COMPARISON BETWEEN THE COMBINED EFFECTS OF STRENGTHENING EXERCISES TO KNEE EXTENSORS AND HIP ABDUCTORS VERSUS STRENGTHENING EXERCISES TO HIP ABDUCTORS ALONE ON Q ANGLE IN PATIENTS WITH KNEE OSTEOARTHRITIS

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Abstract

Knee osteoarthritis is steadily becoming the most common cause of disability for the middle aged and has become the most common cause of disability for those over the age of 65. Objective of the study was to study the combined effect of knee extensor and hip abductor strengthening exercises with hip abductor strengthening exercises alone on Q angle and functional performance in patients with knee osteoarthritis. 90 subjects aged 45 – 70 years with grade 3 knee osteoarthritis (Kellgren–Lawrence grading scale) were made part of the study based on inclusion and exclusion criteria and were divided into three groups named A, B and C. Group A received knee extensors and hip abductors strengthening exercises with conventional physiotherapy treatment. Group B received hip abductors strengthening exercises with conventional physiotherapy treatment. Group C received conventional physiotherapy treatment. Total duration of exercise program was 45- 50 minutes. The exercise program was given on alternate days with a total of 24 sessions and progression of the activity was made within the tolerance of the patient. Pre and post treatment readings were taken of Q angle, pain and functional performance. Results were analyzed using paired and unpaired t- test and ANOVA. Results showed that there is significant difference between strengthening exercises of knee extensors and hip abductors and strengthening exercises of hip abductors alone on pain, Q-angle and functional performance in patients with knee osteoarthritis. The study concluded that patients of knee osteoarthritis are benefitted more by combination of strengthening exercises of knee extensors and hip abductors rather than strengthening exercises of hip abductors alone. So, strengthening exercises to both knee extensors and hip abductors should be added when treating patients of knee osteoarthritis with increased Q-angle.

Keywords: Osteoarthritis, Q-angle, functional performance, knee extensors strengthening exercises, hip abductors strengthening exercises.
Introduction

Knee osteoarthritis is steadily becoming the most common cause of disability for the middle-aged and has become the most common cause of disability for those over the age of 65 (1). It is being estimated that the number of people over the age of 65 will be doubled in the next 20 years (2). Osteoarthritis is the most commonly encountered disease of the musculoskeletal system. Factors such as age, family history, obesity, and hypermobility increase susceptibility to osteoarthritis. Symptomatically, the most commonly affected joint in osteoarthritis is the knee joint. The physical disability arising from knee prevents the performance of daily life activities and negatively affects life quality. Several factors play roles in the occurrence of physical disability. These include pain, joint movement restriction, muscle weakness and coordination impairment (3). The coexistence of knee osteoarthritis and weakness of the quadriceps muscle group are well known (4). A high Q angle interferes with the smooth gliding movement between the knee cap and the knee. Over time, especially with repetitive activities, this type of micro trauma causes non-specific pain to the front of your knee. As this abnormal tracking continues between the knee cap and the knee, various knee muscles become imbalanced, and the cartilage on the underside of the knee cap begins to wear and thin. Eventually your knees become degenerative and develop osteoarthritis (5). The physiotherapy treatment advocates the use of strengthening exercises in manages the patients with osteoarthritis (6).

Closed kinetic chain exercises are physical exercises performed where the hand for arm movement or foot for leg movement is fixed and cannot move. The hand or foot remains in constant contact with the surface, usually the ground or the base of a machine. These exercises are typically weight bearing exercises, where an exerciser uses one’s own body weight or external weight (7). Patients with knee osteoarthritis often have weakness of their hip abductor muscles. Knee osteoarthritis patients have also been shown to have altered biomechanics at the hip, leading to abnormal loading on the medial side of their knee joint. This increase in loading is thought to result in an increased knee adductor moment during gait because of weak hip abductors. Hip abductor muscle weakness may result in impaired frontal-plane pelvic control during gait, leading to greater medial compartment loading in people with knee osteoarthritis (8). Due to increase in the value of Q angle and weakening of quadriceps and hip abductor muscles in patients with osteoarthritis of knee joint, an effective exercise protocol need to be established that can revert back these changes.

Need of study: Osteoarthritis is the most common cause of disability for the middle aged. The increased Q angle is one of the important component for causing the deformity and there is no manipulation or adjustment to reduce Q angle. There are number of studies which show the beneficial effect of strengthening exercises on patients with knee osteoarthritis, but there are very few studies which show the beneficial effect of strengthening exercise on Q-angle. So there is a strong need to establish the relationship between the strengthening exercises and Q-angle.

Aim of the study: To compare the combined effect of knee extensor and hip abductor strengthening exercises with hip abductor strengthening exercises alone on Q angle in patients with knee osteoarthritis.
Objectives: To study the combined effect of knee extensor and hip abductor strengthening exercises with hip abductor strengthening exercises alone on Q angle, functional performance and clinical symptoms in patients with knee osteoarthritis.

Null hypothesis: There will be no significant difference between combined effect of knee extensor and hip abductor strengthening exercises and hip abductor strengthening exercises alone on Q angle in patients with knee osteoarthritis.

Alternate hypothesis: There will be significant difference between combined effect of knee extensor and hip abductor strengthening exercises and hip abductor strengthening exercises alone on Q angle in patients with knee osteoarthritis.

Review of Literature
Hollman et al. (2000) did a study to examine relationships between hip muscle strength, Q angle and foot pronation and concluded that reduced strength of the hip abductors relative to adductors is associated with increased Q angle and pronation at the foot (9). Sokhangoeei et al. (2010) did the study to verify the efficiency of closed kinetic chain exercise and open kinetic chain exercise protocols on patellofemoral syndrome rehabilitation and concluded that treatments based on exercises for quadriceps femoris strengthening produced improvements on a number of PFS signals and symptoms, with no evidences of differences between OKC and CKC exercises (10).

Study design- Experimental study design comparative in nature
Research setting- Out Patient Department of Physiotherapy, Gian Sagar Medical College and Hospital and Out Patient Department, Gian Sagar College of Physiotherapy, Ramnagar, Rajpura, distt. Patiala.

Study duration - 6 months
Population - Patients with knee osteoarthritis from In Patient and Out Patient Department of Orthopaedics and Physiotherapy from Gian Sagar Medical College and Hospital and Out Patient Department of Physiotherapy from Gian Sagar College of Physiotherapy, Ramnagar, Rajpura, distt. Patiala.

Sample - 90 subjects.

Sampling technique- Random Sampling technique

Inclusion criteria: Individuals aged 45 to 70 years, both male and female patients, Grade 3 osteoarthritis according to Kellegren and Lawrence scale, patients having pain or difficulty in rising from sitting or ascending and descending stairs (11) and patients with mild to moderate pain.

Exclusion criteria: Any history of cardiopulmonary illness, any history of neurological disorder, patients who had serious knee trauma, surgical intervention in the last 6 months, any systemic arthritic condition (12), referred leg pain, rheumatoid arthritis and patients participating in other research study involving knee joint.

Procedure
90 subjects were made part of the study based on inclusion and exclusion criteria. After taking consent, the subjects were randomly divided into three groups named A, B and C of 30 subjects each. Group A received the knee extensor strengthening exercises and hip abductor strengthening exercises along with conventional physiotherapy treatment. Group B received hip abductor strengthening exercises along with conventional physiotherapy treatment. Group C was the control group and received the conventional physiotherapy treatment. Baseline readings of Q
angle, functional performance and clinical symptoms were be taken for all the patients at the beginning of the study and at the end of the study to compare the results. Treatment session were be divided into three phases: First phase was the warm up phase. Hot pack was given to affected knee for 15 minutes. After that stretching exercises was given for hip abductors, hamstrings and quadriceps muscle with 30 second hold and 3 repetitions. Second phase was the intervention phase. It included the knee strengthening and hip abductor strengthening exercises. The exercises were given according to the group. Third phase was the cool down phase. It also included range of motion exercises for all major joints of lower limb for 5 – 10 minutes. All the groups then followed a 8 weeks exercise programme starting with 10 repetitions of all the exercises once a day and subsequently progressing depends on the condition of patient. The exercises were given on alternate days. All measurements were repeated at the end of the 8 week exercise programme.

**Independent variables:** Knee extensor and hip abductor strengthening exercises.

**Dependent variables:** Western Ontario and McMaster Universities Osteoarthritis index (WOMAC) and Q angle

**Operational tools:** Goniometer, Foot ruler, Weight cuffs

**Data analysis:** Results were analysed by paired and unpaired t-test and ANOVA.

### Table 1
Pre-treatment and post-treatment readings of VAS score

<table>
<thead>
<tr>
<th>Groups</th>
<th>Pre-treatment</th>
<th>Post-treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>5.83 ± 0.69</td>
<td>1.46 ± 0.77</td>
</tr>
<tr>
<td>Group B</td>
<td>5.5 ± 0.82</td>
<td>1.66 ± 0.66</td>
</tr>
<tr>
<td>Group C</td>
<td>5.83 ± 0.83</td>
<td>3.46 ± 1.11</td>
</tr>
</tbody>
</table>

### Table 2
Pre-treatment and post-treatment readings of WOMAC index

<table>
<thead>
<tr>
<th>Groups</th>
<th>Pre-treatment</th>
<th>Post-treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>2.41 ± 0.22</td>
<td>0.95 ± 0.34</td>
</tr>
<tr>
<td>Group B</td>
<td>2.31 ± 0.17</td>
<td>1.4 ± 0.15</td>
</tr>
<tr>
<td>Group C</td>
<td>2.28 ± 0.18</td>
<td>1.47 ± 0.15</td>
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</tbody>
</table>
### Table 3
#### Mean and standard deviation of pre-treatment and post-treatment Q-angle(Rt.)

<table>
<thead>
<tr>
<th>Groups</th>
<th>Pre-treatment</th>
<th>Post-treatment</th>
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</thead>
<tbody>
<tr>
<td>Group A</td>
<td>25.63 ± 2.25</td>
<td>23.66 ± 2.38</td>
</tr>
<tr>
<td>Group B</td>
<td>25.7 ± 2.26</td>
<td>24.96 ± 2.15</td>
</tr>
<tr>
<td>Group C</td>
<td>25.93 ± 2.55</td>
<td>25.4 ± 2.59</td>
</tr>
</tbody>
</table>

### Table 4
#### Mean and standard deviation of pre-treatment and post-treatment Q-angle(Lt.)

<table>
<thead>
<tr>
<th>Groups</th>
<th>Pre-treatment</th>
<th>Post-treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>25.7 ± 2.26</td>
<td>24.2 ± 2.29</td>
</tr>
<tr>
<td>Group B</td>
<td>25.93 ± 2.55</td>
<td>25.4 ± 2.66</td>
</tr>
<tr>
<td>Group C</td>
<td>25.63 ± 2.25</td>
<td>25 ± 2.14</td>
</tr>
</tbody>
</table>

### Discussion

Osteoarthritis is the most common condition amongst all affecting almost 80% of older population and hampering their activities of daily living and overall well being (National Pain Foundation 2011).

Nakagawa et al. 2008 in a study analysed the compliance to exercise therapy in osteoarthritic participants with knee osteoarthritis and declared that demographic, psychosocial, and disability-related measures did not predict compliance with any consistency across various phases of the trial. They also stressed that in the hip abductors and lateral rotators strengthening exercises should be incorporated with quadriceps strengthening exercises patients with knee osteoarthritis for additional benefits with respect to the perceived pain symptoms during functional activities in patients after six weeks of treatment. Supporting the results of present study(14), Sarkar et al. in their study in 2009 have concluded that on Isometric Quadricep Activation on “Q” Angle reduce the increased Q-angle in patients of knee osteoarthritis with an increased Q-angle (15).

Study done by O'Reilly, Muir and Doherty in 1999 closely relates with findings of the present study. They concluded that the study has drawn the inference that a strengthening exercise programme to hip abductors and knee extensors can significantly reduce knee pain and improve functional performance (16).

In the present study, there is significant difference in values of means when group A, B and C was compared, for VAS, WOMAC scores and Q-angle. There is significant difference of paired t-test between pre and post variables of all the groups for VAS and WOMAC and Q-angle. The results show that there is significant difference of unpaired t-test between group A and group B,
group B and group C, group C and group A for VAS, WOMAC and Q-angle. The results show
the significant difference in all the three groups when compared with ANOVA.

Conclusion
The conclusion of present study is that the patients of knee osteoarthritis associated with
increased Q-angle are benefitted more by combination of knee extensors and hip abductors
strengthening exercises programme rather than strengthening exercises to hip abductors alone.

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