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Effect of hip muscles strengthening versus quadriceps strengthening in patients with osteoarthritis knee- A comparative study

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Abstract
Background: Osteoarthritis (OA) of knee is very common in middle-aged patients. Women have a greater tendency than men. One in three people over 60 years is affected and more than three in four persons over the age of seventy show some radiographic evidence of the condition. Knee OA is responsible for more disability in walking, stair climbing and housekeeping in non-institutionalised people aged 50 years and over than any other disease.
AIM: The main aim of the study was to compare the effectiveness of the hip muscles strengthening and quadriceps strengthening in patients with OA knee.
Methodology- 30 patients with OA knee were selected and randomly divided into two groups. Group A (hip muscle strengthening) and Group B (quadriceps strengthening). The treatment was given 3 days a week of 4 weeks. The WOMAC scale and NPRS were used for the pain and functional status for as outcome measure were taken before and after 4 weeks of treatment.
Results: Paired t test was used to compare the pre and post values of the intra groups and unpaired t test was used to compare the inter groups. After treatment the result shows a significant improvement in both the groups. But the group A was more effective than the group B.
Conclusion: The study shows that the hip muscles strengthening is more effective than the quadriceps strengthening.

Keywords: osteoarthritis, knee, quadriceps, hip muscles

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). [1] The typical radiographic features are the formation of osteophytes at the joint margins, joint space narrowing, subchondral sclerosis, subchondral cyst formation and chondrocalcinosis. [2]
Among all the joints in the body, osteoarthritis affects the knee joints most and it could be primary or secondary. The knee is the most common weight-bearing joint. [3]
OA experience increasing difficulty with daily functional activities. In fact, knee OA is responsible for more disability in walking, stair climbing and housekeeping in non-institutionalised people aged 50 years and over than any other disease.[4]Altered biomechanics, resulting in increased joint loading rate or localised stress in the articular cartilage, has an important role in both the initiation and progression of knee OA. [5]
Regular exercise can improve physiological impairments associated with osteoarthritis including muscle strength, joint range of motion, proprioception, balance and cardiovascular fitness. Exercise therapy for patients with osteoarthritis of knee has significant impact on muscle weakness, pain and function in osteoarthritis. [6]
Hip muscles strength has the potential to alter knee load. [7] The hip abductors have been likened to the “rotator cuff of the hip”, with the gluteus medius and gluteus minimus. [8]
Strengthening of the hip musculature could help improve lower extremity alignment and tracking of the patella, reducing excessive retropatellar joint pressure and ultimately leading to decreased pain and improved function. [9]
Quadriceps is known as the powerhouse of the knee. A strong quadriceps helps to protect the knee and reduces the load on it and thereby reduces the pain in the knees. [3]
Coordination of the activity of the medial and lateral components of the quadriceps femoris muscle influences patellar tracking. [10]

Need of the Study
The purpose of the current study was to compare the effectiveness of hip muscles strengthening and quadriceps strengthening in reducing pain and improving function in patients with osteoarthritis of knee, as limited evidence is available regarding effect of hip muscles strengthening in improving pain and functional status in OA knee

Methods and Materials
Inclusion criteria
1. Age 40 to 60 years
2. Clinically diagnosed OA knee by orthopedician
3. Morning pain & stiffness

Exclusion criteria
1. Fix flexion deformity (FFD)
2. Recent history of trauma
3. Any neurological involvement

Outcome Measures
1. WOMAC Scale
2. NPRS

Data Collection Procedure
All patients were diagnosed clinically to have Osteoarthritis of knee by orthopaedic doctor. The procedure was clearly explained to all the patients and their consent was obtained prior to study. All subjects were randomly divided in to two groups. In group A, Hip muscles strengthening (N=15). In group B, Quadriceps strengthening (N=15). All the subjects were examined for pre-treatment scores of WOMAC scale and NPRS scale. Post treatment scores of WOMAC scale and NPRS scale were taken after 4 weeks.

Intervention
- Patient visited 3 times a week of 4 weeks individually.
- Each session consisted of 5 minutes of warm-up (walking), 20 minutes of directed exercise, and 5 minutes of cooldown (walking).
- Resistance and repetitions were progressed as in table no.1

Table 1

Standarized exercise progression using theratube				
Week	**Set-1**	**Set-2**	**Set-3**	**Frequency/week**
1	Red(20)	Green(20)	Blue(20)	3
2	Red(25)	Green(25)	Blue(25)	3
3	Green(20)	Blue(20)	Black(20)	3
4	Green(25)	Blue(25)	Black(25)	3

Group A
1. Hip abductor strengthening was performed with patients positioned side lying on a plinth. Theratube was tied just above the ankle at one end and attached to the bottom of the plinth at the other (fig.1). The exercise was performed against the resistance by abducting the hip from 0º to 30º. [11]

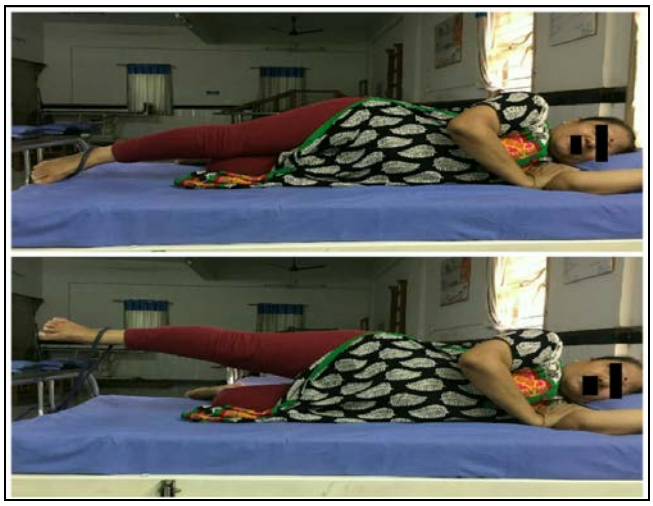


Fig 1

2. Hip external rotator strengthening was performed with patients seated at the edge of a plinth and the knee flexed to 90º (fig.2). Theratube was tied around the ankle and was secured to a rigid pole.The exercise was performed against the resistance by externally rotating the hip from 0ºto 30º. [11, 12, 13, 14]

Fig 2

Group B
1. The patient was seated at the edge of a treatment table, and the knee was flexed to 30º (fig.3). Theratube was tied around the ankle and was secured to the bottom of the treatment table. Patients performed the exercise against resistance by extending the knee from 30º of knee flexion to full knee extension. [11, 15, 16]

Fig 3

2. Patients stood with theratube passing beneath both feet while holding one end of the tube in each hand (fig.9). Patients then performed a partial squat against Resistance from the start position to full knee extension while squeezing a ball between both knees. [12. 13. 15. 17]

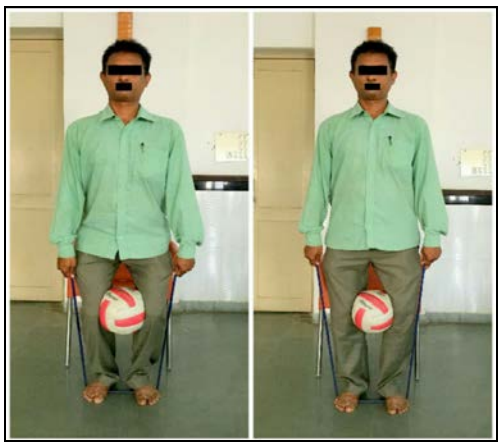
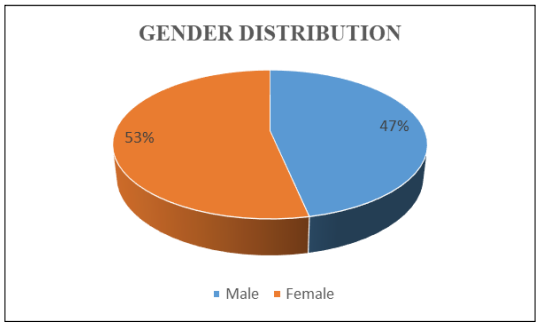


Fig 4

Result and Data Analysis

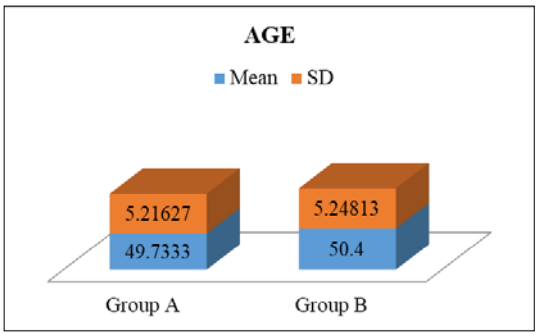
- The data were obtained before the treatment and after the 4 weeks of treatment for the statistical analysis.
- Paired t test was used for the comparison between the pre and post value of outcome measures within the groups.
- Unpaired t test was used for the comparison between the group A and group B values of outcome measures within the groups.

1. Gender Distribution



Graph 1

2. AGE



Graph 2

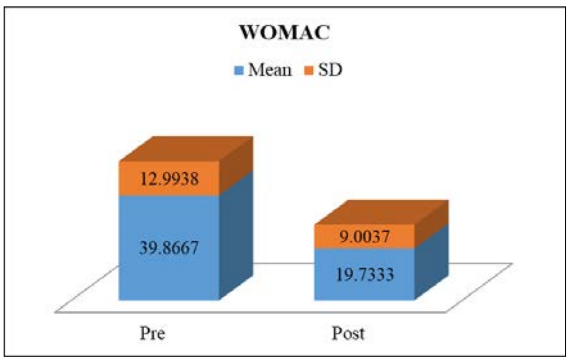
Intra Group Comparison

3. Group A

- Table no.2 displays the values of pre and post of the WOMAC scale for the hip muscles strengthening exercises.

Table 2

WOMAC	MEAN	SD	t value	P value
Pre	39.8667	12.9938	14.174	<0.0001
Post	19.7333	9.0037		

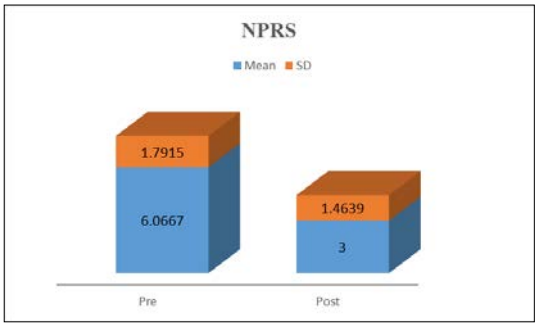


Graph 3

- Table no.3 displays the values of pre and post of the NPRS for the hip muscles strengthening exercises.
- Paired t-test was used to compare.

Table 3

NPRS	MEAN	SD	t value	P value
Pre	6.0667	1.7915	14.869	<0.0001
Post	3.00	1.4639		



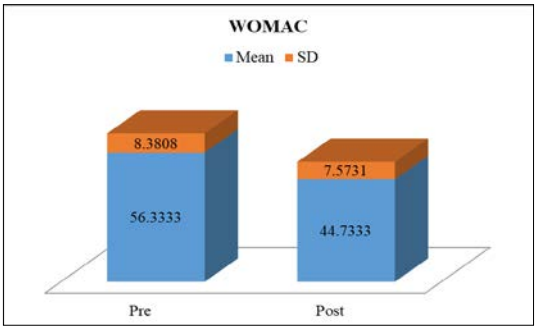
Graph 4

4. Group B

- Table no.4 displays the values of pre and post of the WOMAC scale for the quadriceps strengthening exercises.

Table 4

WOMAC	MEAN	SD	t value	P value
Pre	56.3333	8.3808	22.149	<0.0001
Post	44.7333	7.5731		

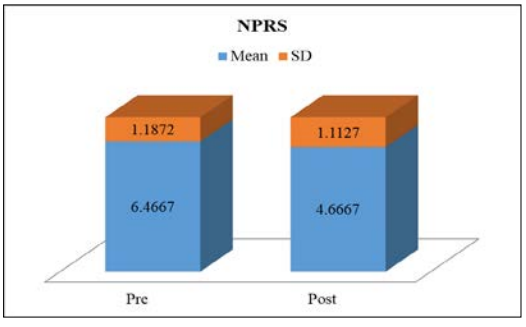


Graph 5

- Table no.5 displays the values of pre and post of the NPRS for the quadriceps strengthening exercises.

Table 5

NPRS	MEAN	SD	t value	P value
Pre	6.4667	1.1872	10.311	<0.0001
Post	4.6667	1.1127		



Graph 6

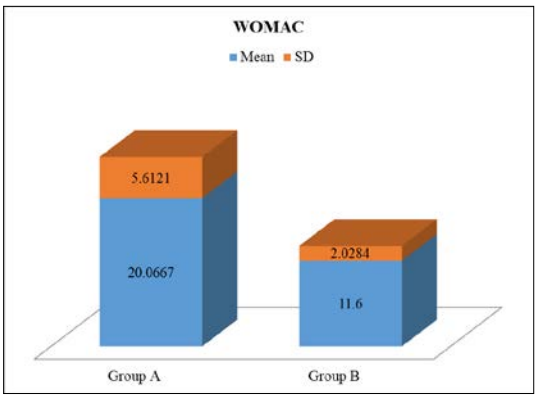
Inter Group Comparison

5. Group A V/S Group B

- Table no.6 displays the values of WOMAC scale between Group A and Group B.

Table 6

WOMAC	MEAN	SD	t value	P value
GROUP A	20.0667	5.6121	5.49	<0.0001
GROUP B	11.600	2.0284		

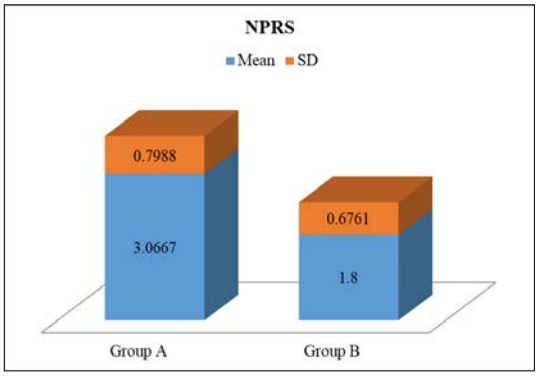


Graph 7

- Table no.7 displays the values of NPRS between group A and Group B.

Table 7

NPRS	MEAN	SD	t value	P value
GROUP A	3.0667	0.7988	4.688	<0.0001
GROUP B	1.8000	0.6761		



Graph 8

Interpretation of Result

Intra group analysis for hip muscles strengthening (table no.3 and 4) and quadriceps strengthening (table no.5 and 6) shows the comparison of pre and post for reduce pain and improve functional status. The comparison done through paired t test. The p value comparison pre and post treatment score of WOMAC is 0.0001 while for NPRS is 0.0001. The p value is <0.05 which shows that both intra groups are significant in reduce pain and improve functional status.

Inter group analysis of hip muscles strengthening v/s quadriceps strengthening (table no.7 and 8) shows the comparison between two groups (A and B) of WOMAC scale and NPRS for reduce pain and improve functional status. The comparison done through unpaired t test. The MEAN±SD values are comparing group A and group B (table no.7 and 8) which shows that both group A (hip muscles strengthening) (Mean±SD=20.0667±5.6121 and 3.0607±0.7988) is more effective than group B (quadriceps strengthening) (Mean±SD=11.600±2.0284 and 1.8000±0.6761).

Discussion

Both the hip muscles strengthening program and the quadriceps strengthening program decreased pain and improved the functional status in patients with OA knee.But, the decreases in pain and improvements in functional status were greater in patients who received the hip strengthening exercises than in patients who received the quadriceps strengthening exercises.

Recent evidence, however, suggests that hip muscles strength may be important for reducing the knee adduction moment. [18] During walking, hip muscles stabilise the pelvis on the hip joint in the frontal plane. The position of the pelvis can alter the position of the body's centre of mass and thereby alter loads at the knee joint. [18, 19] The knee adduction moment has been shown to relate to radiographic disease severity, [20, 21, 22, 23] varus alignment, [21, 24, 25, 26] and knee pain. [24, 25, 27, 28]

Researchers have proposed that during the single-limb stance phase of gait, weakness of the stance-limb hip abductor muscles may lead to drop of the pelvis toward the contralateral limb, shifting the body's center of mass away from the stance limb toward the swing side. These adjustments, theoretically, could lead to higher knee adduction moments and greater medial knee joint loading. Thus, increasing the strength (force-generating capacity) of the hip abductor muscles and controlling the pelvis in the frontal plane might reduce joint loading and have a disease-modifying effect. [18, 29] Khayambashi *et al* reported that 8 weeks of hip abductor and external rotator strengthening shows reduced pain and improved health status in patients with OA knee compared to the control group. The hip external rotators helps in weight bearing at knee joint and it reduces the joint load over medial side of the knee.

In subjects with knee OA, pain is typically increased by load bearing and relieved by rest. Quadriceps weakness have been attributed to disuse atrophy of the muscle as the patient minimizes painful weight-bearing activities. In addition, quadriceps weakness may precede and serve as a risk factor for incident radiographic changes of knee OA.

Quadriceps strengthening exercises are commonly prescribed for patients with knee OA because they can reduce pain and improve function. [30, 31]

Boon-Whatt Lim's study showed that Quadriceps strengthening did not have any significant effect on knee adduction moment in participants with either more malaligned or more neutrally aligned knee OA. But, the benefits of quadriceps strengthening on pain were more evident in those with more neutral alignment.

We found that quadriceps strengthening is effective to reduce pain and improve function in patients with OA knee. But the hip muscles strengthening is more effective in patients with OA knee.

Conclusion

Both the treatment hip muscles strengthening and quadriceps strengthening are effective in patients with OA knee. But the hip muscles strengthening is more effective treatment than quadriceps strengthening in improving pain and functional status in patients with OA knee.

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