Effects of Isometric Training Vs Aerobic Exercise Program along with Ultrasound for Osteoarthritis of Knee

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Abstract

Background: Knee osteoarthritis (OA), commonly known as degenerative joint disease, is frequently brought on by wear-and-tear and articular cartilage loss that occurs over time. It comes in two categories: primary and secondary, and it most frequently affects the elderly. Articular degeneration caused by primary osteoarthritis has no discernible underlying etiology.

Purpose: To compare the effectiveness of isometric training and aerobic exercise programs along with ultrasound for OA knee patients.

Materials Required: 52 subjects were selected from the prem physiotherapy clinic according to inclusion and exclusion criteria during the period of November 2022 to July 2023. They were divided into two categories: Group A(n=26) and Group B(n=26). The pre and post-test values were measured by Numeric pain rating scale (NPRS) and WOMAC questionnaire. Group A received conventional treatment that is isometric training along with ultrasound and Group B received aerobic exercise along with ultrasound. Both training programs were given for 4 weeks, weekly 5 days.

Results: A statistically important distinction <0.0001 between groups A and B was found via statistical analysis of information that was quantitative.

Conclusion: Isometric training along with ultrasound of group A were proven to be more successful than group B aerobic exercise along with ultrasound in reducing pain.

Keywords: Osteoarthritis, Ultrasound, Aerobic exercise, Isometric training

Introduction

Osteoarthritis (OA) of the knee is the most prevalent condition among older individuals. As population ages on average, knee OA is growing more prevalent. A number of factors, such as age, weight, and joint injury from repetitive motions like squatting and kneeling, contribute to the development
of osteoarthritis (OA) in the knees. Leptin, cytokines, mechanical stressors, and other factors can all contribute to knee OA. In patients with knee discomfort, OA of the knee should not be assumed to be the cause of the pain. Both primary (idiopathic) and secondary osteoarthritis of the knee exist. Post-traumatic, congenital/malformation, postoperative, metabolic, hemochromatosis, chondrocalcinosis, and endocrine issues are some of the secondary causes of knee osteoarthritis.¹

The prevalence is around 10%. Men are less likely than women to suffer knee OA. Both men and women experience this, with men older than 55 having a lower incidence of knee OA than women. Knee OA, which normally proceeds slowly over a period of 10 to 15 years and causes difficulty in daily activities, affects all three compartments of the knee joint: the medial, lateral, and patello femoral joint. In the past, it was believed that inflammation had nothing to do with articular cartilage loss and was instead predominantly brought on by the “wear and tear” of aging.²

Therapeutic ultrasound (US) is known to reduce edema, relieve discomfort, increase range of motion (ROM), and hasten tissue repair. The US has been used to treat various musculoskeletal conditions. Muscles are contracted during isometric activities without joint movement. In people with osteoarthritis, these exercises can help increase muscle strength and stability around the knee joint, which can lessen symptoms and enhance functional outcomes³. Aerobic exercise programs have a broader impact on overall cardiovascular fitness, weight management, and joint mobility. They can provide systemic benefits and contribute to overall well-being. Ultrasound therapy, when used in conjunction with exercise, may help alleviate pain, reduce inflammation, and promote tissue healing. Education and home activities are also part of exercise interventions.⁴ In general, treatments have been more effective at reducing pain than in reducing disability. Exercise can help with many of the issues that contribute to disability. Exercise, including both aerobic and strength training, has been studied as a treatment for knee osteoarthritis, with mixed results.⁵

Targeting particular muscle groups with isometric workouts helps strengthen the quadriceps, hamstrings, and calf muscles.⁷ These muscles can be strengthened to help support the knee joint and ease pain.

**Aim**

The aim of this study is to evaluate the efficacy of isometric training vs aerobic exercise program along with ultrasound for knee osteoarthritis patients.

**Methods**

An experimental study conducted on 52 subjects with early knee osteoarthritis age between 45-65 was taken from prem physiotherapy clinic from November 2022 to July 2023. Convenient sampling was used in this study.

**Inclusion Criteria:**
- Both male and female are included.
- Both the gender diagnosed unilateral Osteoarthritis knee.
- Grade 2 and 3 according to ARC grading.
- Postmenopausal women.

**Exclusion Criteria:**
- Hip, knee, ankle surgery in affected leg.
- Any malignancy in the affected leg.
- Tumors involved leg.
- Any neurological or balance impairment in the involved leg.
- Lower limb replacement.

**Outcome Measures:**

Assessment taken before and after 4 weeks of study
- Numerical pain rating scale (NPRS)
- Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)

**Procedure**

52 subjects were divided into two categories: Group A (n=26) and Group B (n=26). The pre and post-test values measured by NPRS scale and WOMAC questionnaire. Group A received conventional treatment that is isometric training along with ultrasound and Group B received aerobic exercise along with ultrasound. Both training programs were given for 4 weeks, weekly 5 days.
Control Group: (group A) Conventional Treatment

- **Ultrasound**
  
  Continuous ultrasound at the frequency of 3MHz. This group was given continuous mode and a transducer area of 5cm² were administered to the knee for 12 minutes per session, five days per week over the period of 2 weeks.

- **Straight leg Raises:**
  
  The patients were asked to lie on their back with one leg straight and the other bent. Lift the straight leg slowly off the floor, hold for a moment, and then slowly bring it down. Start with a few repetitions and gradually increase over time. Repeat with the other leg.

- **Pillow Squeeze:**
  
  Pillow squeeze: Ask the patient to squeeze the knees together, Squishing the pillow between them. Hold for 5 seconds. Relax. Do two sets of 10 repetitions. Switch legs after each set.

- **Seated Hip March:**
  
  Ask the patient to sit up straight in a chair. Kick the left foot back slightly, then keep the toes on the floor. Lift the right foot off the floor, knee bent. Hold the right leg in the air for 3 seconds, slowly lower the foot to the ground. Do two sets of 10 repetitions, switch legs after each set.

- **Side Leg Raise:**
  
  Ask the patient to stand and hold the back of a chair for balance. Place the weight on the left leg. Stand tall and lift the right leg out to the side. Keep the right leg straight and outer leg muscles tensed. Hold 3 seconds, then slowly lower the leg. Do two sets of 10 repetitions, switch legs after each set.

- **Static Quadriceps:**
  
  Ask the patient to place the small rolled towel underneath one knee. Then the patient to position himself lying on the back with the knees straight, pull the toes up towards you. Tighten the muscles at the front of your thigh, and press the back of the knee onto the towel. Hold for 5 secs and relax. Repeat for 10 times. Switch to the other leg.

- **One leg Balance:**
  
  Ask the patient to stand behind the kitchen counter without holding on, and slowly lift one foot off the floor. Ask the patient to stay balanced for 20 seconds without grabbing the counter, repeat this move twice, then switch to the other side.

- **Supine Heel Slides:**
  
  Ask the patient to lie on their back with the legs straight, then bend the knee and slide the heel upward towards your buttocks, then slide the heel back down. Don't lift your heel off the bed and don't let your knee roll inward. Follow up to 10 repetitions, two to three times per day. Then do this exercise with the other leg.

- **Protocol:**
  
  The subjects were instructed to perform each exercise twice, for a total of ten repetitions, 4-5 times a week.

Experimental group: (group B) Aerobic Exercise Program Along With Ultrasound

- **Ultrasound**
  
  Continuous ultrasound at the frequency of 3MHz. This group was given continuous mode and a transducer area of 5cm² were administered to the knee for 12 minutes per session, five days per week over the period of 2 weeks.

- **Walking:**
  
  Ask the patient to stand and ask the patient to start walking slowly with short distances and gradually increase the duration and intensity over the time. 3 repetitions, two times per day.

- **Cycling:**
  
  Ask the patient to start the cycling slowly in static position. If you start to feel a pain in knees, then stop it immediately. Initially start the program for 5 minutes session a day. After you do the cycling with successfully with no pain, increase the duration to 7 minutes. Then gradually increase the duration of the time.

- **Water Aerobic:**
  
  Ask the patient to start off walking in shallow water, around waist height. Lengthen your spine and
walk by putting pressure on your heel first and then your toes. Instead of walking on your tiptoes. Keep the arms at your side in the water, and move them as you walk. Continue walking for 5 to 10 minutes.

Protocol:

The subjects were instructed to perform each exercise twice, for a total of ten repetitions, 4-5 times a week.

Data Analysis:

Graph 1 - Shows the pre and post test values of NPRS in group A

Graph 2 - Shows the pre and post test values of NPRS in group B

Graph 3 - Shows the post test values of NPRS for both the group.

Graph 4 - Shows the pre test and post test values of WOMAC in group A

Graph 5 - Shows the pre test and post test values of WOMAC in group B
Graph 6 - Shows the post test values of group A and group B using WOMAC

Results

A statistically significant difference between groups A and B as well as within each group was found by statistical analysis of quantitative data.

The post-test values of NPRS in both the groups. The post-test value with a mean and SD of 5.12 and 1.56 in group A and 6.50 and 1.21 in group B with t value of 3.5814 with significance.

The post-test values of WOMAC for both the groups. The post-test value with a mean and SD of 56.19 and 4.58 in group A and 65.69 and 5.34 in group B with t value of 6.8848 with significance.

And this suggests that group A performed considerably better than group B. This strongly suggests that Isometric training is effective in improving knee strength and in reducing pain and thus improves quality of life and function in OA.

Discussion

The most common condition of aged people is osteoarthritis of knee and one of the primary causes of disability. Knee OA is becoming more common as the population average age rises. It happens when cartilage of knee joint breaks down, causes bones to rub together. The friction makes knees hurt, becomes stiff and swell. Clinical symptoms include joint stiffness, pain, and dysfunction, but pain is the most common complaint among patients. Knee osteoarthritis is divided into two types: primary (idiopathic) and secondary. People who have knee-osteoarthritis, Strength training, range of motion exercises, and cardiovascular activities are given. Education and home activities are also part of exercise interventions. In general, treatments have been more effective at reducing pain than in reducing disability. Exercise can help with many of the issues that contribute to disability. Exercise, including both aerobic and strength training, has been studied as a treatment for knee osteoarthritis, with mixed results. The goal of the study was to determine how Isometric training with Ultrasound affected individuals with OA knees. Research studies stated Isometric training exercises have significant improvement in patients with knee osteoarthritis.

KN Subramanian et al 2023 conducted study among 340 OA Knee patients and are randomized into two groups. Case group (Group A) and Control group (Group B). quadriceps strengthening is tied up with a better prognosis in patients with moderate OA knee. In this study 52 subjects were taken and divided into two groups. Isometric training along with ultrasound (Group A) and Aerobic exercise program along with ultrasound (Group B) and concluded that Isometric training is effective in reducing pain and improves muscle strength in OA knee patients.

Anwer S et al 2014, conducted study among 42 subjects and were allocated into two groups. Experimental group (n=21) and control group (n=21) concludes that isometric quadriceps exercise is effective in reducing pain. Similarly, in this study Isometric training along with ultrasound group has beneficial effects on quadriceps muscle strength, pain, and functional disability in patients with osteoarthritis of the knee.

Sengul A, et al 2022 conducted study among 30 subjects. The subjects were randomly divided into two groups according to the type of performing the quadriceps isometric exercises as group 1 (performing in knee extension) and group 2 (performing in knee flexion) and concluded that exercises performed in knee extension were found to be more effective in reducing joint stiffness. Similarly this study concluded that quadriceps muscle strengthening maintains beneficial effects in patients with knee OA such as significant reduction of knee pain and improvement of knee function.
Conclusion

In conclusion, this study provides robust evidence supporting the efficacy of Isometric training and Aerobic exercise with conventional therapy as a management strategy for osteoarthritis knee. The significant improvements observed in muscle strength, pain levels, stiffness, knee alignment, and postural stability highlight the positive impact of this combined approach on function and overall well-being in individuals with knee osteoarthritis. The findings suggest that Isometric training, when integrated with conventional therapy, surpasses the effectiveness of conventional therapy alone in terms of pain reduction, functional restoration, and improved quality of life. By targeting muscle strength, aligning the knee joint, and enhancing postural stability, this comprehensive approach addresses the multifaceted aspects of osteoarthritis knee management.

Ethical clearance: The ISRB committee of a private hospital and institution in Chennai has provided its clearance for the conduct of human research that complies with all applicable national laws, institutional regulations. (Application Number 03/096/2022/ISRB/SR/SCPT)

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