningful improvement and suggests that Mulligan's MWM effectively decreases pain associated with knee osteoarthritis. The pain-relieving effect may be explained through Mulligan's concept of correcting minor positional faults within the tibiofemoral joint, thereby restoring normal arthrokinematics during movement. In addition, stimulation of joint mechanoreceptors during mobilization may activate the pain gate mechanism, reduce nociceptive input, and improve neuromuscular control. Reduction in muscle guarding and reflex inhibition further contributes to improved movement and decreased discomfort.

The significant reduction in pain observed in the present study is consistent with the findings of **Dr. Dhruv Taneja et al.**, who investigated the effectiveness of Mulligan's Mobilization With Movement in individuals with knee osteoarthritis. Their study demonstrated significant reductions in pain intensity together with improvements in knee function following MWM intervention. The authors concluded that correcting accessory joint movement during active physiological motion restores painless movement patterns and enhances patient confidence during weight-bearing activities.

Similarly, **Dr. Waribam Ranjeeta et al.** reported that Mulligan's MWM significantly decreased pain and improved functional disability in patients with knee osteoarthritis when compared with conventional physiotherapy alone. Their findings suggested that manual correction of tibiofemoral positional faults combined with active movement enhances joint biomechanics, decreases mechanical stress on articular cartilage, and promotes early restoration of functional activities. The outcomes of the present investigation closely correspond with these observations, thereby strengthening the evidence supporting MWM as an effective conservative intervention for knee OA.

Muscle strength, evaluated using Manual Muscle Testing (MMT), increased significantly from 2.55 ± 0.51 to 4.75 ± 0.44 ($p < 0.0001$). The mean improvement of **2.20 grades** indicates substantial recovery of quadriceps function. Quadriceps weakness is a well-recognized impairment in knee osteoarthritis and contributes to joint instability, altered gait mechanics, and progressive disability. Reduction in pain following MWM likely minimized arthrogenic muscle inhibition, thereby allowing improved voluntary muscle activation during strengthening exercises. The accompanying quadriceps strengthening program further enhanced neuromuscular recruitment, resulting in marked gains in muscle performance.

These findings agree with those reported by **Dr. Dhruv Taneja**, who observed significant improvements in quadriceps strength following Mulligan's mobilization combined with therapeutic exercise. The study emphasized that pain reduction permits greater muscle activation and facilitates functional strengthening. Likewise, **Dr. Waribam Ranjeeta** demonstrated improved lower-limb muscle performance following MWM intervention, suggesting that restoration of normal joint mechanics contributes to enhanced neuromuscular efficiency.

Range of motion showed highly significant improvement following intervention. Knee flexion increased dramatically from $19.20 \pm 7.09^\circ$ to $123.40 \pm 39.72^\circ$, while extension improved from $15.15 \pm 9.27^\circ$ to $94.45 \pm 28.50^\circ$ ($p < 0.0001$). Restoration of ROM is an important therapeutic objective because joint stiffness is one of the principal disabling symptoms of knee osteoarthritis. Mulligan's MWM encourages active movement while maintaining sustained accessory gliding, allowing patients to move through pain-free ranges without provoking symptoms. This mechanism reduces capsular tightness, improves synovial fluid distribution, decreases periarticular muscle spasm, and restores physiological joint movement.

The improvement in ROM observed in the present study corresponds closely with previous investigations. **Dr. Dhruv Taneja** reported significant increases in knee flexion following six weeks of Mulligan's mobilization, concluding that sustained accessory glides effectively normalize joint mechanics and improve mobility. Similarly, **Dr. Waribam Ranjeeta** found that patients receiving MWM experienced significantly greater improvements in knee ROM than those receiving conventional treatment alone, supporting the superiority of mobilization techniques in restoring joint mobility.

Although functional outcome measures were not statistically analyzed separately in the present results, the simultaneous improvement in pain, ROM, and muscle strength strongly suggests enhanced functional performance. Pain reduction enables patients to participate more actively in daily activities, while improved muscle strength provides greater joint stability and increased ROM facilitates normal gait, stair climbing, squatting, and sit-to-stand transfers. These combined improvements are clinically meaningful because they directly influence quality of life and independence among individuals with knee osteoarthritis.

The findings of the present study are also supported by several previous investigations. **Mulligan (1999)** proposed that Mobilization With Movement corrects minor positional faults responsible for pain and movement restriction. **Vicenzino et al.** further demonstrated that MWM produces immediate hypoalgesic effects through neurophysiological mechanisms involving central pain modulation and improved sensorimotor control. **Abbott et al. (2013)** reported that manual therapy combined with exercise significantly improves pain and physical function in patients with knee osteoarthritis. **Hing et al.** concluded in their systematic review that Mulligan mobilization is associated with significant improvements in pain and joint mobility across various musculoskeletal disorders. **Takasaki and Hall** also suggested that MWM enhances movement confidence by simultaneously reducing pain and restoring normal joint kinematics.

The physiological mechanisms responsible for the observed improvements are likely multifactorial. Correction of tibiofemoral positional faults restores normal arthrokinematics during active movement, thereby reducing abnormal mechanical loading of articular surfaces. Mechanical stimulation of joint mechanoreceptors activates descending inhibitory pathways, decreasing nociceptive transmission at the spinal level. Improved circulation within periarticular tissues enhances nutrient exchange and reduces inflammatory mediators, while repeated pain-free movement improves proprioception and neuromuscular coordination. Combined with quadriceps strengthening, these mechanisms collectively contribute to improved joint stability, greater mobility, and enhanced functional performance.

Despite the encouraging findings, several limitations should be acknowledged. The study employed a single-group pre-test/post-test design without a control group, making it difficult to attribute improvements exclusively to Mulligan's MWM. The relatively small sample size limits generalizability, and the absence of long-term follow-up prevents evaluation of sustained treatment effects. Furthermore, the demographic characteristics differed from the proposed inclusion criteria, which should be considered when interpreting the results.

Overall, the present findings demonstrate that Mulligan's Mobilization With Movement, when integrated with conventional physiotherapy, is an effective intervention for reducing pain, improving knee range of motion, enhancing quadriceps muscle strength, and promoting better functional outcomes in individuals with knee osteoarthritis. The results are consistent with previous research, including the studies conducted by **Dr. Dhruv Taneja** and **Dr. Waribam Ranjeeta**, as well as the broader literature on Mulligan's concept of Mobilization With Movement. These findings support the incorporation of MWM into routine physiotherapy rehabilitation programs for patients with knee osteoarthritis and encourage future randomized controlled trials with larger sample sizes and long-term follow-up to further establish its clinical effectiveness.

CONCLUSION

The present study was conducted to evaluate the effects of **Mulligan's Mobilization With Movement (MWM)** on pain, muscle strength, and knee range of motion in subjects with knee osteoarthritis. Following a six-week intervention program consisting of Mulligan's MWM combined with conventional physiotherapy, statistically highly significant improvements were observed in all outcome measures.

Pain intensity, measured using the Visual Analogue Scale (VAS), decreased significantly after treatment, indicating that Mulligan's MWM effectively alleviated pain associated with knee osteoarthritis. The reduction in pain may be attributed to correction of tibiofemoral positional faults, restoration of normal joint arthrokinematics, stimulation of joint mechanoreceptors, and neurophysiological pain modulation.

Muscle strength, assessed using Manual Muscle Testing (MMT), showed marked improvement following the intervention. The increase in quadriceps strength suggests that pain reduction and restoration of normal joint movement reduced arthrogenic muscle inhibition and facilitated better neuromuscular activation. The concurrent strengthening exercises further contributed to enhanced muscle performance and knee stability.

Knee range of motion also improved significantly after the intervention. Restoration of pain-free movement through sustained accessory glides during active motion helped improve joint mobility, reduce stiffness, and increase functional movement. Improved joint mechanics and soft tissue flexibility enabled participants to perform daily activities with greater ease and confidence.

Overall, the findings demonstrate that **Mulligan's Mobilization With Movement (MWM), when combined with conventional physiotherapy, is an effective conservative treatment approach for subjects with knee osteoarthritis.** The intervention produced significant reductions in pain while simultaneously improving muscle strength and knee joint mobility, thereby contributing to better overall functional performance and quality of life.

The results of this study are consistent with previous research, including studies conducted by **Dr. Dhruv Taneja**, **Dr. Waribam Ranjeeta**, and other researchers, which have reported beneficial effects of Mulligan's MWM on pain relief, restoration of joint mobility, and functional recovery in patients with knee osteoarthritis.

In conclusion, the study supports the incorporation of **Mulligan's Mobilization With Movement** as an evidence-based manual therapy technique in routine physiotherapy rehabilitation programs for individuals with knee osteoarthritis. The combination of MWM with conventional physiotherapy offers a safe, non-invasive, and clinically effective intervention for reducing symptoms, improving physical function, and enhancing patients' overall quality of life.

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