

Immediate effect of Mobilization with Movement for Tibio-femoral joint OA during stair climbing on EMG parameters of gluteus medius muscle

Radhika Chintamani*, Amrutkuvar Rayjade, Trupti Yadav

1. Assistant Professor, Faculty of Physiotherapy, Krishna Institute of Medical Sciences Deemed to be University Karad-MAHARASHTRA,
2. Associate Professor, Faculty of Physiotherapy, Krishna Institute of Medical Sciences Deemed to be University Karad-MAHARASHTRA,
3. Assistant Professor, Faculty of Physiotherapy, Krishna Institute of Medical Sciences Deemed to be University Karad-MAHARASHTRA.

ABSTRACT

Introduction: Tibio-femoral Osteoarthritis is commonest form of OA, in entire knee complex. It is already known that, gluteus medius is weak in subjects with TFJ OA. MWM for TFJ OA, is proved to be significant in reducing pain, disability and improving painless ROM. Very limited studies are known to clarify the difference in EMG activity in gluteus medius muscle immediately post-MWM for TF OA.

Objective: To investigate the immediate effect of MWM for tibio-femoral joint OA during stair descent on EMG parameters of gluteus medius muscle.

Methodology: This is an experimental study conducted on 62 subjects with Tibio-femoral OA. Subjects were recruited on the basis of the inclusion and exclusion criteria. MWM During stair descent was given along with IFT. EMG activity of gluteus medius muscle was checked during stair descent and trendelenburg test.

Results: The comparison between pre and post therapy test scores indicated that therapy was statistically significant in the outcome measures: Pain (VAS) in knee joint during stair descent, Motor Evoked Potential of gluteus medius muscle and kinesiophobia with p value (<0.001), (<0.0001), and (<0.05) respectively.

Conclusion: The treatment showed significant improvement in all the outcome measures. And the therapy significantly proved effective in improving the Maximum peak amplitude showing that the strength of gluteus medius improved with MWM.

Keywords: MWM, Stair descent, Tibio-femoral Joint OA, Gluteus medius, EMG Parameters.

Introduction:

Osteoarthritis (OA) is the most common degenerative disorders in which degeneration of cartilage is prominent further leading to subchondral bony erosion. Knee joint is the common joint affected earliest in this disorder. Types of Knee joint osteoarthritis are; tibio-femoral OA and patella-femoral OA. Medial aspect of knee joint is affected commonly in Tibio-femoral OA due to anatomically, distally placed medial femoral condyle compared to lateral femoral condyle. There is no known cure for OA. Treatment of Knee OA, includes physical therapy, surgical therapy or pharmacological therapy. As, age being the major cause of Knee joint OA, any therapy is focused to control pain and improve function along with quality of life. However, the added high risk of surgical and pharmacological intervention, especially in elderly subjects delays the therapy for OA. In contrast, manual therapy has least side effects to hamper the daily activities, in fact manual therapy, a branch of physiotherapy is known to improve quality of life by decreasing pain and increasing ROM thus reducing disability.[1]

Several studies have proved that, persisting knee joint OA leads to development of weakness of gluteus medius due to inappropriate weight bearing. Inappropriate weight bearing leads to change in muscle activation pattern thus leading towards weakness of gluteus medius muscle[2] Gluteus medius is a major Hip abductor. Trendelenburg described a test to assess the weakness of gluteus medius. The test suggests that; on standing on one leg stance if the weakness is persisting in ipsilateral lower extremity, then the positive sign would be drop of pelvis on the contralateral aspect. This occurs as the gluteus medius of one extremity stabilizes the pelvis of the contralateral low extremity. [3]

Several studies already demonstrate the usefulness of Mobilization with movement over the factors affecting knee joint OA[1]. Further several studies have also proved the benefits of knee joint mulligan mobilization while stair climbing up and climbing down to improve the joint function. [4]

Gluteus medius muscle is very important while climbing the stairs either up or down. The pelvic inclination if not maintained in a straight line, as in case of gluteus medius weakness, there will be pelvic drop while the limb is lifted upwards[3]. This suggests that, the gluteus medius weakness induces difficulty in stair climbing up and down. Though, studies prove that MWM works significantly over the knee functions in subjects with

Osteoarthritis, very limited studies show the effect of MWM over the activity of gluteus medius during stair climbing and immediately post therapy during trendelenburg test.

MATERIALS AND METHODS

Participants:

From a previous study, 62 participants were determined to be necessary. Inclusion criteria for recruitment were; Tibio-femoral osteoarthritis with grade: 2-3 by Kellgren-Lawrence classification system[5], subjects willing to participate in study, age: 50-60 years and pain during stair descent. Exclusion criteria were: grade of knee joint arthritis greater than 3, surgery of any part of lower extremity, neoplasia, any allergic skin condition and known case of severe balance issues, cardiopulmonary and neurological disorders. Subjects were recruited by convenience sampling. Study population was selected from the outpatient department of physiotherapy of KRISHNA HOSPITAL- Karad India, diagnosed with tibio-femoral OA grade: 2-3. This study was approved by the Institutional Ethics Committee KIMSDU Karad. All participants were informed about the procedures and the written informed consent form was taken to participate in the study. Subjects were recruited on the basis of inclusion and exclusion criteria.

Experimental Procedure:

Demographic details and outcome measures like (age, gender, weight, BMI, pain intensity by VAS, kinesiophobia, MEP of gluteus medius muscle during stepping activity) were recorded pre-therapy. After measurement of baseline data, participants were asked to perform one round of stepping up and down. It is a one-time intervention, where the therapy was given only for once (10 reps of MWM). With the glide maintained, the subject was asked to climb up and down the stairs. During both stair climbing up and down the screw home mechanism rule was followed for every subjects while leaving the glide. Immediately post therapy outcome measures were noted down. During stair climbing up the tibia rotates externally while the knee flexes and during stair climbing down, the tibia rotates internally as the knee extends. This screw home principle was used to deliver the glide. During stair ascent the knee flexes, hence the glide was directed towards external rotation and during stair descent, the knee extends, hence the glide was directed towards internal rotation.

Outcome Measures:1. Electromyographic Recording:

For analyzing muscle activity, surface EMG of gluteus medius muscle using gel-coated surface electrodes. Bipolar surface Electrodes were aligned parallel to the gluteus medius muscle fiber orientation, placed on one-half of the distance between the greater trochanter and lateral aspect of the iliac crest. A reference electrode was placed over the. Surface electrodes were placed and maintained at the site with the help of tape. Electrodes were placed 2 cm apart to minimize cross-talk between the surface electrodes placed on a muscle. Electromyographic signals were recorded bilaterally for gluteus medius muscles. EMG activity of both these muscles were recorded stair decent activity.[6]

2. Kinesiophobia and VAS :scales were administered on each subject.[7-8]

The outcome measure readings were taken on pre-therapy and immediately post-therapy.

RESULTS:

I. Demographic Characteristics of Participants: Age, Gender and weight showed no significant difference between pre therapy and post therapy.

II. EMG readings of Ipsilateral Gluteus Medius (MEP values):

Group x time analysis by student's t test (Mean \pm SD):

Activity limitation	Pre-therapy			Post-therapy		
	Stair ascent	Stair descent	Trendelenburg test	Stair ascent	Stair descent	Trendelenburg test
MEP	20.9 \pm 11.8	15.8 \pm 10.8	23.9 \pm 11.8	23.5 \pm 5.0	20.4 \pm 9.4	27.0 \pm 12.6

Suggesting that; motor evoked potentials significantly improved during stair ascent, descent and Trendelenburg test with p values; <0.05, <0.0001 and <0.0001.

III. Kinesiophobia: Pre-therapy was not significant immediately post-therapy, the measure was significant with p value: 0.001.

IV. Pain (VAS): Post therapy p value was statistically significant (p value= 0.001).

DISCUSSION:

In the present study, all the outcome measures enlisted above were significantly improved immediately post-therapy

1. The EMG parameters: Motor evoked potential of gluteus medius muscle improved significantly during stair ascent, descent as well as during trendelenburg test. This shows that, gluteus medius activity can be improved while performing daily activities especially, during stair ascent descent and one leg standing after giving mulligan mobilization while stair climbing. The reason for improvement in MEP of gluteus medius muscle may be due to; the re-alignment of the tibia over femur during MWM, which is definite reduction of pain, thus reducing overactivity of TFL. Weakness of gluteus medius will cause the secondary hip abductor muscle to fire, so that the desired action is carried out. MWM delivered in this study was in the direction of screw home mechanism so, aligning back the rotated tibia on the femur which generally occurs in knee joint osteoarthritis known as Bow leg, will reduce the bow leg and also, decrease the over activity of TFL, thus firing gluteus medius during the activities. Also, aligning the tibia over femur will benefit the direction of muscle pull of gluteus medius muscle, thus facilitating the muscle biomechanically.
2. VAS: pain was significantly reduced for which the reasons may be; manual touch and pressure during the MWM. MWM is known to have a hypoalgesic effect of the mobilization which means pain relieving effect and the mobilization being given in weight bearing position while stair climbing induced more better effect in relieving pain. MWM is also known to improve knee joint function which are reduced due to pain such as, sit to stand, walking, climbing stairs, squatting etc. delivering the glide to the affected knee joint reduces the pain and improves the quality and range of motion during that particular activity.
3. Kinesiophobia: fear of fall was reduced because of improvement in painless Range of motion of knee joint during stair ascent and descent, thus improving the balance in subjects. Also, subjects with OA are kinesiophobic due to severe pain in knee joint while weight bearing, muscle imbalance due to degeneration of knee joint and mal alignment of tibia over femur due to cartilage erosion. MWM is known to correct the weight bearing alignment of the tibia over femur, reduces pain during weight and non-weight bearing thus reducing kinesiophobia.

CONCLUSION: The glide delivered during stair climbing up and down while following the screw home mechanism of the knee joint during stair climbing, definite improved the muscle activity of gluteus medius muscle tallied statistically with motor evoked potentials. This shows significant improvement in strengthening of the hip muscle along with knee joint parameters. Mulligan glide delivered while stair climbing following the screw home mechanism pattern not only reduced pain, but also improved the movement quality thus reducing fear of movement. The reduction of pain during weight bearing/ stair climbing is due to the glide giving in the normal biomechanical aspect which induced the normal movement with respect to kinetic and kinematic principles of the body. Kinesiophobia in subjects with Osteoarthritis as seen above is generally due to severe pain experienced by subjects while moving the knee both in open and closed kinematic chain movements. In this study, the glide was delivered in weight bearing position, which reduced the pain aspect of the knee joint, thus reducing kinesiophobia of the subjects with knee Osteoarthritis.

STRENGTHS: The study analyzed the MEP during stair ascent and descent also during trendelenburg test suggesting the improvement in gluteus medius muscle activation immediately post-therapy.

LIMITATION: EMG parameters of contralateral extremity not assessed as long term osteoarthritis can cause few changes in the contralateral knee joint as well.

FUTURE SCOPE: Assessing the hip abductor of contralateral extremity would have been effective to check the effectiveness of MWM of ipsilateral affected knee joint on contralateral strength of gluteus medius muscle.

ETHICAL CLEARANCE: Obtained from Krishna Institute of Medical Sciences, deemed to be University Karad-Maharashtra INDIA.

CONFLICT OF INTEREST: None

FUNDING: Self funding

REFERENCES:

1. Alkhawajah h. and Alshami A. The effect of mobilization with movement on pain and function in patients with knee osteoarthritis: a randomized double-blind controlled trial. BMC musculoskeletal disorders.2019;20(452):1-9

2. Megha M, Mohanty P and Pattnaik M. Effectiveness of patellofemoral mobilisation, stretching and strengthening on walking ability and stair climbing in subjects with osteoarthritic knee – a comparative study. *EC orthopaedics*.2017;5.2:55-66
3. Karen K, Chirag P, Preston W, Michael P Carolyn E et al. Steps towards the validation of the Trendelenburg test: The effect of experimentally reduced hip abductor muscle function on frontal plane mechanics. *Clinical Journal of Sport Medicine*.2013;23(1):45-51
4. Takasaki H, Hall T and Jull G. Immediate and short-term effects of Mulligan's mobilization with movement on knee pain and disability associated with knee osteoarthritis – A prospective case series. *Physiotherapy Theory and Practice*2012::1–9
5. Kohn M, Sassoon A and Fernando N. Classifications in Brief: Kellgren-Lawrence Classification of Osteoarthritis. *Clin Orthop Relat Res*.2016; 474:1886–1893
6. Fujita K, Kabata T, Kajino Y, Iwai S, Kuroda K, Hasegawa K et al. Quantitative analysis of the Trendelenburg test and invention of a modified method. *Journal of Orthopaedic Science*. 2016;09(007):1-8
7. Huang H, Nagao M, Arita H, Shiozawa J, Nishio H, Kobayashi Y, et al. Reproducibility, responsiveness and validation of the Tampa Scale for Kinesiophobia in patients with ACL injuries. *Health and Quality of Life Outcomes*. 2019;150(17): 1-8
8. Harshwardhan H, Laddha G and Gupta P. Outcome assesment of proximal fibular osteotomy in medial compartment knee osteoarthritis. *International Journal of Orthopaedics Sciences* 2020; 6(1): 183-185