ORIGINAL ARTICLE

IJPHY

MULLIGAN'S MOBILISATION WITH MOVEMENT (MWM) RELIEVES PAIN AND IMPROVES FUNCTIONAL STATUS IN OSTEOARTHRITIS KNEE

[*1]Reepa Avichal Ughreja
[2]Yagna U Shukla

ABSTRACT

Background: There are several manual therapy techniques for limited and painful knee flexion, but there are very few evidence about the effectiveness of Mulligan's Mobilisation With Movement (MWM) in osteoarthritis of the knee. The objective of the study was to find the effect of MWM on pain and functional status in patients with osteoarthritis knee.

Methods: 30 patients diagnosed with medial compartment tibiofemoral osteoarthritis of the knee were randomized into two groups (experimental and control groups) with 15 subjects in each group.The experimental group received medial glide MWM and medial rotation glide MWM in weight bearing and non-weight bearing positions after which the patients were asked to walk for a while. Conventional therapy in the form of shortwave diathermy (SWD), quadriceps strengthening and stretching of the calf and hamstrings was given to both the experimental and the control group. The intervention regimen lasted for seven days. Outcome measures were WOMAC score, VAS score and distance walked in 6-minute walk test.

Result: The study showed significant improvement in VAS ($p<0.05$ in control group, $p<0.001$ in experimental group), WOMAC scale($p<0.05$ in control group, $p<0.001$ in experimental group) and distance walked in 6 minutes($p<0.05$ in control group, $p<0.001$ in experimental group) in both the groups, but all these improvements were highly significant in experimental group ($p< 0.001$) than those in the control group.

Conclusion: Mulligan's MWM is significantly effective in relieving pain and improving functional status in osteoarthritis of the knee.

Keywords: Mulligan, Mobilisation, MWM, OA Knee, WOMAC, VAS.

Received 06th January 2017, revised 27th February 2017, accepted 15th March 2017

www.ijphy.org

10.15621/ijphy/2017/v4i2/141954

CORRESPONDING AUTHOR

[*1]Reepa Avichal Ughreja

Krupanidhi College ofPhysiotherapy, CarmelaramPost, Bangalore, Karnataka.

[2]Senior lecturer, Physiotherapy Department Government Spine institute Civil Hospital, Ahmedabad.

INTRODUCTION

Osteoarthritis (OA) is the commonest type of arthritis causing pain and functional disability especially in elderly. As compared to other joints, OA of the knee causes greater disability and clinical symptoms [1,2]. OA of the knee has emerged as a major health problem all over the world [3,4]. There is a correlation between the disability and pain associated with knee OA and a loss of quadriceps femoris muscle strength, [5-7] coronary heart disease [8], and depression [9].

OA knee mainly affects the medial tibiofemoral compartment of the joint [41,42]. During the stance phase of gait, torque production by hip abductors in the stance limb is reduced which causes a pelvic drop in the contralateral swing limb [43]. Thus, the center of mass of the body is shifted towards the swing limb, which in turn increases the forces on the medial Tibiofemoral compartment of the supporting limb.

There are several treatment options for OA. Despite the benefits of exercise and the various modalities,[10-14] Manual Therapy (MT) techniques have also been reported to be effective when used in conjunction with joint mobility and strengthening exercises [14-17]. G D Deyle et al. 2005 [16] found that there was greater improvement in functional status and symptoms of the knee with passive physiological and accessory movements in OA knee than with home exercises alone. Paul A Van Den Dolder, Roberts 2006 [17] reported that Cyriax and medial glide MWM techniques improved functional status and flexion in patients with anterior knee pain. Apart from these two studies, there is very few evidence on the effectiveness of Mulligan's MWM techniques in patients with osteoarthritis knee. There is a clear need for further study of Manual Therapy.

Mobilization with Movement (MWM) is a manual therapy technique advocated by Brian Mulligan for treating joint pain, stiffness, and dysfunction [18]. In this technique, the painful movement is performed actively by the patient while the physiotherapist applies a sustained glide perpendicular or parallel to the joint. This technique aims at restoring pain-free and a full range of motion in the joint [19]. It is postulated that MWM minimizes the positional faults at joints which occur following a joint injury[19-22].

MWM treatments have shown rapid improvements in pain and functions in several Studies [23-25] and trials [26,27], but the effect of MWM in osteoarthritis (OA) knee have not been evaluated in these studies.

Hence, the primary aim of the study was to determine the effect of Mulligan's Mobilisation with Movement plus conventional physical therapy on pain and functional status and to co-relate any positive findings in the modern study.

MATERIALS AND METHODS

Study design: Randomised control trial

Participants: This study was conducted in Physiotherapy department of Civil Hospital, Ahmedabad. All the patients were referred from Orthopaedic Outpatient Department, Civil Hospital, Ahmedabad. The sample size consisted of 30 (Thirty) patients who were diagnosed with Medial Compartment Tibiofemoral Osteoarthritis knee, as per the inclusion Criteria and Exclusion Criteria.

Inclusion criteria: Subjects with age group: 45-70 years, tibiofemoral arthritis of knee with the involvement of medial compartment, subjects diagnosed with OA knee according to clinical criteria of classification by Altman [28], history of osteoarthritis knee within one year. No impairment in other body parts which would not allow the subject to participate in the study.

Exclusion criteria: History of trauma within 1 year, osteoarthritis with acute pain according to International Association for the Study of Pain (IASP), association with other pathology eg. fractures, bursitis, backache, radiating pain to legs, etc., those who had taken steroid injection in knee within last 30 days, those who had undergone any lower limb surgery in the last 6 months, those who did not attend the required number of treatment sessions.

Procedure : On the first visit, a complete Orthopaedic Assessment was done. Thirty subjects who were found suitable for participation in the study were requested to sign Consent Forms. Pre-participation evaluation form consisting of VAS Scale, Western Ontario and Mc Master Universities Index of Osteoarthritis, Timed 6 minute walk test and Mulligan Knee Assessment Charts were filled. Then the subjects were allocated randomly into two groups (group A and B) with 15 subjects in each group.The data about the outcome measures were collected at the baseline (day 0) and day 7 of the treatment. The subjects were allowed to continue their daily activities but were asked not to receive any other treatment throughout the course of the study, apart from routine physician management.

Intervention

Group A received Mulligan's Mobilisation With Movement (MWM) and conventional physical therapy. Group B received conventional physical therapy alone. Both the groups attended seven treatment sessions (one session per day for seven days) in the Physiotherapy department of Civil Hospital, Ahmedabad.

Mobilization with Movement (MWM) protocol:

The subjects in group A received an intervention which consisted of medial glide MWM or medial rotation MWM(whichever was best indicated for pain relief for a particular patient).

Techniques :

1. For medial glide MWM, the patient was made to lie supine (for non- weight bearing position) and standing with one leg on a stool (for weight bearing position). The therapist then kept the palmar aspect of the right hand on the upper aspect of the leg (distal to knee) and left a hand on the lower aspect of the thigh (proximal to knee). Then, the therapist applied medial glide to the knee and asked the patient to perform

knee flexion and extension maintaining the medial glide throughout the range of motion.

2. For medial rotation MWM, the therapist grasped the upper aspect of the tibia with both the hands(keeping thenar aspect posteriorly and fingers anteriorly), rotated the tibia medially and asked the patient to flex and extend the knee while maintaining the medial rotation glide throughout the range of motion.

On the very first day of treatment, the patient was assessed completely about the perception of pain in weight-bearing as well as non-weight-bearing positions. If the patient had pain in both the positions, he/she was given MWM (2 sets of 10 repetitions) first in the non-weight bearing position. After that, in the weight bearing position, he/she was assessed for pain in different functional activities. e.g.

1. Putting the affected leg up and down on a stool
2. Stepping the affected knee on the stool and moving it front and back
3. Stepping up and down on the stool

If all the activities were found painful two sets of 10 repetitions of MWM was given in the first functional activity. Once that activity became pain- free, the MWM was given to the next activity (2 and then 3). Most of the patients were able to progress to the third functional activity on the third or fourth day of treatment. Thus, a total of four sets of 10 repetitions per session were given to ensure prolonged correction of tracking and sufficient afferent input [18,19]. At the end of 4 sets patients were asked to walk a few steps. After this session of MWM, conventional physical therapy was given to these subjects.

Conventional physical therapy protocol:

It consisted of Shortwave diathermy for 10 minutes and conventional exercises. These conventional exercises included:

1. Strengthening exercises:

A. Staticquadricepsexercise: Patient is positioned in supported long sitting position. He then contracts the quadriceps femoris muscle and pushes the knee down.

B. Vastus Medialis Oblique exercises:

   i. Last 15^{o} extension: Patient is in long sitting position with the affected knee flexed to 15^{o}. He then contracts the quadriceps muscle to straighten his knee fully.

   ii. Supine - Hip flexion abduction external rotation with knee extension:

   iii. With the patient supine, he flexes his hip to15^{o}, adducts it 10^{o} and then externally rotates it with the knee extended.

C. Resisted quadriceps exercise: Patiently is in high sitting position. Then straightens his knee fully against resistance given by the therapist or by the weight cuff (whichever is tolerated by the patient) tied to the ankle.

D. Hamstrings are strengthening exercises: Patient is in a prone lying position. He then bends his knee in the available range against the resistance given by the therapist or by the weight cuff tied to the ankle.

E. Hipabductors arestrengtheningexercises: Patient is in side lying position. He then abducts his hip with the knee extended (against the resistance of weight cuff or the therapist).

Note: In all strengthening exercises, each contraction was held for ten secs followed by a 3 sec rest and repeated ten times.

2. Stretching exercises:

A. Calf stretching: Patient is placed in supine position with knee extended. The therapist keeps his hand behind the plantar aspect of patient's foot and dorsiflexes the patient's foot.

B. Hamstring stretching: With the patient in supine position, the therapist grasps the patient's leg and raises the whole leg keeping the knee extended.

Note: Each stretch was held for 30 secs and repeated three times.

Knee care was taught to all the patients. The patients in both the groups were advised to do two sessions of the conventional exercises at home. In the case of bilateral involvement of Osteoarthritis, the most painful knee was treated.

Outcome measures

Measures were used to collect data at baseline and one week (i.e., after seven sessions of treatment). The data that were collected to characterize the participants at baseline included age, gender, duration of the problem, body mass index (BMI).

Primary outcome:

The primary outcome measure was taken as Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) [29,30] to measure patients' perceptions of pain, stiffness, and dysfunction. Patients were asked to score 24 parameters from 0(none) to 4(extreme), and total scores were recorded at baseline and one week.

Secondary outcome:

The secondary outcome measures were: Visual Analogue Scale (VAS), Timed 6-minute walk test and overall satisfaction with the treatment.

VAS [31], a self-assessing questionnaire was used to assess the severity of pain. A 10-cm line was drawn on a sheet of paper and divided into ten equal sections, with 0 representing "no pain" and 10 representing "unbearable pain." Each participant was asked to indicate on the scale the level of pain in his or her knee joint before and after treatment. The patient would be marking on the scale himself indicating as a Subjective Experience.

The timed 6-minute walk test was used to measure the functional exercise capacity [32-35]

Of the OA knee patients. The patients were asked to walk in the department on a course 30m long for six mins. The patients were encouraged to cover as much distance as possible in 6 mins. At the end of 6 mins, the patients were

asked to stop and the distance walked was recorded.

Simple, functional tests (e.g., walking, knee bending, step-ups) that produced pain were used to get an idea of daily baseline measurements to help evaluate the effect of the treatment.

Data analysis

Wilcoxon signed - rank test [36] was applied to both the experimental group and the control group (i.e. Within the Group). T values were calculated for WOMAC, VAS and Timed 6-minute walk test within each group. Then, these T values were compared with the table value at N=15 (sample size), and p was calculated. If T value was greater than the table value and $p<0.05$, then that indicated a significant improvement in that outcome measure in that particular group (95% Confidence limits or 5% level of significance). If $p<0.01$, it indicated highly significant improvement at 99% confidence limits.

Wilcoxon rank sum test [36] (Mann-Whitney U test) was then applied to both the groups to compare the improvement in VAS and WOMAC in between the two groups T values for both VAS and WOMAC were calculated. Then, Z value was calculated which was compared with the table value, and p-value found out. If the Z value was less than the table value, and $p<0.01$, it indicated the higly significant difference between the two groups.

Student's T test was applied to both the groups to find out any improvement in thedistance walked in 6 minutes. Paired t- test was used to calculate the difference within the Group. Unpaired t- test was used to calculate the difference between the Groups.

RESULTS

Flow of participants, therapists through the study

Thirty participants were included in the study who were then enrolled into the experimental group (n=15) and the control group (n=15). Each participant received

the intervention that was randomly allocated to her. There was no loss to follow-up of participants for any reason. No participant asked to leave the study before completion. The baseline characteristics of the participants in each group are presented in Table 1.

Table 1: Baseline characteristics of the participants

Characteristic		Experimental Group A	Control Group B
Age (yrs), mean (SD)		55.13 (8.91)	53.8 (8.8)
Gender	Male Count	4 (25%)	4(25%)
	Female Count	11(75%)	11(75%)
Duration (months),mean (SD)		38.76 (5.63)	20.04 (2.06)
Body Mass Index (kg/m^2)		24.13 (3.96)	25.26 (2.09)

Effect of interventions

Primary outcome:

Functional status of the participants, as measured by WOMAC, improved by a mean of 19 (SD 3) in the experimental group, whereas the control group improved by a mean of 4 (SD 0.95). This is shown in Table 2 and 3. When Wilcoxon Rank Sum Test (Mann-Whitney U test) was applied to compare the improvement in WOMAC in between the two groups, results showed the highly significant difference between them at 95%cl, $p<0.001$(table 4).

Table 2: VAS, WOMAC and 6 min walked distance at day 1 and 7 in experimental group

Scales	DAY 1 Mean (SD)	DAY 7 Mean (SD)	Difference	T Value	P
VAS	6.97 (2.02)	3.37 (2.00)	3.6 (0.02)	120	<0.01
WOMAC	49.67 (12.36)	30.53 (9.05)	19 (3)	120	<0.01
6 min walked distance (m)	251.47 (73.19)	313.07 (60.61)	61.6 (12.58)	9.29 (t-test)	<0.01

Table 3: VAS, WOMAC and 6 min walked distance at day 1 and 7 in control group

Scales	DAY 1 Mean(SD)	DAY 7 Mean(SD)	Difference	T	P
VAS	6.5(1.56)	5.9(1.53)	0.6(0.03)	55	<0.05
WOMAC	48.57 (11.57)	44.167 (10.62)	4.4(0.95)	120	<0.05
6 min walked distance	251(73)	257.5(73.2)	6.5(0.2)	3.774 (t-test)	<0.05

Table 4: VAS and WOMAC obtained on comparing both the groups

Scales	T1	T2	Z values	P Value
VAS	128	332	4.334	<0.001
WOMAC	154.5	310.5	3.235	<0.001

Secondary outcome

On Visual Analogue Scale (VAS), the experimental group showed improvement by

4(SD 0.02), whereas the control group showed improvement by 0.6(SD 0.03). On applying Wilcoxon Rank Sum Test, there was a significant difference between the two groups (95%cl, $p<0.001$)

Regarding the distance walked in 6mins, the experimental group showed an improvement of 62m(SD 12.6) whereas the control group showed an improvement of 7m(SD 0.2). Paired t-test showed a significant difference between both the groups but improvement in the experimental group was more as compared to the control group (Table 5). Unpaired t-test showed a highly significant difference between the groups ($p<0.001$,95% cl, table 6).

Table 5: Results of Paired t- test for 6 min walked distance

Group	t value	P value	Result
Experimental Group	9.29	P < 0.001	Highly Significant
Control Group	3.77	P < 0.05	Significant

Table 6: Results of Unpaired t- test for 6 min walked distance

Group	t value	P value	Result
Comparing both Groups	t=8.26	P < 0.001	Highly significant

DISCUSSION

The results of this study indicate that there is a significant improvement in Pain and Functional Status in Patients with Osteoarthritis knee at the end of 1week after Mobilisation with Movement (MWM) when given along with Conventional therapy as compared to Conventional therapy alone.

Both groups showed improvements which were indicated by sufficient reductions in VAS, WOMAC scores and improvement in the distance walked in 6 minutes at the end of 1 week. A study by Barr et al. 1994 [37] suggested that WOMAC scores reduced by a minimum of 20% to 25% levels were considered as meaningful. In the experimental group, it was found that the WOMAC scores exceeded this level of improvement. The WOMAC scores after the treatment in the group who received MWM daily for a week were markedly better (approx. 40% reduction) than the WOMAC scores seen in Group B (9% reduction).The 6 min distance in Group A increased by approximately 22 % which is far beyond that for Group B (which showed an increase in distance by just 5 % or so). Similarly, the VAS score in Group A was reduced by an average of 52% which is a highly significant improvement as compared to Group B where there was only 10% reduction on average. It was also observed that in the experimental group, some patients who had decreased ROM of knee flexion also showed significant improvements. The strength of the muscles of the lower limb and the standing & walking balance of the patients were also improved. Subjects in the experimental group were more satisfied with the outcome of the treatment than subjects in the control group.

The significant difference between groups is due to the additional effects of MWM therapy which the other group was not receiving. A study by Deyle et al. 2000 [14] showed no significant change in WOMAC scores or 6-minute walk test measurements in patients with knee OA when treated with a placebo treatment.

The findings of the present study were consistent with those of previous studies of peripheral joints (other than knee) [23-27,38] for the same therapeutic regimen. For example, a study by Vicenzino et al. 2001 on tennis elbow patients assessed the effects of lateral glide MWM on pain-free grip strength (PFGS) and pressure pain threshold (PPT) and reported an immediate 50% increase in PFGS, with only a 10% increase in PPT.

The study showed greater improvement of functions with MWM along with exercise than that reported with other treatments [11,39,40] One of the important reasons for improvement in functional status with MWM treatment in osteoarthritis is that it caused considerable reduction in pain and stiffness, and thus the pain free range of movement allows the subjects to perform exercises and daily activities more successfully without pain.

Although the present study was a randomized trial, some methodological limitations were still present. The study consisted of a few subjects which should be revised to a large number of subjects & for a longer duration of the period. Furthermore, this was a short-term study of 1 (one) week & no further follow up was taken. Knee Range of Motion and the strength of the muscles were not measured. The home program taught to the patients was not supervised. There is need to investigate the effect of specific techniques like weight bearing and nonweight bearing MWM in osteoarthritis knee, so as to find out which one produced better pain relief and more consistent results. Lastly, it would be recommended to have further study & find out how long the MWM effects last for, whether its effect is maintained or reduced on a long-term basis and whether it has a role in reducing the need for total knee replacement surgeries in future.

CONCLUSION

The results of this study on 30 patients with osteoarthritis knee supported the hypothesis of this study. Hence, it was concluded that Mulligan's MWM) along with Conventional Therapy showed significant improvement in Pain & Functional Status in patients with OA knee. The results were consistent with the previous reports for the same therapeutic regimen (but in other peripheral joints).

REFERENCES

[1] Felson DT, Zhang Y, Hannan MT, et al. The incidence and natural history of knee osteoarthritis in the elderly: the Framingham Osteoarthritis Study. *Arthritis Rheum*.1995; 38(10):1500–1505.

[2] Felson DT, Naimark A, Anderson J, et al. The prevalence of knee osteoarthritis in the elderly: the Framingham Osteoarthritis Study. *Arthritis Rheum*.1987;30(8):914–918.

[3] Corti MC, Rigon C. Epidemiology of osteoarthritis: prevalence, risk factors, and functional impact. *Aging Clin Exp Res*.2003; 15(5):359–363.

[4] De Filippis L, Gulli S, Caliri A, et al. Epidemiology and risk factors in osteoarthritis: literature review data from "OASIS" study [in Italian]. *Reumatismo*.2004; 56(3):169–184.

[5] Lewek MD, Rudolph KS, Snyder-Mackler L. Quadriceps femoris muscle weakness and activation failure in patients with symptomatic knee osteoarthritis. *J Orthop Res*.2004; 22(1):110–115.

[6] Fitzgerald GK, Piva SR, Irrgang JJ. Reports of joint in-

stability in knee osteoarthritis: its prevalence and relationship to physical function. *Arthritis Rheum*.2004; 51(6):941–946.
[7] Fitzgerald GK, Piva SR, Irrgang JJ, et al. Quadriceps activation failure as a moderator of the relationship between quadriceps strength and physical function in individuals with knee osteoarthritis. *Arthritis Rheum*.2004; 51(1):40–48.
[8] Philbin EF, Ries MD, Groff GD, et al. Osteoarthritis as a determinant of an adverse coronary heart disease risk profile. *J Cardiovasc Risk*.1996; 3(6):529–533.
[9] Wolfe F. Determinants of WOMAC function, pain and stiffness scores: evidence for the role of low back pain, symptom counts, fatigue and depression in osteoarthritis, rheumatoid arthritis and fibromyalgia. *Rheumatology (Oxford)*.1999;38(4):355–361.
[10] Philadelphia Panel. Philadelphia Panel Evidence-Based Clinical Practice Guidelines on Selected Rehabilitation Interventions for Shoulder Pain. *Phys Ther*.2001; 81(10):1719–1730.
[11] Puett DW, Griffin MR. Published trials of nonmedicinal and noninvasive therapies for hip and knee osteoarthritis. *Ann Intern Med*.1994; 121(2):133–140.
[12] Deal CL, Schnitzer TJ, Lipstein E, et al. Treatment of arthritis with topical capsaicin: a double-blind trial. *Clin Ther*.1991; 13(3):383–395.
[13] Mei-Hwa Jan, Huei-Ming Chai, et al. Effects of Repetitive Shortwave Diathermy for Reducing Synovitis in Patients With Knee Osteoarthritis: An Ultrasonographic Study. PHYS THER .2006; 86(2):236-244.
[14] Deyle GD, Henderson NE, Matekel RL, et al. Effectiveness of manual physical therapy and exercise in osteoarthritis of the knee: a randomized, controlled trial. *Ann Intern Med*.2000; 132(3):173–181.
[15] Falconer J, Hayes KW, Chang RW. Effect of ultrasound on mobility in osteoarthritis of the knee: a randomized clinical trial. *Arthritis Care Res*.1992; 5(1):29–35.
[16] Gail D Deyle, Stephen C Allison et al., Physical Therapy Treatment Effectiveness for Osteoarthritis of the Knee: A Randomized Comparison of Supervised Clinical Exercise and Manual Therapy Procedures Versus a Home Exercise Program, PHYS THER.2005; 85(12):1301-1317
[17] Paul A Van Den Dolder, Roberts. Six sessions of Manual Therapy increase knee flexion & improve activity in people with anterior knee pain: a randomised controlled trial. Aust J Physiother. 2006;52(4):261-4.
[18] Mulligan, B., Manual Therapy, - "NAGS", "SNAGS", MWMS" etc. 5th ed. 2004.
[19] Linda Exelby. Peripheral Mobilisation with Movement. Manual therapy.1996;1(3):118-126.
[20] Elahi S, Cahue S, Felson DT, et al: The association between varus-valgus alignment and patello-femoral osteoarthritis. Arthritis Rheum. 2000 Aug; 43(8):1874-80.
[21] Mizuno Y, Kumagai M, Mattessich SM, et al: Q-angle influences tibio-femoral and patello-femoral kinematics. J Orthop Res 2001;19(5):834-40.
[22] Cooke D, Scudamore A, Li J, et al. Axial lower-limb alignment: comparison of knee geometry in normal volunteers and osteoarthritis patients. Osteoarthritis Cartilage. 1997;5(1):39-47.
[23] Vicenzino, B. and A. Wright, Effects of a Novel Manipulative PhysiotherapyTechnique on Tennis Elbow: A Single Case Study. Manual Therapy. 1995;1(1):30-35.
[24] O Brien, T. and B. Vicenzino, A study of the effects of Mulligan's mobilization with movement treatment of lateral ankle pain using a case study design, Manual Therapy, 1998. 3(2):78-84.
[25] Abbott, J., C. Patla, and R. Jensen, Grip strength changes immediately following Elbow Mobilisation with Movement in subjects with lateral epicondylalgia, in Proceedings of the 7th Scientific Conference of the IFOMT in conjunction with the MPAA, K. Singer, Editor. 2000, University of Western Australia: Perth, Australia. p. 8-10.
[26] Vicenzino, B., S. Buratowski, and A. Wright, A preliminary study of the initial hypoalgesic effect of a Mobilisation with Movement treatment for lateral epicondylalgia, in Proceedings of the 7th Scientific Conference of the IFOMT in conjunction with the MPAA, K. Singer, Editor. 2000, University of Western Australia: Perth, Australia. p. 460-464.
[27] Vicenzino, B., Paungmali A, Buratowski S, Wright A. Specific manipulative therapy treatment for chronic lateral epicondylalgia produces uniquely characteristic hypoalgesia. *Man Ther*.2001; 6(4):205–212.
[28] Altman RD. Criteria for classification of clinical osteoarthritis. *J Rheumatol Suppl*.1991; 27:10–12.
[29] Bellamy N. WOMAC: a 20-year experiential review of a patient-centered self-reported health status questionnaire. *J Rheumatol*.2002; 29(12):2473–2476.
[30] Bellamy N, Buchanan WW, Goldsmith CH, et al. Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. *J Rheumatol*.1988; 15(12):1833–1840.
[31] Hendiani JA, Westlund KN, Lawand N, et al. Mechanical sensation and pain thresholds in patients with chronic arthropathies. *J Pain* 2003;4(4):203–211.
[32] Ettinger WH Jr, Burns R, Messier SP, et al. A randomized trial comparing aerobic exercise and resistance exercise with a health education program in older adults with knee osteoarthritis: the Fitness Arthritis and Seniors Trial (FAST). *JAMA*.1997; 277(1):25–31.
[33] Guyatt GH, Sullivan MJ, Thompson PJ, et al. The 6-minute walk: a new measure of exercise capacity in patients with chronic heart failure. *Can Med Assoc J*.1985;132(8):919–923.
[34] Ouellet D, Moffet H. Locomotor deficits before and two months after knee arthroplasty. *Arthritis Rheum*.2002; 47(5):484–493.

[35] Foley A, Halbert J, Hewitt T, Crotty M. Does hydrotherapy improve strength and physical function in patients with osteoarthritis: a randomised controlled trial comparing a gym based and a hydrotherapy based strengthening programme. *Ann Rheum Dis*.2003; 62(12):1162–1167.
[36] Alired A. Rim. Basic Biostatistics In Medicine and Epidemiology. 1980.
[37] Barr S, Bellamy N, Buchanan WW, et al. A comparative study of signal versus aggregate methods of outcome measurement based on the WOMAC Osteoarthritis Index. *J Rheumatol*.1994; 21(11):2106–2112.
[38] Abbott J, Patla C, Jensen R. The initial effects of an elbow mobilisation with movement technique on grip strength in subjects with lateral epicondylalgia. *Man Ther*.2001; 6(3):163–169.
[39] Van Baar ME, Assendelft WJ, Dekker J, et al. Effectiveness of exercise therapy in patients with osteoarthritis of the hip or knee: a systematic review of randomized clinical trials. *Arthritis Rheum*.1999; 42(7):1361–1369.
[40] Fransen M, McConnell S, Bell M. Therapeutic exercise for people with osteoarthritis of the hip or knee: a systematic review. *J Rheumatol*.2002; 29(8):1737–1745.
[41] Ledingham J, Regan M, Jones A, Doherty M: Radiographic patterns & association of OA knee in patients referred to hospital . Ann Rheum Dis 1993, 52(7):520-526.
[42] Iorio R, Healy WL: Unicompartmental arthritis of knee . J Bone Joint Surj Am. 2003; 85- A(7): 1351-1364.
[43] Mackinnon CD, Winter DA. Control of whole body balance in the frontal plane during human walking. J Biomech 1993; 26(6): 633-644.

Citation
Ughreja, R. A., & Shukla, T. U. (2017). MULLIGAN'S MOBILISATION WITH MOVEMENT (MWM) RELIEVES PAIN AND IMPROVES FUNCTIONAL STATUS IN OSTEOARTHRITIS KNEE . *International Journal of Physiotherapy,* 4(2), 132-138