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Effectiveness of strengthening of chief pelvic stabilizer on hip abductor torque in osteoarthritis knee

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Abstract
Background: Osteoarthritis knee is the most common degenerative condition affecting the age greater than 40 years leading to pain, functional disability and muscle weakness. Physiotherapists have been exploring different forms of exercise intervention, like conventional exercise, resisted exercise, aerobic exercise etc. Despite the number of studies showing evidence on particular intervention towards outcome measure, evidences are still needed for proving usefulness chief pelvic stabilizer i.e. hip abductor muscle strengthening as a treatment for of OA knee patients.
Objective: To evaluate the efficacy of chief pelvic stabilizer i.e. hip abductor muscle strengthening exercises in patient with OA knee.
Intervention: 58 individuals with OA knee were included and allocated to two groups (n=29 in each group). Groups were administrated with hip abductor strengthening exercises along with Conventional therapy and Conventional therapy alone for 4 weeks (5 days per week). Hip abductor torque was used to assess changes between baseline and post intervention.
Results: The experimental group (Group A) was associated with significant greater change in hip abductor torque, compare to control group (Group B).
Conclusion: Strengthening of pelvic stabilizer improves the hip abductor torque and in OA knee and reduces biomechanical load from the knee joint.

Keywords: OA Knee, hip abductor strengthening, hip abductor torque, conventional exercises

Introduction
Hip muscle weakness occurs as consequence of OA knee and mechanism behind it is same as quadriceps weakness. i.e. because of pain functionality is reduced that lead to less activation of muscle causing atrophy of muscle fibers leading to muscle weakness [1, 2, 3]. People with knee OA demonstrate significant weakness of the hip musculature. Hip abductor muscle weakness leads to impaired control of pelvis in frontal plane which results in drop of pelvis towards opposite side which ultimately results into shifting of center of mass away from the stance limb towards swing side. That causes excessive loading at medial knee joint of stance limb which results in pain and functional abnormality [2, 4]. Weaker hip abductors associated with lower external hip rotation moment on the osteoarthritis stance limb would result in additional pelvic drop of the contralateral swing limb, shifting the body's COG towards swing limb. This would lengthen the lever arm at the Osteoarthritc knee, thus increasing medial knee load provoking the disease progression Hinman *et al.* concluded that People with knee OA demonstrate significant weakness of the hip musculature. Findings from this study support the inclusion of hip strengthening exercises in rehabilitation programs [3]. Zhang *et al.* concluded that weakness of hip abductor in OA knee leading to shifting of pelvis on contralateral side. That causes more loading of medial knee joint causing provocation of the condition [5]. K.L. Bennell *et al.* concluded that isolated strengthening of the hip muscles improves symptoms and functionality in the patients with OA knee [6, 7, 8]. Shakoor N. *et al.* concluded that significant improvements in knee pain and functionality in the patients with OA knee following the standard quadriceps strengthening exercise. Khalil Khayambashi *et al.* concluded that hip abductor strengthening is effective in improving pain and health status compare to quadriceps strengthening in female with PFPS [8]. So the incorporation of hip abductor strengthening should be considered while designing a rehabilitation protocol.

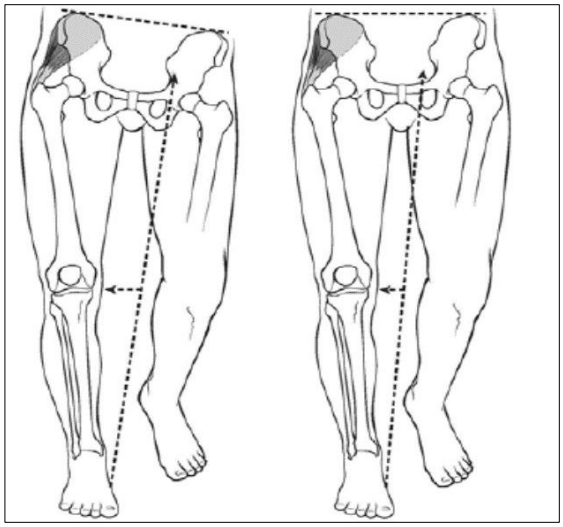


Fig 1: Hip abductor weakness leading to increase stress at medial compartment of knee joint [2].

Methodology

Procedure of the study

- Study Design: Experimental
- Study Duration: 1 Year
- Study Population: Patients with Osteoarthritis of knee Joint
- Sampling Technique: Purposive sampling
- Sample Size Calculation
- Sample size was calculated on G*power software. Based on previous studies estimated sample size of 25 participants in each group. By taking into account a probable 15% drop out rate, the sample size is increased by 4 patients in each group – 29 participants per group; so total 58 patients were included in this study.

Inclusion Criteria

- Age 40 to 65 years.
- Both Male and Female
- Patient with knee pain, crepitation, stiffness of joint.
- Average knee pain >4 on an 11-point scale [NPRS] (0 =no pain; 10 = maximal pain)
- Patient with Grade- 2 & 3 OA knee as per Kellgren-Lawrence classification.
- BMI should be within this range: 18.5 to 24.9.

Exclusion Criteria

- Any inflammatory arthritis
- Patients who have taken intra-articular corticosteroid or hyaluronic injections within last 6 months,
- History of hip or knee joint replacement or tibial osteotomy,
- Unable to ambulate without assistive device.

Tools and Materials Used

- Weighing Scale
- Belt (Non- elastic)
- Measure tape
- Informed consent form
- Data recording sheet

Procedure

Group-A (experimental group)

- Hip abduction in side lying
- Isometric hip abduction
- Hip abduction in standing
- Along with these exercises subjects in experimental group also received the conventional
- exercise as described in

Group – B. Group-B (Control Group) [11].

- Static quadriceps exercise
- VMO strengthening exercise using boister
- Terminal knee extension in high sitting position
- Outer range knee extension exercise
- Inner range knee extension exercise

Outcome

Pre and post treatment hip abductor torque was measured by using Spring Weighing scale. As Reliability of Spring weighing Scale is very high (ICC- 0.998) for measurement of hip abductor strength (12). Using a spring weighing scale hip abductor strength was measured. The instrument was kept horizontally over the floor. Top end of the instrument was kept fixed and bottom end contenting hook was attached to the belt loop. Belt is of non-elastic material. Subject was asked to stand by keeping the loop at the lateral malleoli of affected lower extremity and then subject was asked to abduct the leg. Pulling weight in kilograms was measured. Both the feet were at equal horizontal level. Reading was taken thrice and average of those reading was considered. Patient was allowed to do a trial performance prior taking three final readings (12). This measurement was taken before the treatment and at the end of 4th week of treatment.

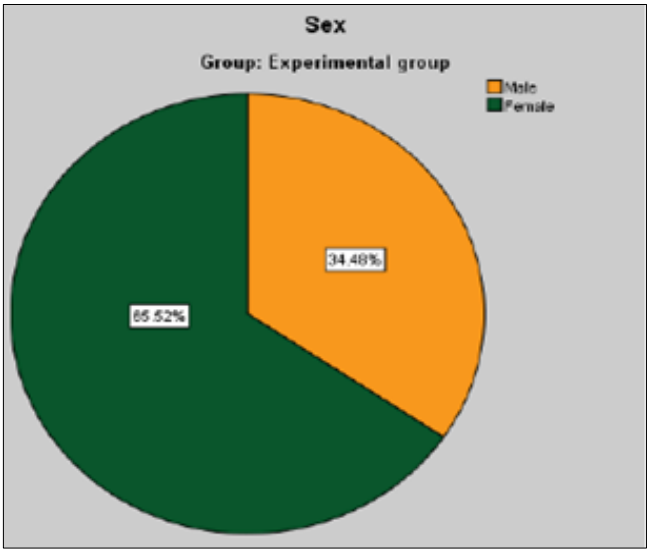
Torque = (force * moment arm) ÷ Body Weight [13, 14, 15].

Where Force is in newton, Moment-arm is in meter and body weight is in kilogram. Moment- arm length for torque calculation was based on taking limb length measurement. The moment - arm was taken from ASIS to the medial malleolus minus 5 cm (16).

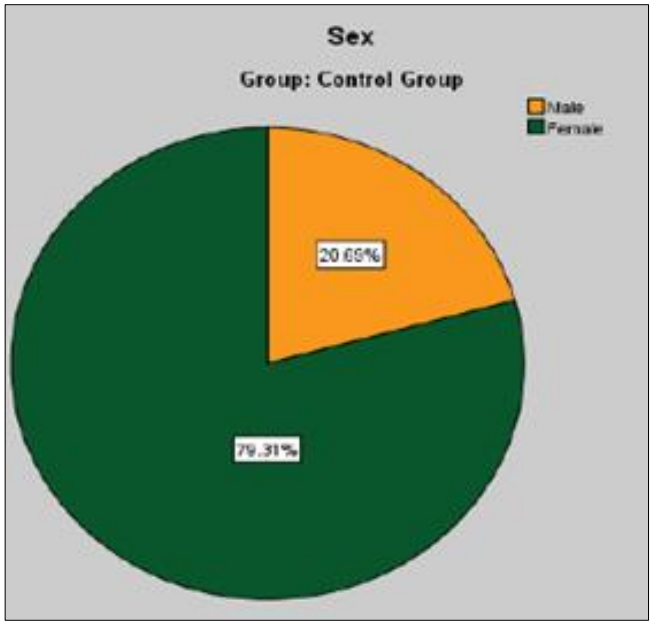
Data analysis and Results

- IBM SPSS version 20.00 was used for Data Analysis.
- Normality was checked by Shapiro Wilk Test.

Baseline was checked by Mann Whitney U-Test.



Graph 1: Demographic data in experimental Group



Graph 2: Demographic data in experimental Group

Table 1: Normality Test

Outcome	p Value by (Shapiro-Wilk test)
Hip abductor torque	0.00

As the p values for all the outcome is less than 0.05 (<0.05) that indicates data are not normally distributed.

Table 2: Baseline Equality

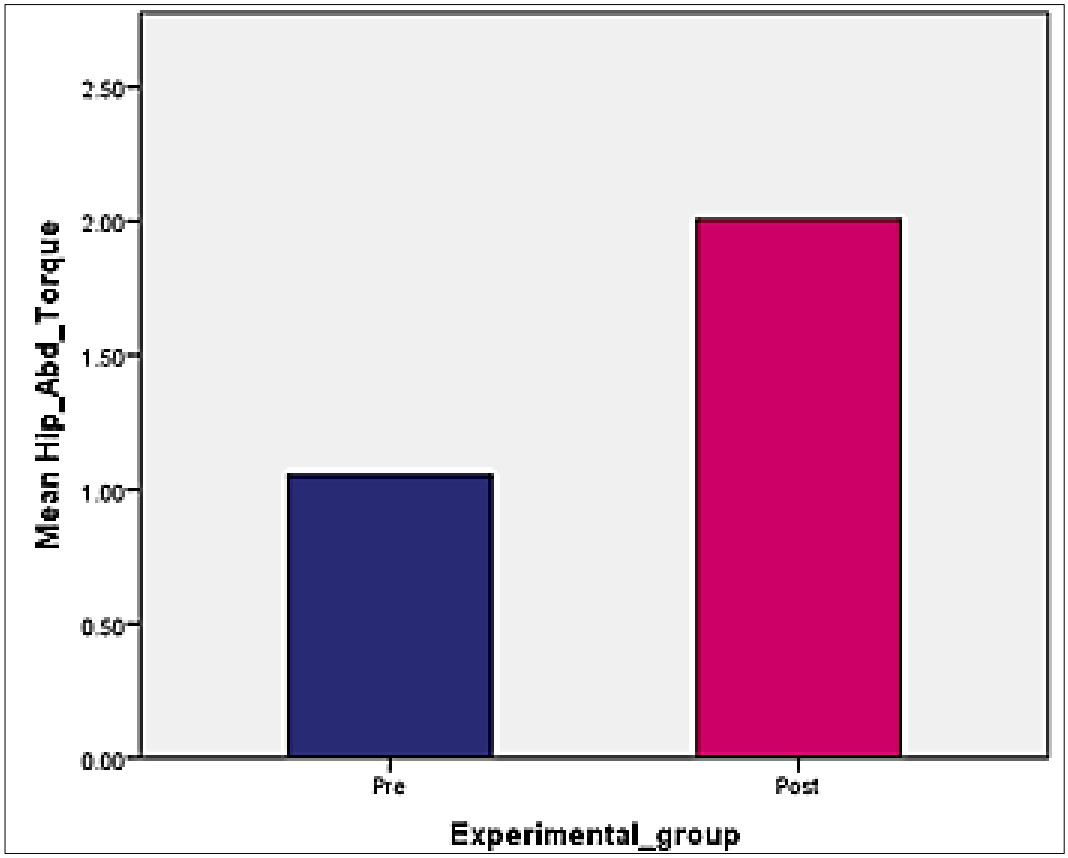
Outcome	p Value by (Independent samples Mann-Whitney U test)
Hip abductor torque	0.083

As the data are not normally distributed non-parametric test (independent samples Mann- Whitney U test) for baseline assessment has been used.
As the p values for all the outcome is greater than 0.05 (>0.05) that indicates Baseline for both outcome is equal.

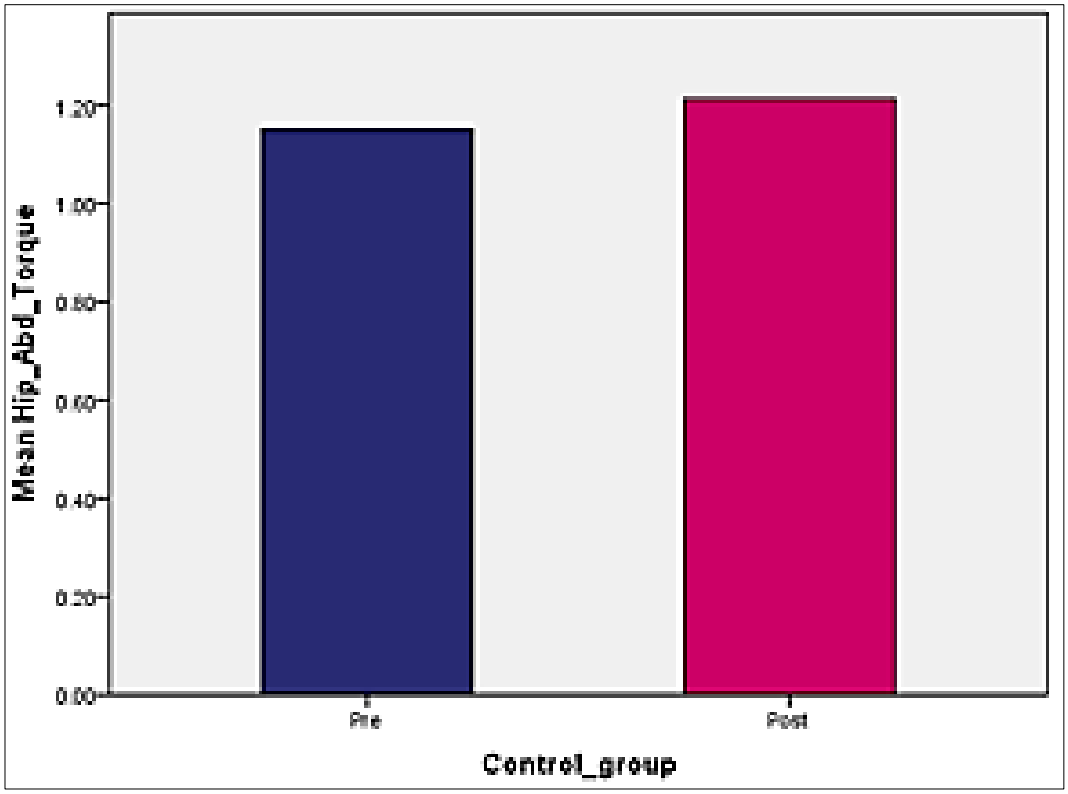
Table 3: Within Group Comparison Related sample Wilcoxon Signed Rank test

Variable	Level	Mean±SD	Z value	P value
Hip Abductor Torque (Experimental group	Base	1.06 ± 0.15	-4.70	0.00
	4th Week	2.0 ± 0.43		
Hip Abductor Torque (Control group)	Base	1.15±0.22	-2.62	0.009
	4th Week	1.21±0.18		

Result shows significant difference between baseline and 4th week (p< 0.05) in both the groups



Graph 3: Pre-Post Hip Abductor Torque in Experimental Group

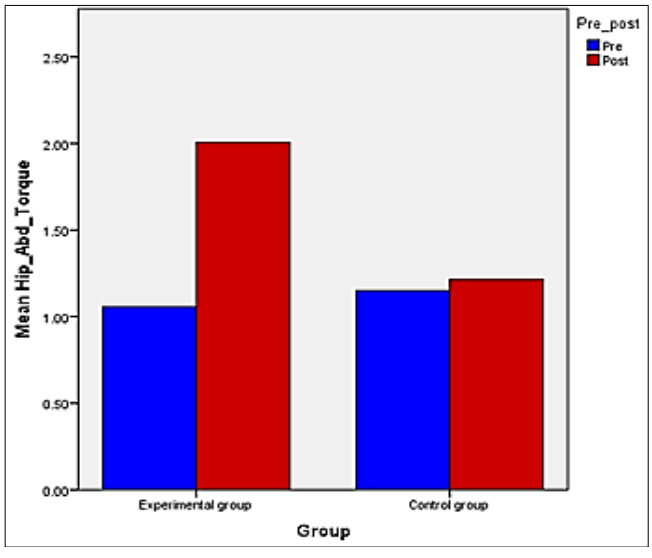


Graph 4: Pre-Post Hip Abductor Torque in Control Group

Table 4: Between Group Comparison Independent Sample Mann – Whiteney U test

Variable	Level	Mean±SD (Experimental group)	Mean±SD (Control group)	Z value	P value
Hip Abductor Torque	Base	1.06 ± 0.15	1.15±0.22	-1.73	0.083
	4th Week	2.0 ± 0.43	1.21±0.18	-6.19	0.00

Result shows significant difference between two groups at the end of the 4th week as $p< 0.05$.



Graph 5: Between Groups comparison of pre-post hip abductor torque

Discussion

As earlier mentioned in result between groups comparison was done by using independent sample Mann Whitney U test for hip abductor torque. That shows significant difference in experimental and control group. As mean of hip abductor torque of experimental group at 4th week is 2.00±0.43 of hip abductor torque of control group at 4th week 1.21±0.18.So, experimental group shows better statistical and clinical improvement (Table - 4).The result showed remarkable improvement in Hip abductor Torque in experimental group compare to control group. Results showed clinically significant improvement in hip abductor strength As MDC for hip abductor torque – 0.07.So, Pelvic stabilizer should be included in protocol of OA knee in order to improve hip abductors strength which has a greater impact in stabilization of pelvis. In this way the Biomechanical load over the medial compartment of Knee joint can be reduce, which helps in delaying of progression of the condition.

Khalil Khayambashi *et al.* [8] checked the effectiveness of isolated hip abductor and external rotator strengthening in subjects with patella-femoral pain syndrome. They had taken two groups. First one experimental group received hip strengthening exercises and other group was control group with no intervention. That study revealed that hip strengthening exercises Significantly decreases pain and improves health status compare to control group. When we Compare the baseline results of experimental group of Present study with this study there was no Significant difference. But the present study reveals that hip abductor strengthening along with conventional exercises improves hip abductor strength, functionality and reduces pain in 4 weeks only Both Where as in this study they have mentioned the improvement in condition in 8weeks and follow up of 6 months. So, present study shows improvement earlier compare to this study.

Chang *et al.* studied that weaker hip abductors associated with lower external hip rotation moment on the osteoarthritic stance limb would result in additional pelvic drop of the contralateral swing limb, shifting the body's COG towards swing limb. This would lengthen the lever

arm at the Osteoarthritc knee, thus increasing medial knee load provoking the disease progression [17]. On the bases of that K.L. Bennell *et al*. did study on hip abductor strengthening to check external hip adduction moment, pain and functionality [15]. The results of their study concluded that hip strengthening reduces the pain, improves functionality and improve muscle strength in 13 weeks of intervention. Where as in present study all this benefits i.e. reduced pain, improved functionality, improved muscle strength occurs with combined hip abductor strengthening and conventional exercise i.e. quadriceps exercise within 4 weeks only.

Elizabeth Sled *et al*. checked the effect of home exercise program of hip abductor exercise in OA knee.40 subjects were recruited for experimental group and were asked to perform exercise 4 times per week up to 8 weeks. results of this study shows improvement in strength, functionality, reduces pain at the end of the 8 week and it is also compare with the control group i.e. group with no intervention [14]. Where in present study comparison is done between two groups in which both groups are receiving conventional therapy but experimental group was receiving additional hip abductor strengthening program. Positive results were obtained within 4 weeks.

Hip abductor weakness is associated in OA knee and mechanism behind that is same as quadriceps weakness that is because of pain functionality is reduced. That causes atrophy of the muscle fiber leading to weakness of hip abductors. That results in additional pelvis drop on the contralateral side, shifting the body's COG towards contralateral side increasing medial knee load provoking the disease [17]. So, by strengthening the hip abductor muscle further provocation of the condition can be delayed; symptoms can be reduced and functionality can be improved.

Limitation

- Result cannot be generalized to entire OA knee population as this study is having criteria regarding age, BMI, grade of OA.

Future Recommendation

- As this RCT is focused over only one outcome i.e. hip abductor torque, in the next studies importance of Pelvic stabilizers on other outcomes can be checked.
- The study should have a follow up in order to evaluate the consistency of effectiveness of hip abductor strengthening exercise that is maintained or not over the period of time.

Conclusion

- This study reveals that hip abductor strengthening can be considered for the treatment of OA knee. As hip abductor strengthening along with conventional therapy improves hip abductor torque Pelvic stabilizer should be included in protocol of OA knee in order to improve hip abductors strength which has a greater impact in stabilization of pelvis. In this way the Biomechanical load over the medial compartment of Knee joint can be reduce, which helps in delaying of progression of the condition.

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