EFFECTIVENESS OF MEDIAL MULLIGAN GLIDE VERSUS INTERNAL ROTATION MULLIGAN GLIDE IN KNEE OSTEOARTHRITIS – A RANDOMIZED CLINICAL TRIAL

EFICIENȚA GLISĂRII MEDIALE MULLIGAN VERSUS GLISAREA MULLIGAN ÎN ROTAȚIE INTERNĂ ÎN OSTEOARTRITA GENUNCHIULUI – STUDIU CLINIC RANDOMIZAT

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Keywords: Knee Osteoarthritis, Medial Mulligan Glide, Internal Rotation Mulligan Glide, MWM.

Abstract

Background and Objectives. The objectives of the present study was to compare the effectiveness of Medial Mulligan Glide MWM and Internal Rotation Mulligan Glide MWM in terms of pain, range of motion, functional performance and functional disability in subjects with knee osteoarthritis.

Study design. Randomized Clinical Trial

Materials and Methods: A written informed consent was obtained from 60 participants and were randomly assigned into the two groups i.e. group A and B, each group comprising of 30 participants. Group A was treated with Medial Mulligan Glide MWM and group B was treated with Internal Rotation Mulligan Glide MWM. Both the group received short wave diathermy and supervised exercise as a conventional treatment. Outcome was measured in terms of Visual Analogue scale, knee range of motion, functional performance (TUGT, TSTST, TUDST) on 1st day pre-intervention, 1st day post-intervention and 7th day post-intervention. Functional disability was measured by Western Ontario and McMaster University Osteoarthritis Disability Index (WOMAC) on 1st day pre-intervention and 7th day post-intervention.

Results. In the present study intra group comparison result showed that pain relief, improved knee range of motion, functional performance and reduced functional disability was statistically significant in both the group. Whereas inter group comparison results showed that group B i.e. Internal Rotation Mulligan Glide MWM is better as compared to group A i.e. Medial Mulligan Glide MWM.

Conclusion. The inter group comparison showed that group B i.e. Internal Rotation Mulligan Glide MWM is superior.

Cuvinte cheie: osteoartrita genunchiului, glisarea medială Mulligan, glisarea Mulligan în rotație internă, MWM.

Rezumat

Introducere și obiective. Scopul acestui studiu este de a compara eficiența tehnicii Mulligan de glisare medială și glisarea Mulligan în rotație internă MWM în ceea ce privește durerea, amplitudinea de mișcare, performanța funcțională și disabilitatea funcțională, la pacienții cu osteoartrită.

Design-ul studiului. studiu clinic randomizat

Material și metodă. S-a obținut un consimțământ scris de la cei 60 de participanți, care au fost apoi distribuiți aleator în două grupuri, de ex. grupul A și B, fiecare grup fiind alcătuir din 30 de participanți. La grupul A s-a folosit glisarea medială Mulligan MWM și la grupul B s-a folosit glisarea Mulligan în rotație internă MWM. Ambele grupuri au mai urmat ședințe de diatermie cu unde scurte, și exerciții convenționale de reucperare sub supraveghere. Rezultatele s-au analizat folosind Scala Analog Vizuală, amplitudinea de mișcare a genunchiului, performanța funcțională (TUGT, TSTST, TUDST) în ziua 1 pre-intervenție, ziua 1 post-intervenție și ziua 7 postintervenție. Disabilitatea funcțională s-a evaluat cu Western Ontario și McMaster University Osteoarthritis Disability Index (WOMAC) în ziua 1 pre-intervenție și ziua 7 post-intervenție.

Rezultate. În acest studiu, comparația intragrup a rezultatelor a demonstrat că reducerea durerii, creșterea amplitudinii de mișcare, performanța funcțională și reducerea disabilității funcționale au fost semnificative statisitic la ambele grupuri. La compararea intergrup a rezultatelor, s-a observant că grupul B i.e. glisarea Mulligan în rotație internă are rezultate mai bune decât grupul A i.e. glisarea medială Mulligan MWM.

Concluzii. Comparația intergrup a demonstrat că rezultatele obținute prin folosirea glisării Mulligan în rotație internă MWM este mai eficientă.

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Introduction

Osteoarthritis (OA) is the 2nd most common rheumatological disorder. Is a non-specific term, denoting an inflammatory, degenerative joint process without an auto-immune component that may affect the articular cartilage, and the other soft tissues associated with the joint.

Osteoarthritis has been defined by the American College of the Rheumatology (ACR) as a "heterogeneous group of conditions, which lead to joint symptoms and signs associated with defective integrity of the underlying bone and joint margins." Osteoarthritis is becoming increasingly recognized in both developed and developing countries as a major cause of pain and disability. 44% - 70% of people over the age of 55 years having radiological evidence, and this figure rises to 85% in the 75 years of age group. The peak onset of development of osteoarthritis is between 50 to 60 years old. OA is the most frequent joint disease encountered in the clinical practice with a prevalence rate of 22% to 39% in India and is the most common cause of locomotor disability in the elderly.[1] OA can develop in any joint in the body, but knee and hip joint are the most common sites for developing osteoarthritis as they both are weight bearing joints. Knee joint Osteoarthritis is a most common form of osteoarthritis. Six percent of adults of age 30 or older in US population have knee symptoms, which is twice as many as those with hip symptoms.[2] The American College of Rheumatology has established criteria for classifying knee OA with the classification tree format. This criterion includes regular experience of knee pain, couple with either osteophyte finding on radiograph or combination of morning stiffness lasting for 30 minutes or less, age of 40 years or older and crepitus on the motion.[3] Most of the individuals with Knee OA complains of: knee pain, morning stiffness, muscle weakness, loss of range of motion, and decreased functional ability such as: walking, squatting, sit to stand and stair climbing.[4] Joint pain of osteoarthritis is exacerbated by activity and relieved by rest. In severe conditions, it is painful even at rest.

Risk factors for knee osteoarthritis are age, gender, obesity, previous knee injury, and occupation.[5] Treatment of OA of knee and hip is often symptom-based and involves: reduction in joint pain and stiffness, maintenance and improvement of joint mobility, improvement in physical activity, limiting or slowing the joint degradation, and patients education. [6] Current physical therapy management for knee OA is aiming to reduce pain and improve muscle performance. It includes electrotherapy, exercise therapy, massage, hydrotherapy, manual therapy, and tapping. The effectiveness of electrotherapeutic modalities such as: short wave diathermy, transcutaneous electrical nerve stimulation (TENS), low-level laser therapy and therapeutic ultrasound was investigated and this has been found to be effective to reduce pain and stiffness.[7] Therapeutic exercises including strengthening exercise, aerobic exercise, and balance training, have been reported to result in functional improvement and pain reduction in a subject with knee osteoarthritis. [8] Isometric quadriceps exercise are somewhat used frequently in physiotherapy to improve muscle tone, static endurance, strength and prepare the joints for more vigorous activity.

Mulligan's mobilization with movement (MWM) is a manual therapy treatment technique, used in the management of various musculoskeletal conditions given by Brain Mulligan in 1980. [9-11] It is the combination of two components, joint mobilization, and active movement.[11] Mulligan proposed that a minor positional fault of the joint may occur following an injury or strain and cannot be detected by X-ray.[11] It turns results in movement restriction and pain. Therefore when sustain correction mobilization, pain-free movement is restored, and several repetitions will be expected to bring lasting improvement.

The treatment technique is, when the therapist applied a sustained accessory glide at a right angle or parallel to a joint and patient move the joint actively.[9] The aim of Mulligan's MWM is to restore a painless and full range functional movement from a painful and limited movement. To date, most of the Mulligan MWM studies emphasize on spine, upper extremities, and lower extremities.[12-14] It showed that Mulligan MWM is effective in reducing pain and improving range of motion. In Mulligan concept, there are two techniques often used for knee osteoarthritis. One is Medial Mulligan Glide MWM, and another one is Internal Rotation

Mulligan Glide MWM. Studies have been done to see the effect of Mulligan mobilization with movement in knee osteoarthritis[15-16]. They used Medial Mulligan Glide and Internal Rotation Mulligan Glide both in patients with knee osteoarthritis. The results reveal that Mulligan's MWM techniques may effectively reduce pain and increase range of motion. However, there has been no study done to see the effectiveness of Medial Mulligan glide versus Internal rotation Mulligan glide in a patient with Knee OA.

Hence, the purpose of this study is to investigate the comparative effectiveness of Medial Mulligan glide and Internal rotation Mulligan glide in terms of pain, range of motion (ROM) and functional abilities in subject with Knee OA.

Methodology

Study design: Randomized clinical trial.

(Institutional Ethical clearance was obtained from approval of this study)

Source of data

Data collection was from Physiotherapy OPD of KLES Dr. Prabhakar Kore Hospital and MRC, Belgaum, and KLES Shri. B.M. Kankanwadi Ayurveda Hospital and MRC, Belgaum (Karnataka).

Type of data collection: Primary data.

Duration of the study: Study period from 15 February 2011 to 15 January 2012.

Recruitment and consent form participants with pain in the knee joint and radiologically diagnosed with knee osteoarthritis (Grade III by Keller en and Lawrence radiological criteria) who were referred to physiotherapy department and willing to take treatment for 7 consecutive sessions are recruited for the study. A written informed consent is taken from each participant.

Sampling Design: Random sampling method

Sampling method: Envelope method

Sample Size: 60 subjects. It is calculated on the basis of past physiotherapy records.

Inclusion Criteria: Both male and female participants who fulfilled the criteria of American College of Rheumatology for Knee OA:

- Regular knee pain and crepitus on the motion.
- Kellgren and Lawrence grade III.
- Age 40 years or older
- Subjects with symptoms for a duration of more than three months.
- Subjects with both unilateral and bilateral knee osteoarthritis.

Exclusion Criteria:

- A traumatic injury to knee within six months of study.
- Any recent surgical interventions.
- An intra-articular steroid injection to knee within three months.
- Peripheral Vascular disease.
- Systemic and/or neurological illness.

Intervention

Participants are randomly allocated into two groups:

Group A: SWD + Medial Mulligan glide MWM + Supervised Exercise

Group B: SWD + Internal Rotation Mulligan glide MWM + Supervised Exercise

All two groups were received the selected treatment one session per day for seven consecutive days.

Group A:

Participants were treated with short wave diathermy for 20 minutes along with Medial Mulligan Glide MWM and supervised exercise.

Application of Short Wave Diathermy

Participant's thermal sensation of the body part was recorded, and all metal objects, synthetic materials, clothing and electronic devices from the body part to be treated was removed. The therapist position the subject in supine lying with the knee in extension and was

treated with continuous mode short wave diathermy in the contra- planar method using pad electrodes for 20 minutes per day per sitting. Intensity was tuned and adjusted to comfortable warmth based on participant's feedback.

Medial Mulligan Glide MWM

The participant was asked to lie prone on the couch with a pillow below the interested leg, in completely relaxed position. The therapist stood on the contra-lateral side, and Mulligan's belt was placed around therapist waist and participant's lower leg so that proximal edge of the belt was at the tibial joint margin. Then the therapist stabilized the thigh above the knee with one hand, the lower leg being supported by the other hand. Once the knee was glided medially with the help of belt and participant was asked to flex his knee. Medial Mulligan Glide MWM is given in three sets of ten repetitions.

Supervised Knee Exercise

Static Quadriceps

This exercise was emphasized right from day one of the treatment. The static quadriceps exercise is first taught on the unaffected leg, and the contraction felt by the patient along with the therapist. The participant was in a supine lying position; a rolled towel is placed underneath the popliteal fossa. The participant was asked to press the rolled towel by isometrically contracting the quadriceps with the hold time of six seconds and repeated ten times with ten-second rest between each repetition.

Static Hamstrings

The static hamstrings exercise is first taught on the unaffected leg, and the contraction felt by the patient along with the therapist. The participant was in a supine lying position; a rolled towel is placed underneath the heel. The participant was asked to press the rolled towel by isometrically contracting the hamstrings with the hold time of six seconds and repeated ten times with ten-second rest between each repetition.

Strengthening of vastus medialis

The participant was asked to sit on a chair comfortably with the knees bent and was instructed to straighten the knee slowly with hip adduction and internal rotation and asked to maintain the contraction for 6 seconds. Repeat the exercise 10 times with ten-second rest between each repetition.

Group B:

Participants were treated with short wave diathermy for 20 minutes along with Internal Rotation Mulligan Glide MWM and supervised exercise. Short wave diathermy and supervised exercise were given in same way as in group A.

Internal Rotation Mulligan Glide MWM

The participant was asked to lie supine on the couch. The therapist stood on the affected side of the knee. Then slowly, patient's knee was flexed just short of the painful limitation and therapist grasped the lower leg and rotated the tibia internally on the femur and simultaneously fibula was moved ventrally with the glides maintained. The participant was instructed to perform flexion with three sets of ten repetitions.

The outcome measures of the pre and post treatment are subjected to statistical analysis for significance.

Outcome Measures

Pain Intensity

Pain score of the patients involved in this study were recorded by using visual analog scale (VAS). The visual analogue scale is a 10 cm straight line drawn on a paper, marked with numbers 0 to 10 where 0 symbolized no pain and 10 symbolized the worst pain and participants were asked to mark a point on this line as per the severity of his/her pain which indicates present pain level. Much evidence has been produced to establish the reliability and validity of the VAS in the assessment of pain, in knee conditions of elderly patients.[17]

Range of motion

Active range of knee flexion was measured using the standard technique of measuring range with the help of Universal Goniometer. Goniometric measurement of knee range of movement has been shown to be more accurate and reliable than visual estimation alone.[18]

Functional Performance Tests

The functional performance tests showed an acceptable test-retest reliability (0.80) and internal consistency (0.80) on walking, stair climb and chair rise in subjects with knee osteoarthritis. This showed that functional performance test is reliable and can be used as outcome measures in the evaluation of therapeutic interventions. [19]

The Timed Up and Go Test (TUGT)

The subject was asked to get up from the chair, walk 3 meters, return to the chair and sit down as fast and safe as possible. Examiner recorded the total duration of TUGT by using a stopwatch.

The Timed Sit to Stand Test (TSTST)

The subject was instructed to stand up from a sitting position from the chair and then return to sitting position as fast and safe as possible. Examiner recorded the total duration of TSTST by using a stopwatch.

The Timed Up and Down Stair Test (TUDST)

The subject was instructed to up and down a flight of stairs with 11 steps as fast and as safe as possible. Examiner recorded the total duration of TUDST by using a stopwatch.

Functional Disability

Functional disability was measured by Western Ontario and McMaster University Osteoarthritis Disability Index (WOMAC), a well validated, self-report, self-complete questionnaire designed for hip or knee osteoarthritis contains 24 items which measure severity of pain (5 items), stiffness (2 items), and physical functioning (17 items). Each item is scored 0 to 4. The total score ranges from 0-96, where a higher score indicates a higher level of disability. A study done to assess the reliability and validity of Western Ontario and Mc Master University Osteoarthritis Index (WOMAC), showed that it is one of the most valid and reliable outcome measures in Asian patients with knee osteoarthritis.[20]

Visual Analogue scale, knee range of motion, functional performance (TUGT, TSTST, TUDST) on 1st-day pre-intervention, 1st-day post-intervention, and 7th-day post-intervention. Functional disability was measured by Western Ontario and McMaster University Osteoarthritis Disability Index (WOMAC) on 1st-day pre-intervention and 7th-day post-intervention.

Statistical Analysis

Statistical analysis for the present study was done manually as well as using the statistics software SPSS 15 version so as to verify the results obtained. For this purpose, data was entered into an excel spreadsheet, tabulated and subjected to statistical analysis. Various statistical measures such as mean, standard deviation and test of significance such as Chi-Square test, paired ‘t’ test, One way Analysis of Variance (ANOVA) and multiple comparison tests were utilized for this purpose for all available scores for all the participants. Normal data from patient’s demographic data i.e. age, sex distribution, height, weight, BMI were analyzed using ‘F’ test or ANOVA and Chi-Square test. Intra- group comparison of the pre interventional and post interventional outcome measures was done by using student paired ‘t’ test whereas one-way ANOVA was used to measure the intergroup difference. Probability values less than 0.05 were considered statistically significant.

Results

The study included 60 subjects. Table 1 shows the baseline characteristics of the subject.

Table 1. Table 1: Baseline characteristics of participants

Variable	Group A	Group B
Age (years)	60.67±6.95	59.87±6.75
Gender	M-8 & F-22	M-6 & F-24
Height (meters)	1.55±0.05	1.54±0.05
Weight (kg)	63.43±5.58	62.47±5.81
BMI (kg/m^2)	26.76±2.50	26.05±4.74

Table 2: Comparison of VAS, ROM, TUGT, TSTST and TUDST score in two groups

Outcome Measures / Groups	Pre	Post (1st day)	Post (7th day)	Difference			p- value		
				Pre- Post 1	Pre-Post 7	Post 1- Post 7	Pre- Post 1	Pre-Post 7	Post 1- Post 7
VAS (cms)									
Group A	6.54±0.82	4.07±0.91	1.32±0.31	2.43±0.86	5.07±0.94	2.63±1.09	<0.001**	<0.001**	<0.001**
Group B	7.21±0.88	3.72±0.59	0.33±0.29	3.53±0.82	6.77±1.01	3.23±0.68	<0.001**	<0.001**	<0.001**
p- value	0.003**	0.084+	<0.001**	<0.001**	<0.001**	0.014*			
ROM (°)									
Group A	110.00±5.41	122.00±4.07	135.33±4.14	12.00±3.37	25.33±6.69	13.33±4.22	<0.001**	<0.001**	<0.001**
Group B	104.83±5.79	125.00±3.71	139.50±1.53	20.17±3.59	34.67±5.56	14.50±3.04	<0.001**	<0.001**	<0.001**
p- value	0.001**	0.004**	<0.001**	<0.001**	<0.001**	0.224			
TUGT (secs)									
Group A	32.93±2.15	30.03±1.88	26.20±1.97	2.90±0.84	6.73±1.87	3.83±1.58	<0.001**	<0.001**	<0.001**
Group B	32.83±2.94	29.10±3.09	22.60±3.74	3.73±0.74	10.23±1.97	6.50±1.79	<0.001**	<0.001**	<0.001**
p- value	0.681	0.163	<0.001**	<0.001**	<0.001**	<0.001**			
TSTST (secs)									
Group A	3.00±0.00	2.03±0.16	2.00±0.00	0.97±0.18	1.00±0.00	0.03±0.18	<0.001**	<0.001**	0.326
Group B	3.10±0.40	2.07±0.25	2.07±0.25	1.03±0.18	1.03±0.18	0.00±0.00	<0.001**	<0.001**	<0.001**
p- value	0.179	0.561	0.155	0.163	0.321	0.321			
TUDST(secs)									
Group A	32.37±3.87	29.57±3.84	25.93±3.72	2.80±0.78	6.43±1.50	3.63±1.07	<0.001**	<0.001**	<0.001**
Group B	33.43±4.38	29.47±4.68	23.33±5.52	3.97±0.72	10.10±1.58	6.13±1.66	<0.001**	<0.001**	<0.001**
p- value	0.322	0.928	0.037*	<0.001**	<0.001**	<0.001**			

Table 4: Comparison of WOMAC (%) in two groups (inter and intra-group)

WOMAC (%)	Group A	Group B	p- value
Pre	44.81±3.52	44.66±2.97	**0.855**
Post (7th day)	8.40±1.80	6.66±1.09	**<0.001****
Difference Pre-Post 7	36.41±2.57	37.99±3.36	**0.046***
p- **value Pre-Post 7**	<0.001**	<0.001**	

The group B showed significant improvement in VAS (p<0.001), ROM (p<0.001), TUGT (p<0.001), TUDST (p<0.001) and WOMAC (p<0.001) as compared to group A on pre-post 1st day (p<0.001) and pre-post 7th day (p<0.001). For TSTST, there was no significant difference between the groups pre-post 1st day (p=0.163) and pre-post seventh day (p=0.321). Result also showed a significant difference within the groups on pre-post first day and pre-post seventh day for all outcome measures

Discussion

The present clinical trial was conducted to compare the effectiveness of Medial Mulligan Glide MWM and Internal Rotation Mulligan Glide MWM with a common treatment of short wave diathermy and exercise to both groups. The result from the statistical analysis of the present study supported the alternative hypothesis that stated that there will be a beneficial effect on the participants treated with Internal Rotation Mulligan Glide MWM. The mean values of data from present study indicates that group B showed better pain relief on visual analogue scale, improved knee range of motion, improved functional performance (TUGT, TSTST,TUDST) and reduced functional disability.

When the intra-group means values of VAS were analyzed it was found statistically significant in both groups pre-1st-day post, pre-7th-day post, and 1st-day post-7th-day post in both the groups. However, when inter-group comparison is done, group B showed statistical significance over group A in relieving pain. In the present study reduction in pain level, as quantified by VAS, with the application of Mulligan MWM is consistent with the findings of previous studies15,16. However, none of the studies has compared the two Mulligan MWM techniques. It is the first study to date to compare the effect of two Mulligan MWM techniques. Results of the present study showed that Internal Rotation Mulligan Glide MWM is better than Medial Mulligan Glide MWM in relieving pain after the single treatment session and after seven treatment session in subjects with knee OA.

The neurophysiological mechanism of the MWM for immediate pain-relieving effects remained unclear. Several studies reported that passive mobilization treatments of the cervical spine and peripheral joint produced immediate hypoalgesia and concurrent excitation in the motor system and the sympathetic nervous system.[21-23] The gate control theory proposed by Melzack and Wall emphasizes the importance of neural input via large diameter myelinated afferent neurons to inhibit nociceptive afferent input at the spinal cord level. The gate could be modified by a descending pain inhibitory system (DPIS).[24] It is suggested that an adequate non-noxious sensory input that can activate the DPIS, in particular, could be responsible for mediating this immediate analgesic response. Several animal studies have demonstrated that the midbrain lateral-dorsal periaqueductal gray (PAG) plays an important role in the DPIS. [25,26] Stimulation on lateral-dorsal PAG area demonstrated a non-opioid form of analgesia that is not tolerant to repeated application and antagonized by naloxone. Moreover, stimulation of this lateral-dorsal PAG area resulted in a rapid hypoalgesia accompanied with sympathoexcitation. [25,26] The similar results were also found in several MWM-related studies.[27,28] Therefore,

the neurophysiological mechanism of the MWM was considered similar to the mechanism of passive mobilization technique.[27,28]

In the present study, the application of the knee MWM resulted in significantly positive changes in the knee pain. Evgeniya Dimitrova et al (2008), did a study to see the efficacy of mobilization with movement in patient with knee OA and showed that MWM is feasible and efficacious in individual with knee OA in reducing pain and improving ROM. [16,37] The present study showed the same results with better improvement in Internal Rotation Mulligan Glide MWM group and this corresponds with the findings of studies Paungmali et al..who reported 15% improvement on PPT following MWM treatment in subjects with lateral epicondylar GIA.[28] The Internal Rotation Mulligan Glide MWM group showed greater immediate and short-term treatment (7 sessions) effects on increasing knee ROM than the Medial Mulligan Glide MWM group. It is the first study that investigated the immediate and short-term treatment (7 sessions) effects of Medial Mulligan Glide MWM and Internal Rotation Mulligan Glide MWM treatment technique for knee OA. The Internal Rotation Mulligan MWM group showed greater improvement in knee ROM than the Medial Mulligan Glide MWM group. The results were consistent with previous studies conducted on Mulligan MWM in knee OA and other joints. The Mulligan MWM studies showed an immediate increase of 15% to 20% in ROM on ankle and shoulder joints could be achieved.[29,30] In the present study, knee ROM improved by 20.17±3.59° immediately following the Internal Rotation Mulligan Glide MWM treatment. The effect was maintained and further improved by 34.67±5.56° after seven treatment sessions.

Lewit in 1985 has shown that reduced joint mobility can often result in a mechanical block from the inert structures within the joint. Joint afferent discharge and optimal muscle recruitment are often closely linked. Joint mobility can thus be reduced as a result of reflex muscle splinting which prevents further damage and reduces nociceptor discharge from the joint by holding it in the midrange position. It is suggested that treatment directed at the joint will have an effect on muscle activity and vice versa. Hence to affect muscle activity reflexively via the joint afferents, the mobilization technique must be performed.[31] With respect to the research, the clinical efficacy of Mulligan MWM technique has been established for improving joint function, with a number of hypotheses for its cause and effect. Mulligan's original theory for the effectiveness of an MWM is based on a concept related to a 'positional fault' that occurs secondary to an injury and lead to mistracking of the joint, resulting in symptoms such as pain, stiffness and weakness.[9] The cause of positional faults are suggested to be due to changes in the shape of articular surfaces, thickness of cartilage, orientation of fibres of ligaments and capsules, or the direction and pull of muscles and tendon. Mulligan MWM corrects this by repositioning the joint causing it to track normally.[9,30,31]

The most common alteration in the alignment of the osteoarthritic knee is a varus deformity.[32] Varus deformity is often associated with internal femoral torsion because subjects with knee OA tend to rotate externally the tibia to point their feet straight ahead.[32] So when correct Internal Rotation Mulligan Glide MWM is given positional fault is corrected and range of motion improves with a reduction in pain. It leads us to infer that Mulligan's proposed mechanism of action for MWM as a reduction of a positional fault. However, the mechanism behind Medial Mulligan Glide MWM remains unclear. Alternatively, it is equally plausible that no positional fault exists but rather, there is purely a limitation of joint motion, the Mulligan MWM have produced its effect through improving accessory joint motion, not a change in positional fault.[33] Sharma et al.[34] revealed that greater quadriceps force was beneficial in the neutrally aligned or stable knees with laxity but it was associated with an increased likelihood of tibiofemoral OA progression in the misaligned and unstable knees. On the other hand, Steultjens et al.[35] reported that the major causes of ROM limitation of the arthritic knee are joint pain and weakness of the quadriceps muscle. With these regards, we suggest that utilizing Internal Rotation Mulligan Glide MWM to neutralize the knee joint alignment and to reduce pain may have a higher priority than strengthening the quadriceps muscles in the clinical practice.

In the present study, significant immediate improvement and after seven sessions it was found in all three functional performance tests (TUGT, TSTST, TUDST) in the both groups. However, better improvement was seen in group B as compared to group A. It has been demonstrated that Mulligan MWM can enhance motor activity along with hypoalgesia and sympathoexcitatory responses. Vicenzino et al.[36] and Paungmali et al.[28] found that application of MWM with a lateral glide to the elbow joint increased pain-free grip force (PFGF) in subjects with lateral epicondylalgia. The passive mobilization showed the similar results. Sterling et al.[22] revealed that cervical mobilization decreased superficial neck flexor activity. They suggested that facilitation of the deep neck flexor muscle function occurred in subjects with neck pain after cervical mobilization treatment. In addition, Vicenzino et al.[37] found cervical mobilization improved PFGF in subjects with lateral epicondylalgia.

In contrast, Moss et al.[38] found no significant improvement in timed up and go test following knee joint mobilization in the subjects with knee osteoarthritis. However, there was a trend towards significant improvement in efficiency of walking after knee joint mobilization compared to before treatment condition. The authors claimed that this might be due to low statistical power and/or large measurement error and low test reliability associated with using a manual stopwatch.[38] Walking, sit to stand, as well as to ascend and descending stairs are important functional activities in daily life. Our study results showed the Internal Rotation Mulligan Glide MWM treatment technique could improve and maintain these essential functional performances in subjects with knee OA.

In the present study, when the mean scores of Western Ontario McMaster University Osteoarthritis Disability Index was analyzed intra-group, was found statistically significant in both the groups and has shown reduced WOMAC scores which represents an improvement in pain, range of motion and function activities, whereas inter-group comparison was done, group B had shown statistically significant changes in pain, range of motion, and functional activities than group A which indicated that Internal Rotation Mulligan Glide MWM is better than Medial Mulligan Glide MWM in reducing functional disability of subjects with knee OA.

A study done by Chandana Saraswathi, showed that a combination of Mobilization With Movement (MWM) with hot pack and supervised knee exercise program is more effective than hot packs and supervised knee exercise only in decreasing pain, stiffness and improving functional capacity as assessed on WOMAC in patients with primary knee osteoarthritis.[15] This study used Medial Mulligan Glide MWM and Internal Rotation Mulligan Glide MWM both the techniques and reported improved functional capacity as assessed on WOMAC. Results of the present study showed that Internal Rotation Mulligan Glide MWM is better as compared to Medial Mulligan Glide MWM in improving functional capacity as assessed by WOMAC in subjects with knee OA. These findings hold with usual assumption that pain is a primary factor in limiting function of the patients with knee OA. The pain was found to be associated with muscle weakness, pain coping and psychological wellbeing, whereas disability was associated with muscle weakness, a range of joint motion, pain coping and psychological wellbeing. Both pain and disability there were most strongly associated with kinesiological characteristics and pain coping. By using Rasch analysis, the recent research identified that it may be possible to reduce the WOMAC, as there appears to be redundancy between the pain and functional subscales.[39]

Knee osteoarthritis presents a serious health care problem and produces a huge burden on society. Simple, safe, physical treatment procedures such as Internal Rotation Mulligan Glide MWM could be of great value. It provides immediate pain relief, increases range of motion, improves functional performance and reduces functional disability. It is a low cost and easy means of treatment in subjects with knee osteoarthritis.

Limitations

Mulligan MWM in Weight bearing position was not assessed.

The amount of force applied during Mulligan MWM is a parameter of limited research and documentation with the studies

Conclusion

In conclusion, the present randomized clinical trial provide evidence to support the use of physical therapy regimen in the form of Medial Mulligan Glide MWM and Internal Rotation Mulligan Glide MWM in relieving pain, improving range of motion, improving functional performance and reducing functional disability in subjects with knee osteoarthritis. When the inter-group comparison was done, results showed that group B i.e. Internal Rotation Mulligan Glide MWM is superior. In addition, results also proved that Mulligan MWM improves functional performance that is of great value in improving functional activities, and quality of life as knee osteoarthritis is a heterogeneous condition.

References

[1] Carol David, Jill Lloyd, Chadwick A. (1999), *Rheumatological physiotherapy*. Mosby: 83-95.
[2] Felson, D. T., & Zhang, Y. (1998), An update on the epidemiology of knee and hip osteoarthritis with a view to prevention. *Arthritis and Rheumatism*; 41: 1343-1355.
[3] Altman R, Asch E, Bloch D, Bole G, Borenstein D, Brandt K et al. (1986), Development of criteria for the classification and reporting of osteoarthritis. Classification of osteoarthritis of the knee. Diagnostic and Therapeutic Criteria Committee of the American Rheumatism Association. *Arthritis Rheum*; 29 (8):1039-49
[4] Moskowitz, Roland W. (2009). The burden of osteoarthritis: clinical and quality of life issues. *American Journal of Managed Care*, 15: 223- 29.
[5] Dawson J, Juszczak E, Thorogood M, Marks SA, Dodd C, Fitzpatrick R. (2003), An investigation of risk factors for symptomatic osteoarthritis of the knee using a life course approach. *J Epidemiol Community Health*; 57(10):823-30
[6] Zhang, W., Moskowitz, R.W., Nuki, G., Abramson, S., Altman R.D. et al. (2008), OARSI recommendations for the management of hip and knee osteoarthritis, part II: OARSI evidence – based, expert consensus guidelines. *Osteoarthritis and Cartilage*; (16):137-62.
[7] Fitzgerald GK, Oatis C. (2004), Role of physical therapy in the management of knee osteoarthritis. *Curr Opin Rheumatol*; 16 (2):143-47.
[8] Bennell K, Hinman R. (2005), Exercise as a treatment for osteoarthritis. *Curr Opin Rheumatol*; 17 (5): 634-40.
[9] Mulligan B. (2010), *Manual Therapy "NAGS", "SNAGS", "MWMS*", etc. 6th ed. Wellington, New Zealand Plane view Services Ltd; 2010.
[10] Exelby L. (1996), Peripheral mobilizations with movement. *Man Ther*; 1(3):118-26.
[11] Vicenzino B, Paungmali A, Teys P. (2007), Mulligan's mobilization-with-movement, positional faults and pain relief: Current concepts from a critical review of the literature. *Man Ther*;12(2):98-108.
[12] Vicenzino B, Branjerdporn M, Teys P, Jordan K. (2006), Initial changes in posterior talar glide and dorsiflexion of the ankle after mobilization with movement in individuals with a recurrent ankle sprain. *J Orthop Sports Phys Ther*; 36 (7): 464 - 71.
[13] Abbott JH. (2001), Mobilization with movement applied to the elbow, affects shoulder range of movement in subjects with lateral epicondylalgia. *Man Ther*; 6 (3):170-77.
[14] Konstantinou K, Foster N, Rushton A, Baxter D. (2002), The use and reported effects of mobilization with movement techniques in low back pain management - a cross-sectional descriptive survey of physiotherapists in Britain. *Man Ther*; 7 (4): 206-14.
[15] Chandana Saraswathi, Kumar Deepak, Sinha Rakesh Kumar. (2007) Role of Mobilization with movement in primary knee osteoarthritis. *International Journal of Physical Therapy*; 1(1): 4-5.
[16] Evgeniya Dimitrova (2008) Efficacy of mobilizations with movement in patients with knee osteoarthritis. *Sports Medicine Journal*; No.16.
[17] Carlsson AM. (1983), Assessment of Chronic Pain. Aspects of the Reliability and Validity of the Visual Analogue Scale. *Pain*; 16: 87-101.
[18] Watkins MA, Riddle DL, Lamb RL, Personius WJ (1991), Reliability of Goniometric Measurements and Visual estimates of Knee Range of Motion obtained in Clinical Setting. *Journal of Physical Therapy*; 71: 15-21.

[19] Lin YC, Davey RC, Cochrane T. (2001), Tests for physical function of the elderly with knee and hip osteoarthritis. *Scand J Med Sci Sports*; 11 (5): 280

[20] Thumboo J, Chew LH, Soch CH. (2001), Validation of Western Ontario and Mcmaster University Osteoarthritis Index in Asians with Osteoarthritis in Singapore. *Osteoarthritis Cart*; 9(5): 440-46.

[21] Moss P, Sluka K, Wright A. (2007), The initial effects of knee joint mobilization on osteoarthritic hyperalgesia. *Man Ther*; 12(2): 109-18.

[22] Sterling M, Jull G, Wright A. (2001), Cervical mobilization: concurrent effects on pain, sympathetic nervous system activity and motor activity. Man Ther;6(2):72-81.

[23] Vicenzino B, Collins D, Benson H, Wright A. (1997), An investigation of the interrelationship between manipulative therapy-induced hypoalgesia and sympathoexcitation. *J Manipulative Physiol Ther*; 21(7):448-53.

[24] Lynch MK, Kessler RM, Hertling D. (1996) *Pain* In Hertling D, Kessler RM, editors. *Management of Common Musculoskeletal Disorders*. Philadelphia: Lippincott Williams & Wilkins; 1996:50-67.

[25] Souvlis T, Vicenzino B, Wright A. (2004), *Neurophysiological effects of spinal manual therapy*. In: J. D. Boyling, G. A. Jull, editors. *Grieve's Moddern Manual Therapy*. 3rd ed. Edinburgh: Churchill-Livingstone; 367-79.

[26] Wright A. (1995), Hypoalgesia post-manipulative therapy: a review of a potential neurophysiological mechanism. *Man Ther*;1(1):11-16.

[27] Paungmali A, O'Leary S, Souvlis T, Vicenzino B. Naloxone (2004), Fails to Antagonize Initial Hypoalgesic Effect of a Manual Therapy Treatment for Lateral Epicondylalgia. *J Manipulative Physiol Ther*; 27(3):180-85.

[28] Paungmali A, Vicenzino B, Smith M. (2003), Hypoalgesia induced by elbow manipulation in lateral epicondylalgia does not exhibit tolerance. *J Pain*; 4(8):448-54.

[29] Collins N, Teys P, Vicenzino B. (2004), The initial effects of a Mulligan's mobilization with movement technique on dorsiflexion and pain in subacute ankle sprains. *Man Ther*; 9(2): 77-82.

[30] Teys P, Bisset L, Vicenzino B. (2008) The initial effects of a Mulligan's mobilization with movement technique on range of movement and pressure pain threshold in pain-limited shoulders. *Man Ther*; 13(1):37-42.

[31] Lewit K. (1985) The muscular and articular factor in movement restriction. *Manual Medicine*; 1: 83-85.

[32] Hertling D, Kessler RM. (1996), *The Knee. Management of Common Musculoskeletal Disorders*. 3rd ed. Philadelphia: Lippincott Willams & Wilkins; 1996: 315-78.

[33] Vicenzino B, Wright A. (1995), Effects of a novel manipulative physiotherapy technique on tennis elbow: a single case study. *Man Ther*; 1(1): 30-35.

[34] Sharma L, Dunlop DD, Cahue S, Song J, Hayes KW. (2003), Quadriceps strength and osteoarthritis progression in misaligned and lax knees. *Ann Intern Med*; 138(8): 613-19.

[35] Steultjens MP, Dekker J, Van Baar ME, Oostendorp RA, Bijlsma JW. (2000) Range of joint motion and disability in patients with osteoarthritis of the knee or hip. *Rheumatology (Oxford)*; 39 (9): 955-61.

[36] Vicenzino B, Paungmali A, Buratowski S, Wright A. (2001), Specific manipulative therapy treatment for chronic lateral epicondylalgia produces uniquely characteristic hypoalgesia. *Man Ther*; 6(4):205-12.

[37] Vicenzino B, Collins D, Wright A. (1996), The initial effects of a cervical spine manipulative physiotherapy treatment on the pain and dysfunction of lateral epicondylalgia. *Pain*; 68 (1): 69-74.

[38] Moss P, Sluka K, Wright A. (2007), The initial effects of knee joint mobilization on osteoarthritic hyperalgesia. *Man Ther*; 12(2): 109-18.

[39] Ryser L, Wright BD, Aeschlimann, Mariacher- Gehler S, Stucki G. (1999), A new look at the Western Ontario McMaster University Osteoarthritis Index using Rasch analysis. *Journal of Arthritis Care and Research*; 12(5): 331-35.