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EFFECTIVENESS OF CLOSED KINETIC CHAIN EXERCISES TO IMPROVE QUADRICEPS STRENGTH AND FUNCTIONAL STATUS IN PATIENTS WITH KNEE OSTEOARTHRITIS

Physiotherapy

Mohammad Chan Basha* MPTH Scholar, Pacific College of Physiotherapy, Pacific Medical University Udaipur, Rajasthan, India *Corresponding Author

Dr Jafar Khan PT Dean & HOD Pacific College of Physiotherapy, Pacific Medical University, Udaipur Rajasthan India

Dr Renuka Pal PT Associate Professor, Pacific College of Physiotherapy, Pacific Medical University Udaipur Rajasthan India

ABSTRACT

The objective of the study was to compare and assess the effects of a 2-week Closed Kinetic Chain Exercise programme on Quadriceps Strength and Function in Knee Osteoarthritis patients. To compare the therapeutic benefits of Closed Kinetic Chain Exercises on the Functional Status and Quadriceps Strength in patients with Knee Osteoarthritis. **Methods:** 20 patients with a mean age of 55 to 75 years were compared. The study comprised both male and female participants. All ten patients were chosen at random for Closed Kinetic Chain Exercises. For two weeks, patients receive treatment five days each week. The WOMAC scale is used to assess the result in terms of pain, stiffness, and functional status. **Results:** With a mean difference of 2.1 between the 0th and 14th days for both groups, CKCE exhibited significantly more improvement. **Conclusion:** The study, therefore, concluded that there is significant improvement in open kinetic chain exercises.

KEYWORDS

Knee Osteoarthritis, Closed Kinetic Chain Exercises, Quadriceps Muscle, WOMAC.

INTRODUCTION

The most prevalent chronic, progressive, degenerative, and incapacitating illness affecting the elderly is this one. The Greek words "osteo," "arthro," and "itis," which translate to "of the bone," "joint," and "inflammation," respectively, are the source of the phrase osteoarthritis. The precise reason is not known[1]. However, it is firmly considered that it develops as a result of ageing, joint wear and tear, or degenerative changes. Osteoarthritis has two types: Osteoarthritis can be either primary or secondary. Primary osteoarthritis results from the normal wear and tear of ageing, excessive use, or obesity. Men had a 40% lifetime risk and women had a 47% lifetime risk of having osteoarthritis of the knee, with higher risks among Asians who are obese[2].

Repetitive weight bearing or extended weight bearing on joints that are sensitive, competitive sports with insufficient rest intervals, an excessively sedentary lifestyle, and obesity are the main causes of Primary Knee Osteoarthritis. The following factors contribute to Secondary Knee Osteoarthritis: Post-traumatic; Varus or valgus deformity in the knee; Lower limb fractures[1].

The site of the joint's load-bearing contact shifts significantly to a zone that is not accustomed to heavy loads during the start period. As a result, the areas that are rarely loaded exhibit cartilage that has deteriorating characteristics, such as fibrillation. In the early stages of osteoarthritis, fibrillation and matrix consolidation are seen together with a loss of proteoglycans at the surface layer. Higher matrix consolidation, increased friction at the surface, increased tangential force at the articular surface, and increased fibrillation at the articular surface all contribute to an increase in shear stress in the collagen network. When cartilage degenerative changes reach a critical point when the tissue is sensitive to heavy stresses, the progression phase of the disease starts. Osteoarthritis progresses when additional compressive stresses are applied to the knee joint, increasing shear when fibrillation is present at the surface. Consistent knee pain, morning stiffness, crepitus, decreased joint functionality, restricted joint motion, tenderness on probing, and joint effusion are a few of these symptoms[7].

Weight-bearing loads on the knee in bilateral stance are evenly distributed between the medial and lateral condyles, however in unilateral stance, the weight-bearing line moves towards the medial compartment to accommodate for the reduced base of support below the centre of mass (or medial and lateral compartments). This movement increases the compressive strains on the medial compartment[14].

The quadriceps muscle's lateral pull is estimated by Q-Angle. It is created by the junction of two lines, one drawn from the centre of the patella to the centre of the tibial tuberosity and the other from the anterior superior iliac spine of the pelvis to the centre of the patella. Males typically have a Q-angle of 10° to 15°, whereas females typically have one of 15° to 20°. Q-angle is raised when there is more lateral pull on the patella[2].

Because the total muscle tension of the quadriceps will be higher than in the muscles shortened state, which is demonstrated by the quadriceps lag or the extension lag, in cases of significant quadriceps weakness, the quadriceps may not be able to produce enough torque to complete the last 15° of non-weight bearing knee extension[7].

Aim of The Study: The aim of the study was to analyse the Effectiveness of Closed Kinetic Chain Exercises to improve Quadriceps Strength and Functional Status in patients with Osteoarthritis.

Methodology: Prospective study design**.** This study was approved by ethical committee of Pacific Medical University. During the period of study, ethical issues will be followed with utmost care and due respect towards the maintenance of privacy of the patients. Each patient will be given detailed explanation about both beneficial and potential harmful effects (if any) of the treatment which he/she supposed to receive. The participants will be explained about the purpose of the trail. The request for termination of the treatment by the patient at any time of the study shall never be denied. Subjects who are of age group between 55 to 75 years diagnosed with knee osteoarthritis. The study was conducted in Physiotherapy Department, Pacific Medical University, Udaipur, India. Patients were trained for five sessions per week for 2 weeks. Simple random sampling method. 10 subjects were included in this study.

Inclusion Criteria: Mean age of 55 to 75 years; Clinical presentation of unilateral knee osteoarthritis; Ability to walk at least 100 meters on an uneven surface; According to the Kellgren and Lawrence grading system based on plain x-rays, patients with knee osteoarthritis in grades 2 and 3 were collected; Patients were diagnosed according to American College of Rheumatology Criteria of knee osteoarthritis; The patient's knee joint should be in close to or full passive range of motion; Vigorous joint motion causing crepitation; Morning stiffness lasting no more than 30 minutes.

Exclusion Criteria: Patients with a previous history of knee surgery; Patients undergoing intra-articular injection of hyaluronic acid/steroids in the last six months; Patients with a history of a pathological condition like malignancy, infection, rheumatoid arthritis, osteomyelitis and other pathologies of muscle, bone, ligaments; Patients with cardiac problems were not included; Patients with knee flexion deformity are also excluded; Patients with

osteoporosis were excluded; Patients with a psychological problem and non-co-operative patients are excluded; Patients with osteoarthritis at other joints except for osteoarthritis of the knee were also excluded.

Procedure: Everyone who took part in the project was required to sign a consent form. Following the agreement, a thorough explanation of the treatment process was given to each participant. For two weeks, patients received training five times each week. The length of each exercise session is roughly 45 minutes. There are three sets of 10 repetitions for each exercise. All participants voluntarily stopped taking their medications for the duration of a specific programme. While the trial was ongoing, patients were instructed not to alter their regular daily routines or engage in any additional physical exercise or physiotherapy. At days 0 and 14, or the pre-test and post-test of the therapy session, patients were evaluated using the WOMAC questionnaire. Patients follow their specific routine when performing their therapeutic workouts.

INTERVENTION

Closed kinetic chain exercise (CKCE)[13]

Each exercise in the closed kinetic chain protocol was performed dynamically with a 3-second rest between the repetition.

Quadriceps Setting Exercises

Patient was made to sit with extended or slightly flexed knee and heel on the floor. Ask the patient to focus on tightening their quadriceps while placing their heel on the floor and thigh on the seat of the chair. Ten seconds of muscle contraction followed by three seconds of relaxation should be repeated.

Stationary Bike

On the stationary cycle, the patient is made to sit comfortably. Correctly adjust the seat height so that your knees don't bend at an angle more than 90 degrees as you pedal. While pedalling, the knee joint shouldn't lock, and it shouldn't be overly bent in the bottom position either. The seat should be parallel to the ground and not slant forward or backward. When the handlebars are raised high enough, the body should be able to stay mostly upright. Throughout the entire revolution, the patient's foot must be totally resting on the pedal. It is not recommended to pedal faster than 50 to 60 revolutions per minute. Five to seven minutes of cycling are required of the patient. Gradually upping the resistance.

Step-Up and Step-Down Exercises

Standing patiently. As soon as the patient is able, start with a low step made of wood that is 2 to 3 inches tall. To prevent "valgus collapse," make sure the patient maintains an upright posture and a knee that is parallel to the ground. Apply a graduated manual resistance force to the lateral aspect of the forward thigh to encourage gluteus medius firing during forward step-ups. When completing eccentric (step down) and concentric (step up) quadriceps workouts, concentrate on controlling your body weight. In order to emphasise the quadriceps and reduce pushing off using the plantar flexors of the trailing extremity, teach the patient to "keep the toes up" or that the heel must be the last to leave the floor and the first to return. Use ankle weights to stiffen the opposition. Despite the increasing difficulty, the patient should still do step ups and downs while maintaining alignment and control. As you advance, gradually incorporate rotational movements as well as walking onto or off of higher tiers.

Partial Squats, Mini-Squats and Short-Arc Training

Standing patiently. The patient should first flex both knees between 30 and 45 degrees before extending them. Prior to Gain ground by using elastic resistance placed beneath both of your feet or holding weights in your hands. lowering the knees, the patient should first lower the hips as if sitting down while keeping the trunk straight and concentrating on maintaining a posterior weight shift. To guarantee gluteal activation and reduced stresses on the patello-femoral joint, the knees should remain in line with the toes and not advance past them. This will prevent valgus collapse. In the later stages of treatment, increase the range of knee flexion when performing squats. By executing unilateral resisted mini squats or squatting on the unstable surfaces, you can make the workout more challenging[16].

Hamstring Setting (Hamstring Sets)

The patient is long-sitting or resting on his or her back with a towel roll beneath the knee. Have the patient contract their knee flexors in an isometric manner for 10 seconds while softly pressing the heel of their foot into the treatment table. Ask the patient to relax for three seconds, then instruct them to contract once again[16].

Hamstring Curls

The patient is standing. As a balancing aid, ask the patient to grasp on to something sturdy. Ask the patient to flex their knee to a 90-degree angle, where resistance is provided by gravity. Use ankle weights to increase the amount of resistance[16].

Outcome Measures[8]: Western Ontario and Mcmaster Universities Arthritis Index (Womac).

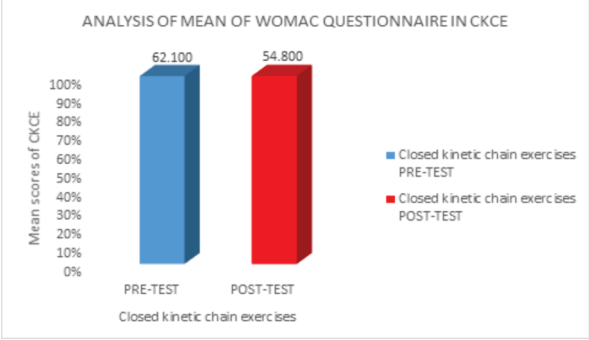
By evaluating seventeen functional activities, five pain-related activities, and two stiffness categories, it was created to measure the dysfunction and pain associated with osteoarthritis of the lower limbs. It has been extensively utilised in clinical trials and is one of the most sensitive tools available for evaluating osteoarthritis of the hip and knee.

RESULTS:

The aim of the study was to find the effectiveness of Closed kinetic chain exercises in patients with osteoarthritis of knee. A total of 10 subjects were included in this study. All the subjects underwent baseline assessment. In this study the treatment session was for 2 weeks, 10 participants completed the treatment session. Both the pre-test and post-test values showed statistically significant scores in WOMAC Questionnaire, where p value was set at $p \leq 0.05$ was significant.

Analysis Of Mean Of Womac Questionnaire In Closed Kinetic Chain Exercises

GROUP		Mean	Std. Deviation	P - Value	Inferences
Closed kinetic chain exercises	PRE-TEST	62.100	8.227	0.000	Highly significant
	POST-TEST	54.800	7.440	0.000	



DISCUSSION:

The study's main objective is to examine the claim that closed kinetic chain workouts have a more notable impact on quadriceps strength and function than open kinetic chain activities. Quadriceps weakness, one of several factors that contribute to the beginning and progression of osteoarthritis, is the major factor that may be modified by resistance training to increase the strength of the musculature surrounding the knee joint. The quadriceps strength is a crucial area to focus on since a weak quadriceps muscle can lead to increased joint strains from a reduced ability to alternate loads across the joint, whereas strengthening activities improve pain and function while also making the quadriceps stronger. Quadriceps strengthening may activate the pain-suppressing endorphin system, favourably shift sensory input to the central nervous system, and engage the gate control mechanism in addition to enhancing blood flow and cartilage nourishment[10]. The exercises used in the current study, open kinetic chain are progressive resistance exercises. They boost the muscles' ability to generate force. The advantages of closed kinetic chain exercises in the lower limb include: they promote more functional patterns, allow simultaneous activation of antagonistic muscle groups, which increases joint stability and stimulates functional movement patterns, they stimulate co-contraction of the hamstring, which helps to reduce anterior tibial translation, and they involve multiple joints during the exercise, which increases mechano-recognition[9].

The inner and middle quadriceps muscle ranges, where there is a consistent tension in the range either in concentric contraction or

eccentric contraction, respond well to open kinetic chain workouts. When a muscle contracts concentrically, the internal tension pulls the bone component in the direction of the muscle pull; when a muscle contracts eccentrically, the internal tension pulls the bony component apart in the direction of the muscle pull, supported by gravity force. Isotonic contractions are utilised to increase muscle strength and mass, but they consume more energy[13].

The resistance during an isokinetic contraction is inversely proportional to the muscle's generated torque. The muscle is often stronger in the middle range compared to the beginning and end ranges. If the resistance is constant, the muscle must work harder while maintaining the same speed and velocity at the start and end of the range of motion. Muscles become more flexible as a result of this type of contraction. The theory behind closed kinetic chain exercises is that they rapidly transition from the learning phase of strength building into the muscular building phase by recruiting muscles in functional and familiar patterns[9].

Due to the weight-bearing position of the limb, closed kinetic chain exercises were more painful than open kinetic chain exercises in the acute phase. Furthermore, by recruiting and engaging muscles in such functional patterns, proprioception and coordination may be enhanced, lowering the chance of injury. The extensor mechanism gains strength during closed kinetic chain activities. In comparison to open kinetic workouts, the force of the knee muscles increases following closed kinetic activities. Both the active and passive ranges of knee flexion significantly increased due to eccentric elements of two different workout regimens. The eccentric muscle workouts increase muscular tension and cause maximum firing, which results in a more effective training outcome[10].

CONCLUSION:

In individuals with osteoarthritis of the knee, closed kinetic chain workouts are more successful in enhancing quadriceps strength and functional status. Patients with osteoarthritis of the knee who received closed Kinetic Chain Exercises saw a considerable reduction in discomfort, an improvement in function, and an increase in muscular strength.

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