



ISSN Print: 2394-7500  
ISSN Online: 2394-5869  
Impact Factor: 5.2  
IJAR 2020; 6(7): 124-128  
[www.allresearchjournal.com](http://www.allresearchjournal.com)  
Received: 20-05-2020  
Accepted: 25-06-2020

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## Effectiveness of Hip musculature strengthening on pain and functional level in patellofemoral joint osteoarthritis

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### Abstract

**Background:** Osteoarthritis is a degenerative disease and is marked by two localized pathological features namely progressive destruction of articular cartilage and the formation of bone at the margins of the joint. The disease mainly affects large weight bearing joints bilaterally (e.g. hip, knee) and confines itself to the affected joint. Extremely common condition after 40 years of age. At knee joint, osteoarthritis mainly affects the medial compartment of tibiofemoral joint however, patellofemoral joint is also prone to develop OA. Common symptoms of OA are: Pain within the joint, morning stiffness, swelling, crepitus, reduced ROM, reduced strength of surrounding musculature and in advanced cases bony deformities.

**Method:** This was a pre and post type of study. Visual Analogue scale (VAS) and WOMAC were used as outcome measures for pain and function respectively. 30 patients having Patellofemoral osteoarthritis between age group 40-60 years were selected according to inclusion and exclusion criteria. They were treated with conventional protocol combined with hip strengthening exercises for a duration of 6 weeks. Treatment sessions were conducted twice per week.

**Purpose of the study:** To check the effect of Hip strengthening exercises on pain, function in patients with Patellofemoral Osteoarthritis.

**Result:** Hip strengthening exercises showed significant improvement in pain and functional level in patients with Patellofemoral Osteoarthritis.

**Conclusion:** The study concludes that hip strengthening protocol is effective in improving pain and function in patients with Patellofemoral Osteoarthritis.

**Keywords:** Osteoarthritis, knee osteoarthritis, patellofemoral osteoarthritis, hip strengthening

### 1. Introduction

Osteoarthritis (OA) is a degenerative type of disease. Pathologically it is marked by two features namely progressive damage to the articular cartilage and formation of bone at the margins of the joint (osteophytes) [3]. Mostly, large weight bearing joints are affected bilaterally (e.g. hip, knee) and the disease restricts itself to the affected joint that is it doesn't spread from one joint to another. It is prevalent after 40 years of age. Most commonly seen in adults older than 65 years of age and affects men more than women before the age of 50 years but the ratio reverses after age 50 [3]. Prevalence is 3.8% of the world's population [1] whereas in Maharashtra, prevalence is 10.2% [5]. Risk factors that show direct relationship with Osteoarthritis are: advanced age, Gender, Obesity, weakness of quadriceps muscle, Major trauma, Genetics, altered joint biomechanics and occupational activities such as jobs that require kneeling and squatting with heavy lifting etc [3]. Generalised symptoms of OA are: Pain, morning stiffness, reduced range of motion (ROM), reduced strength of surrounding musculature and in later stages bony deformities.

Knee joint osteoarthritis primarily affects medial compartment of tibiofemoral joint (joint between medial condyle of femur and medial condyle of tibia) due to higher weight bearing placed on this compartment [3]. However, patellofemoral joint (joint between posterior aspect of patella and patellar notch of femur) is also prone to develop osteoarthritis in isolation because of patellar malalignment, abnormal patellar tracking and direct trauma to patella [3]. According to one study, patellofemoral osteoarthritis was seen in 69% of patients with chronic patellofemoral pain. Clinical features of patellofemoral osteoarthritis include anterior knee pain, a history of significant swelling, genu valgus malalignment, quadriceps muscle

weakness and abnormal pelvic and lower extremity biomechanics. Studies have shown that patients with Patellofemoral OA have weak lower limb muscles notably Quadriceps (hip flexors), hip abductors, hip extensors and hip external rotator muscles. This muscle weakness has been proposed to contribute to patellofemoral malalignment in turn leading to patellofemoral pain and Patellofemoral OA.

Conventional treatment for knee OA primarily focuses on strengthening of quadriceps and not much attention is given on strengthening of other hip muscles which are rather weak in patients with patellofemoral OA. So, this study was done to check the effect of hip strengthening exercises on pain and function in patients with patellofemoral OA at the end of 6 weeks.

## 2. Method

**Ethical Approval:** The study was approved by the institutional ethical committee prior to its commencement. Written and signed consent were obtained from all participants. Also, the participants were assured that the collected data will not be misused in any form.

**Study Design:** This study was a pre and post type of study. 30 participants both male and female within the age group 40-60 years were selected according to the inclusion criteria. Inclusion criteria used for selection of patients was: age between 40-60 years, both genders were included, VAS scores ranging from minimum 1 to  $\leq 7$ [6], hip flexor, extensors abductors and external rotators strength above grade 3 and below grade 5 on MMT, diagnosed by medical physician with knee osteoarthritis in one or both knees with symptoms primarily in anterior knee [1], grade 2 and 3 on Kallgren and Lawrence 5 point classification system, presence of pain in at least 2 of the following activities: ascending and/or descending stairs, sit to stand, squatting, kneeling, prolonged knee flexion, increased activity [1].

Exclusion criteria used while selection of the patient was: participants having other knee conditions causing anterior knee pain, VAS scores more than 7 [6], any cardiovascular conditions [5], any systemic arthritic conditions such as rheumatoid arthritis [5], osteoarthritis grade 2 or below on Kallgren and Lawrence classification system were excluded from the study. Also pregnant females [6], participants those who had used intraarticular corticosteroid injection within past 6 months [8], or those who have history (within past 4 weeks) or are currently using oral steroids [8], participants who are planning to start any other treatment for knee osteoarthritis [8] were also excluded from the study.

**Outcome measures:** Visual Analogue Scale (VAS) for pain measurement, WOMAC for function was used.

**Visual Analogue Scale (VAS):** It is the most widely used scale for rating pain intensity.

Basically, it is a 10cm line ranging from "0" to "10", where "0" indicates 'no pain' and "10" indicates 'worst imaginable pain'. Patient is asked to mark on the line depending upon his/her pain intensity after which therapist measures it with a scale and value is noted accordingly. The test retest reliability of VAS is (0.66-0.77) [9].

**WOMAC:** The Western Ontario and McMaster Universities Arthritis Index (WOMAC) is widely used in the evaluation of Hip and Knee Osteoarthritis. The test retest reliability is good (0.80-0.98) [6] It consists of 24 items divided into 3 subscales: Pain (5 items) Stiffness (2 items) Physical Function (17 items). The test questions are scored on a scale of 0-4, which corresponds to: None (0), Mild (1), Moderate (2), Severe (3) and Extreme (4). The scores for each subscale are summed up, with a possible score range of 0-20 for Pain, 0-8 for Stiffness, and 0-68 for Physical Function. Usually a sum of the scores for all three subscales gives a total WOMAC score.

## 3. Procedure

30 subjects were selected according to the inclusion criteria. Informed consent was obtained from all the participants. After selection, Pre-treatment assessment was done for Pain (VAS) and Function (WOMAC). Treatment session was held twice a week for 6 weeks with each session lasting for approximate 60 minutes. At the end of 6 weeks, post treatment assessment was done for Pain (VAS) & Function (WOMAC).

### A) Conventional protocol:

**1. Pain relief:** Ultrasound [4] (Direct contact method) (Site: over anterior aspect of knee joint, Mode: pulsed, frequency: 1MHz, Intensity: 0.5W/cm<sup>2</sup> Duration: 5 mins)

**2. For swelling reduction:** Cryotherapy [3] at home with ice packs for 10mins twice a day.

**3. To improve ROM:** Mobilisation: Superior and inferior patellar glides and stretching of the tight muscles (Mode: Manual and self-stretching, Hold time: 30 seconds/stretch, Repetitions: 2) [5]

**4. To improve strength:** Initially isometrics, static quadriceps, static hamstrings, static abductors, static adductors 20 repetitions/set [5]. Hold of 6secs each [5].

### 5. Dynamic strengthening exercises:

- VMO: Patient lies supine with a hard roll under the affected knee. Patient is then asked to do active knee extension
- SLR: Patient is in supine position. Patient is asked to raise the leg without bending the knee.

- Prone knee bending: Patient lies in prone position. Patient is asked to bend the affected knee.

### B) Hip Strengthening Exercise Protocol:-

This protocol combines conventional protocol (described above) with strengthening of hip flexors (Quadriceps), Abductors (Gluteus Medius and Gluteus Minimus), Hip extensors (Gluteus Maximus) and Hip external rotators (Gammelli and obturator internus and externus). Resistance was decided according to De Lorme regimen. For all the below exercises: Repetitions<sup>[5]</sup>: 8-10reps/set, Sets<sup>[5]</sup>: 2, Rest interval<sup>[5]</sup>: 2mins

**1. Dynamic Quads (Exercise for Quadriceps Strengthening):** Patient is in high sitting position over the edge of the plinth with hip and knee flexed at 90 degrees. Weight cuff is tied just proximal to ankle joint of the affected extremity. Patient is then asked to actively extend the knee and slowly lower down.



Fig 1: Dynamic Quads

**2. Exercise for Hip Abductor strengthening:** Patient is in side lying position with affected extremity uppermost. Knee of the lower extremity is flexed for stability. Weight cuff is tied just proximal to ankle



Fig 4: Prone SLR

### 3. Stastical Analysis

Data analysis was done using outcome measures Visual Analogue Scale (VAS), Western Ontario McMaster Arthritis Index (WOMAC) with the help of GraphPad in stats. Pre and post data analysis for VAS and WOMAC was done by students paired t-test. Any

joint. Patient is then asked to raise the leg up without bending the knee.



Fig 2: Side Lying SLR

### 3. Clam Exercise (for hip External Rotators Strengthening)

Patient is in side lying position. Both the lower extremities are partially flexed at hip, and heel of the top leg is resting on the heel of bottom leg. Ask the patient to lift the knee of top leg, keeping heels together. Weight is applied to the top leg.[5]



Fig 3: Clam exercise

### 4. Prone SLR (for Hip Extensors Strengthening)

Patient is in prone position. Weight is tied at the ankle joint of the affected extremity. Therapist stabilizes the pelvis. Patient is then asked to raise the leg without bending the knee & slowly lower down.

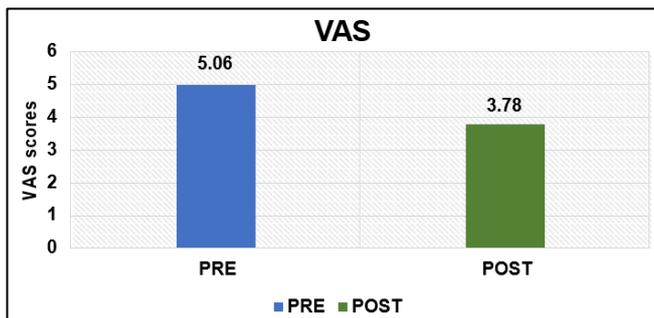
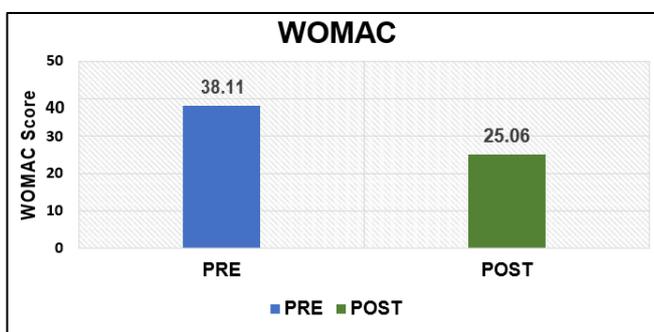
value  $<0.05$  will be considered significant and any value  $>0.05$  will be considered not significant.

### 4. Result

Pre and post data analysis for VAS and WOMAC is as follows:

**Table 1:** Table representing pre-treatment and post-treatment mean of VAS and WOMAC along with standard deviation, p value, t value and result

Outcome measure	Pre- treatment mean & sd	Post- treatment mean & sd	T value	P value	Result
Vas	5.06± 2.046	3.78± 1.178	5.952	<0.0001	Extremely significant
Womac	38.11± 4.84	25.06± 8.19	4.43	<0.0001	Extremely significant

**Graph 1:** Graph representing pre-treatment and post-treatment mean values of VAS.**Graph 2:** Graph representing pre-treatment and post-treatment mean values of WOMAC.

The statistical analysis revealed clear trend towards improvement in pain and function.

## 5. Discussion

Knee Osteoarthritis or in general OA, is an extremely common degenerative disease characterized by pain, swelling, stiffness, reduced ROM and reduced strength of nearby muscles. The present study was done to check the effect of hip strengthening exercises on pain and function in patients with patellofemoral OA. This study included 30 subjects in the age group 40-60 years. The number of male subjects were more than female subjects. Hip strengthening exercises were given along with conventional therapy which included ultrasound, stretching of tight muscles, knee isometrics and general hip and knee AROM exercises. The duration of the protocol was 6 weeks with treatment given for 2 days/week. When pre and post analysis was done it showed that hip strengthening was significantly effective in improving pain, function. The data was analyzed by student paired t test, which showed measurable statistical difference in both the outcome measures. Theresa *et al* and Falah *et al* in their study state that strengthening of hip muscles (abductors, external rotators and extensors) other than Quadriceps was effective in improving pain and health

status in patients with patellofemoral OA. Strengthening of these muscles made correct the patellar malalignment thus improving pain and in turn functional level. Therefore, strengthening of quadriceps, hip abductors, hip extensors and hip external rotators can be given along with conventional physiotherapy in order to improve pain and function in patients with patellofemoral OA.

## 6. Conclusion

As per our results and statistical analysis, this study concludes that hip strengthening protocol is effective in improving pain and function in patients with patellofemoral Osteoarthritis.

## 7. Limitation

Leg dominance and also duration of pain (acute/chronic) was not considered.

## 8. Future Scope

Larger sample size could be considered. Only acute or only chronic cases could be considered.

## 9. Abbreviations

OA: Osteoarthritis ROM: Range of Motion

VAS: Visual Analogue Scale

WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index VMO: Vastus Medialis Obliquus

SLR: Straight Leg Raise

## 10. Acknowledgment

We thank all the participants who participated in the study for their cooperation.

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