Does Strengthening of Hip Abductors Improve Physical Function In Osteoarthritis of Knee?

Dr. Shweta Kulkarni[1], Dr. Mandar Malawade[2], Dr. Priyanka Nakhwa[3]

[1] *Assistant Professor, Dr. A.P.J Abdul Kalam College of Physiotherapy, PIMS, Loni, India, 413736*

[2]*Assistant Professor, Dr. A.P.J Abdul Kalam College of Physiotherapy, PIMS, Loni, India, 413736*

[3]*M.P.T student, A.P.J Abdul Kalam College of Physiotherapy, PIMS, Loni, India, 413736*

Corresponding author: Dr. Shweta Kulkarni

Abstract - Background: ***Lower limb strengthening exercises are an important component of the treatment for knee osteoarthritis (OA). Strengthening the hip abductor may influence medial joint loading and/or OA-related symptoms, but no study has evaluated these hypotheses directly to check the effect of hip abductor strengthening on OA knee patients. The aim of this randomised, single-blind controlled trial is to determine whether hip abductor strengthening can reduce medial knee over load and improve pain and physical function in people with medial compartment knee OA.***

Methods/Design: 80 participants with painful, radiographically confirmed medial compartment knee OA (grade 1/grade2) and varus alignment were recruited and randomly allocated to a hip strengthening or control group. They were allocated in intervention and control groups. Blinded follow up assessment was conducted at 12 weeks after randomization. The primary outcome measures is the WOMAC, NPRS and secondary outcome measure is 6 minute walk test.

Results: The study shows significant effect on strengthening of hip abductor muscles will contribute to the evidence regarding the effect of hip strengthening on knee medial overloads and symptoms in people with medial compartment knee OA as compared to conventional therapy. Conclusion: Hip abductor strengthening is more effective in improving physical function and reducing pain as compared to conventional therapy alone.

Key words: osteoarthritis, hip abductor, strengthening, pain, physical function.

I. INTRODUCTION

Osteoarthritis (OA) is a non-inflammatory degenerative disorder of joints characterized by progressive deterioration of the articular cartilage and formation of new bone (osteophytes). Osteoarthritis is the most common chronic joint condition and a major source of pain and limitation of activity in older adults. Osteoarthritis has significant impact on health related quality of life factors including ambulation, body care and movements, emotional behavior, sleep, home management and work, all of which contribute to “humanistic” burden of Osteoarthritis.

The knee joint is the weight bearing joint; most commonly affected with Osteoarthritis. Diagnosis of Osteoarthritis is made by clinical and radiographic evaluation. According to the American college of rheumatology, clinical criteria for knee Osteoarthritis include knee pain, morning stiffness of the knee for $\leq$ 30 minutes and crepitus on joint motion. Radiographic criteria consist of presence of osteophytes, the loss of joint space, or both.

Knee pain is predominant symptom of knee Osteoarthritis and the reason why individuals seek medical attention. Secondly people with knee Osteoarthritis may report significant limitation in physical functions. For those over the age of 65 years, the Osteoarthritis of knee accounts for the greater physical disability in lower extremity tasks, such as walking, stair climbing and rising from a chair, then any other condition, clearly reducing the quality of life and independence. Risk factor for development and progression of Osteoarthritis are age, joint injury, physical activity, gender, lower limb mal-alignment, varus-valgus knee laxity, bone density, nutritional factors, genetics, muscle weakness.[1]

A variety of exercise programs for knee OA have been described in the literature. These have included general aerobic exercise programs such as walking or cycling as well as more specific programs involving strengthening of particular muscle groups and/or flexibility exercises. Studies investigating the effects of strengthening in patients with knee OA have generally focused on improving quadriceps strength. However, there are very few studies on improving the strength of other lower limb muscle groups such as the hip abductors. Due to the lack of research investigating their efficacy, such exercises are not routinely prescribed for knee OA.[2]

Recent evidence, however, suggests that hip abductor muscle strength is important for reducing the knee adduction moment. During walking, these muscles stabilize pelvis on the hip joint in frontal plane. Position of the pelvis can alter position of the body's centre of mass and thereby alter loads at the knee joint. It is postulated

that during single leg stance support in gait, weakness of ipsilateral hip abductors may drop pelvis towards contralateral swing leg which can shift body's centre of mass away from knee joint centre and increases knee adduction movement.[3]

Hip abductor and adductor muscles may assist in regulating medial-lateral load distribution across the knee joint. Frontal plane hip muscles are important for maintaining stability of the pelvis during gait .It has been hypothesized that weakness of the stance limb hip abductor muscles would lead to drop of the pelvis towards the contralateral (swing) limb during gait, which would shift the centre of mass towards the swing limb. This shift in the centre of mass would theoretically increase the magnitude of the frontal plane lever arm, leading to higher knee adduction movements and greater medial compartment knee joint forces in the stance limb.[27]

Few studies have assessed hip muscle strength in persons with knee OA. According to these studies hip adductor muscles may have increase in strength over time to decrease varus angulation of the limb and reduce the knee adduction movement in those with knee OA. Significant age-associated changes shows reduction in isometric and isokinetic strength of the hip abductor and adductor muscles have been documented. Reduction in strength of these muscles with aging may potentially contribute to frontal plane postural instability and falls among older adults. Given that knee OA affects mostly older adults and often leads to lower activity levels, hip muscle weakness may be present in those with knee OA.[28]

II. METHODOLOGY

The study was conducted in a tertiary care hospital. Target population for study was patients with osteoarthritis of knee joint. Participants were selected with the criteria as age >40 years, radiographic OA with at least Grade 1 medial joint space narrowing or Grade 1 tibia or femoral osteophytes, self reported pain the knee for most of the days of the month and aambulatory subjects. Sample size of 80 was selected by randomised sampling and then randomly assigned to the two groups as interventional and control group.

Baseline evaluation was done by using WOMAC, NPRS and six minute walk test.

Then randomised sampling technique 40 subjects will be assigned to each group.

For interventional group, the hip abductor strengthening program for 5 sessions per week for 12 weeks was given. For control group only conventional therapy treatment was given. Out of 80 participants 68 subjects completed the intervention program. The values of outcome measure were taken at the end of the intervention.

The data collected and was analyzed. Paired T test was used for statistical analysis within the group and unpaired T test between the groups.

III. DATA ANALYSIS AND RESULTS

Descriptive characteristics of the participants are summarized in table below

80 samples fulfilling the inclusion and exclusion criteria were randomly selected and allocated in two groups. 68 samples completed the intervention and 12 samples dropped out of the study. Out of the 68 samples that completed the study 31 were males and 37 were females. The mean age of the sample is 67.5 years and age range is 45-91 years. The mean weight is 84.7 kg and weight range is 58-112 kg. Most of the people who participated in the study were ambulatory without any assistive devices.

	Mean	Range
Age (years)	67.5	45-91
Weight(kg)	84.7	58-112
Frequency		
Gender	Male :31 Female :37	
Affected joint	Right: 36 Left: 32	
Walking aids	None: 52 Cane: 14 Walker:2	
Pain medication	None: 29 Yes: 39	

Table no1: Descriptive characteristics of the participants

Pain, decreased physical function and stiffness are the common clinical features of OA knee. So 6 minute walk test, N.P.R.S and WOMAC was used as outcome measure to assess pain, physical function and stiffness and were assessed prior to the intervention and post intervention.

Outcome measure		Interventional Group		Control Group	
		Pre	Post	Pre	Post
6 minute walk test		342.93	385.56	341.6	359.51
N.P.R.S.	On activity	6.9	4.6	6.93	4.87
	At rest	4	2.2	3.9	2.06
WOMAC	Pain	5.26	2.66	5.45	3.03
	Stiffness	2.2	1.2	2.45	1.29
	Physical function	22.06	13	20.64	12.54
	Total	29	16	28.54	16.87

Table no 2: Comparison of interventional and control group

When post intervention 6 minute walk test values were compared interventional group was more significant as compared to control group. (p= 0.0012).

When post intervention N.P.R.S. on activity and on rest values were compared interventional group was more significant as compared to control group. (p<0.0001) (p=0.0045).

When post intervention WOMAC values were compared interventional group was more significant as compared to control group. (p= 0.0031).

IV. DISCUSSION

In knee osteoarthritis (OA), the medial tibio-femoral compartment is the most common site of disease. The susceptibility of the medial compartment to OA development may relate to greater load distribution (i.e., 60–80%) to the medial than the lateral compartment, even in healthy knees, during gait. Excessive medial compartment loading is widely believed to contribute to medial OA progression. Because direct measurement of knee load. In keeping with the concept that load influences progression, a greater knee adduction moment predicted a greater likelihood of medial OA progression.

However, the knee joint does not function in isolation from the rest of the lower limb kinematic chain during weight bearing activities; hip and ankle/foot mechanics may influence knee joint load during gait.

In theory, reduction of medial load may have a beneficial disease-modifying effect on medial knee OA, i.e., it may slow the rate of OA progression. However, it is unclear how to achieve this reduction. Altering certain kinematic or kinetic parameters during gait could, theoretically, reduce medial overload.

During single limb stance phase of gait, weakness or decreased torque generation of the hip abductor muscles in the stance limb causes excessive pelvic drop in the contralateral swing limb. This drop shifts the body's center of mass toward the swing limb, thereby increasing forces across the medial tibiofemoral compartment cartilage of the stance limb Based on this mechanism, a greater hip abduction moment during gait will prevent excessive medial compartment loading and potentially protect against ipsilateral medial OA progression.

Hence gluteus medius strengthening and conventional therapy was proved more effective than only conventional therapy in reducing pain and improving the physical functions in patients with OA knee.

V. CONCLUSION

Hip abductor strengthening is useful in decreasing pain and improving physical function. Hip abductor is more effective compared to conventional therapy alone.

REFERENCES

[1] Carolyn Kisner, Lynn Allen Colby, Therapeutic Exercise, fifth edition, 2007, chapter 11, page 314.

[2] Ronald McRae, Clinical Orthopaedic Examination, fifth edition, chapter 10, page 212.

[3] John Ebnezar, Textbook of Orthopaedics, third edition,2006, chapter 42, page546

[4] Susan B O'Sullivan. Thomas J Schmitz – Physical rehabilitation, fifth edition, page no: 1066, 1076.

[5] Sled EA, Khoja L, Deluzio KJ, Olney SJ, Culham EG: Effect of a home program of hip abductor exercise on knee joint load, strength, function, and pain in people with knee osteoarthritis.

[6] Alison Chang, Karen hayes, Dorothy Dunlop, Jing Song, Debra Hurwitz: Hip abduction moment and protection against medial tibiofemoral osteoarthritis progression.

[7] Kim L Bennell, Michael A Hunt, Tim V Wrigley, David J Hunter and Rana S Hinman: The effect of hip muscle strengthening on knee load, pain, and function in people with knee osteoarthritis; a protocol for a randomized, single-blind controlled trial.

[8] Petrella RJ, Bartha C: Home based exercise therapy for older patients with knee osteoarthritis: randomized clinical trial.J Rheumatol 2000 sep83(9):1187-95.

[9] Felson DT, Naimark A, Anderson J, Kazis L, Castelli W, Meenan RF: The prevalence of knee osteoarthritis in the elderly. The Framingham Osteoarthritis Study. *Arthritis and Rheumatism* 1987 , 30:914-918.

[10] Hamerman D: Clinical implications of osteoarthritis and aging. *Annals of the Rheumatic Diseases* 1995 , 54:82-85.

[11] Badley E, Wang P: Ledingham J, Regan M, Jones A, Doherty M: Radiographic patterns and associations of osteoarthritis of the knee in patients referred to hospital. *Ann Rheum Dis* 1993 , 52(7):520-526.

[12] Iorio R, Healy WL: Unicompartmental arthritis of the knee. *J Bone Joint Surg Am* 2003 , 85-A(7):1351-1364.

[13] Guccione AA, Felson DT, Anderson JJ, Anthony JM, Zhang Y, Wilson PWF, Kelly-Hayes M, Wolf PA, Kreger BE, Kannel WB: The effects of specific medical conditions on the functional limitations of elders in the Framingham study. *American Journal of Public Health* 1994 , 84:351-35.

[14] Andriacchi T, Lang P, Alexander E, Hurwitz D: Methods for evaluating the progression of osteoarthritis. *J Rehabil Res Dev* 2000 , 37(2):163-170.

[15] Andriacchi T, Mundermann A: The role of ambulatory mechanics in the initiation and progression of knee osteoarthritis. *Current Opinion in Rheumatology* 2006 , 18:514-518.

[16] Sharma L, Kapoor D, Issa S: Epidemiology of osteoarthritis: an update. *Current Opinion in Rheumatology* 2006 , 18:147-156.

[17] Schipplein OD, Andriacchi TP: Interaction between active and passive knee stabilizers during level walking. *J of Orthopaedic Research* 1991 , 9:113-119.

[18] Bailunas A, Hurwitz D, Ryals A, Karrar A, Case J, Block J, Andriacchi T: Increased knee joint loads during walking are present in subjects with knee osteoarthritis. *Osteoarthritis & Cartilage* 2002 , 10:573-579.

[19] Hurwitz D, Ryals A, Case J, Block J, Andriacchi T: The knee adduction moment during gait in subjects with knee osteoarthritis is more closely correlated with static alignment than radiographic disease severity, toe out angle and pain. *J Orthop Res* 2002 , 20:101-108.

[20] Hurwitz D, Sumner D, Andraicchi T, Sugar D: Dynamic knee loads during gait predict proximal tibial bone distribution. *Journal of Biomechanics* 1998 , 31:423-430.

[21] Jackson B, Teichtahl A, Morris M, Wluka A, Davis S, FM C: The effect of the knee adduction moment on tibial cartilage volume and bone size in healthy women. *Rheumatology* 2004 , 43:311-314.

[22] Wada M, Maezawa Y, Baba H, Shimada S, Sasaki S, Nose Y: Relationships among bone mineral densities, static alignment and dynamic load in patients with medial compartment knee osteoarthritis. *Rheumatology* 2001, 40:499-505.

[23] Shrader M, Draganich L, Pottenger L, Piotrowski G: Effects of knee pain relief in osteoarthritis on gait and stair-stepping. *Clinical Orthopaedics and Related Research* 2004 , 421:188-193.

[24] Sharma L, Hurwitz DE, Thonar E, Sum JA, Lenz ME, Dunlop DD, Schnitzer TJ, Kirwanmellis G, Andriacchi TP: Knee Adduction Moment, Serum Hyaluronan Level, and Disease Severity in Medial Tibiofemoral Osteoarthritis. *Arthritis & Rheumatism* 1998 , 41(7):1233-1240.

[25] Fransen M, Crosbie J, Edmonds J: Physical therapy is effective for patients with osteoarthritis of the knee: a randomized controlled trial. *Journal of Rheumatology* 2001 , 28(1):156-164.

[26] Huang M-H, Lin Y-S, Yang R-C, Lee C-L: A comparison of various therapeutic exercises on the functional status of patients with knee osteoarthritis. *Semin Arthritis Rheum* 2003 , 32(6):398-406.

[27] Mikesky AE, Meyer A, Thompson KL: Relationship between quadriceps strength and rate of loading during gait in women. *Journal of Orthopaedic Research* 2000 , 18(2):171-175.

[28] Chang A, Hayes K, Dunlop D, Song J, Hurwitz D, Cahue S, Sharma L: Hip abduction moment and protection against medial tibiofemoral osteoarthritis progression. *Arthritis & Rheumatism* 2005, 52(11):3515-3519.

[29] Mundermann A, Dyrby C, Andriacchi T: Secondary gait changes in patients with medial compartment knee osteoarthritis: increased load at the ankle, knee, and hip during walking. *Arthritis & Rheumatism* 2005 , 52:2835-2844.

[30] Kellgren JH, Lawrence JS: Radiological assessment of osteo-arthrosis. Ann Rheum Dis 1957 , 16(4):494-502.

[31] Altman R, Asch E, Bloch D, Bole G, Borenstein D, Brandt K, Christy W, Cooke T, Greenwald R, Hochberg M, *et al.*: Development of criteria for the classification and reporting of osteoarthritis. Classification of osteoarthritis of the knee. *Arthritis and Rheumatism* 1986 , 29:1039-1049.

[32] Andriacchi T: Dynamics of knee malalignment. *Orthopedic Clinics of North America* 1994 , 25(3):395-403.

[33] Thorp L, Sumner D, Block J, Moisio K, Shott S, Wimmer M: Knee joint loading differs in individuals with mild compared with moderate medial knee osteoarthritis. *Arthritis & Rheumatism* 2006 , 54(12):3842-3849.

[34] Andriacchi T, Mundermann A, Smith R, Alexander E, Dyrby C, Koo S: A framework for the *in vivo* pathomechanics of osteoarthritis at the knee. *Annals of Biomedical Engineering* 2004. , 32(3)

[35] Martin H, Yule V, Syddall H, Dennison E, Cooper C, Aihie Sayer A: Is handheld dynamometry useful for the measurement of quadriceps strength in older people? A comparison with the gold standard Bodex dynamometry. *Gerontology* 2006 , 52:154-159.