



# EFFECT OF STRENGTH TRAINING ON BALANCE, ENDURANCE IN KNEE OSTEOARTHRITIS PATIENTS

**Gunjan Malhotra<sup>1</sup>, Aditi Singh<sup>2\*</sup>**

Author information:

1. Gunjan Malhotra, BPT final year, Amity Institute of Health Allied Sciences, DoPT, Amity University, Noida
2. \*Dr. Aditi Singh, Associate Professor, Gyan Vihar University, Jaipur (corresponding author)

## Abstract

Osteoarthritis is a common condition that affects a large number of individuals, especially older adults. Strength training exercises help in improving the strength and endurance of the muscles surrounding the knee joint, which can reduce the load on the joint and improve joint stability. The purpose of this study was to evaluate the effectiveness of two different exercise protocols i.e., isometric exercises and strength training in combination with hot pack therapy in patients with knee osteoarthritis. The study included 20 subjects between the age group of 40-50 years. The subjects reported a reduction in pain after the strength training program. The pain was assessed using a visual analog scale (VAS), and the mean score before the program was 6.7, which reduced to 4.3 after the program. The mean score for balance before the strength training program was 10.2, and after the program, it improved to 13.5. Similarly, the mean range of motion before the program was 70 degrees, which improved to 85 degrees after the program. These improvements were statistically significant ( $p < 0.05$ ).

The study also showed that both isometric exercises and heat pack therapy are effective in reducing pain and improving strength in knee arthritis patients. By addressing the underlying weakness and instability associated with knee arthritis, strength training may offer a promising approach to managing this condition. This finding highlights the importance of considering a multimodal treatment approach, which includes strengthening exercises, in the management of knee arthritis.

Keywords: Knee osteoarthritis, strength training, balance, endurance.

## Introduction

Millions of individuals worldwide suffer from osteoarthritis (OA), a degenerative joint disease that is one of the main causes of persistent pain and impairment. One of the most prevalent types of OA is knee osteoarthritis (Knee Osteoarthritis), which affects 10% of men and 13% of women over the age of 60. <sup>(3)</sup> As the population ages and obesity rates rise, it is anticipated that Knee Osteoarthritis will become more common.

Articular cartilage degeneration, which can cause discomfort, stiffness, a reduction in range of motion, and a decline in physical function, is what distinguishes knee osteoarthritis. Exercise is regarded as one of the most successful non-pharmacological therapy for knee osteoarthritis control, <sup>(4)</sup> as compared with pharmaceutical intervention. In knee osteoarthritis patients, exercise has been found to enhance physical performance, lessen discomfort, and enhance quality of life.

Exercises such as "strength training" uses resistance to promote muscular growth and increase strength in the muscles. Strength training can help knee osteoarthritis patients with their pain, physical function, and muscle strength, according to earlier studies. <sup>(1)</sup> Less is known about how strength training affects balance and endurance in knee osteoarthritis patients.

The goal of this study is to look into how a strength training regimen affects people with knee osteoarthritis's balance, stamina, and physical function. The study will also look into any potential mechanisms that might underlie how strength training affects these results. This study results could significantly impact how knee osteoarthritis is managed and how to exercise regimens are created for this population.

The aim of this study is to evaluate the effect of strength training in knee osteoarthritis patients.

Need of the study - This study will help to know about the effect of strength training on balance and endurance as compared to the group which includes only isometrics and hot pack as their treatment protocol.

## Materials and methods

The study design for this research involved an experimental study on a study population consisting of individuals aged between 40 to 50 years. The sample size for this study is 20 subjects, and the data collection was done at Chandra Laxmi Hospital. The study received ethical clearance from Amity Institute of Health Allied Sciences, Amity University, Noida.

The research focus on knee osteoarthritis and involves patients who have been diagnosed with the condition. The study examined various aspects of knee osteoarthritis, including its diagnosis, examination, and management through physiotherapy.

The inclusion criteria for this study were as follows. The study aimed to include patients who had knee osteoarthritis and were between the ages of 40 to 50 years old.<sup>(10)</sup> Both primary and secondary knee osteoarthritis patients were eligible for inclusion. It was also required that patients had knee pain in order to be included in the study. By establishing these inclusion criteria, researchers were able to select a specific group of participants that met the necessary characteristics for the study.

The exclusion criteria for this study were as follows. Patients who had rheumatoid arthritis were not eligible for participation. Additionally, patients who were uncooperative were excluded from the study. These criteria were used to ensure that the study participants were only those with knee osteoarthritis and were willing to participate in the study. By excluding patients with rheumatoid arthritis, researchers could focus specifically on the effects of knee osteoarthritis on the study participants. The exclusion of uncooperative patients helped to ensure that the study could be conducted smoothly and efficiently. Overall, the use of exclusion criteria helped researchers to select a specific group of participants who met the necessary characteristics for the study.

#### Instruments Required:

- For Pain: VAS Scale
- For Range of Motion: Goniometer
- For Examination: Balance Boards and Stepper

#### Procedure:

Group A was given treatment regimen consisting of hot pack and isometric exercises. The duration of this treatment was set for 8-10 minutes with only one repetition required. Unlike other treatments, no specified rest time was given between repetitions.

In this phase, the subject was given hot pack therapy for 8-10 minutes to warm up the muscles.<sup>(5)</sup> After that, the subject performs isometric exercises for the quadriceps and hamstrings without the use of weights.<sup>(7)</sup> There are a total of 5 exercises performed as listed below:

1. Towel pressing: The subject is asked to place a towel roll below the knees, and press the knees downwards while holding for 10 seconds in each repetition. The number of sets and reps is not specified.
2. Straight leg raises: The subject lies in a supine position and raises their legs without bending the knees. The number of sets and reps is not specified.
3. Ankle raises: The subject can do this exercise in both sitting and supine lying position. The subject is asked to raise their ankle as much as they can. The number of sets and reps is not specified.
4. Bridging: The subject is in a supine lying position with both hands below the back. The subject lifts their back upward. The number of sets and reps is not specified.

5. Hamstring curls: The subject is asked to curl their hamstrings. The number of sets and reps is not specified.

Group B was given Hot Pack and Strength Training

Week 0-2:

The subjects in Group B received hot pack treatment for 8-10 minutes. This is followed by strength training consisting of the following exercises:

1. Seated extension with weights: For the primary weeks of training, the burden can be 2 kgs. The difficulty is requested to take a seat down on a chair with their returned instantly and toes flat at the floor. Then, they amplify their leg with the burden connected to the ankle. They do 10 repetitions in line with set with a 1-minute relaxation among every set.
2. Seated with therabands or standing: The difficulty is requested to take a seat down or stand at the same time as keeping a theraband with each hand. Then, they circulate their palms farfar from every different to stretch the band. They do 10 repetitions in line with set with a 1-minute relaxation among every set.
3. Sliding and stepping lunges: The difficulty stands with toes shoulder-width aside and one foot on a slider or towel. They then slide the foot backwards right into a lunge after which go back to the beginning position. They do 10 repetitions in line with set with a 1-minute relaxation among every set.
4. Chair stands and squat: The difficulty is requested to face in the front of a chair after which take a seat down down on it and arise once more without the usage of their hands. They do 10 repetitions in line with set with a 1-minute relaxation among every set.

After finishing the exercises, the subjects in Group B are told to calm down via way of means of strolling after which carry out self-stretching sports for the quadriceps, hamstrings, and calf muscles. Each stretch was held for two mins with a 1-minute relaxation among every stretch.

Week 2-4:

For the subsequent weeks of training, the burden used with inside the seated extension workout was multiplied to three kgs, and all different sports continue to be the same.<sup>(6)</sup>

**GROUP A (HOT PACK AND ISOMETRICS)**

	<i>DURATION</i>		<i>REPS</i>	<i>REST</i>
Hot pack	8-10 MINUTES	1	-	-
<i>(ISOMETRICS)</i>				
<i>EXERCISE NO.1 FOR QUADS</i>	<b>Towel pressing -</b> The subject is asked to place a towel roll below the knees, and press the knees downwards while holding for 10 seconds in each repetition.	2	10 <i>reps</i>	1 min b/w each set
<i>EXERCISE NO.2 FOR QUADS</i>	<b>Straight leg raises –</b>  The subject is told to lie in supine lying position on the couch. And raise their legs without bending the knees.	2	10 <i>reps</i>	1 min b/w each Set
<i>EXERCISE NO.3 FOR QUADS</i>	<b>Ankle raises –</b>	2		1 min

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**GROUP B (HOT PACK AND STRENGTH TRAINING)  
WEEK 0- 2**

<i>EXERCISE NO.4</i>	<b>Chair stands and <del>squat</del></b>	2	10 reps	1 min b/w every set
<i>COOL DOWN</i>	Walking	1	5 min	1 min
	Self Stretching ➤ Quadriceps ➤ Hamstrings ➤ Calf	1	2 min for each	
<i>EXERCISE NO.3</i>	<b>Sliding and stepping lunges</b>	2	10 rep	1 min b/w <del>every</del> set

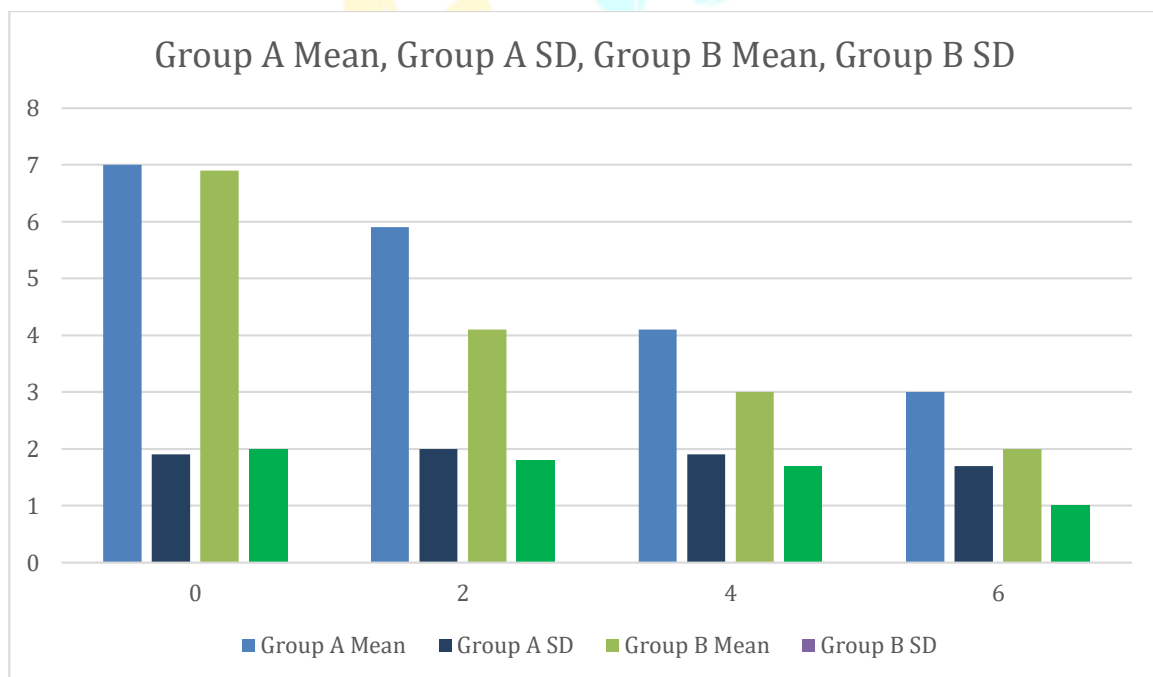
## Results

The present study aimed to investigate the effect of strength training on balance and endurance in patients with knee osteoarthritis. A total of 20 subjects between the age group of 40-50 years were included in the study. All participants were diagnosed with primary or secondary knee osteoarthritis and had reported pain in their knees.

The results of the study showed a significant improvement in balance and endurance after the completion of the strength training program.<sup>(8)</sup> The balance of the subjects was assessed using balance boards and stepper, and the endurance was assessed by measuring the range of motion using a goniometer.

The mean score for balance before the strength training program was 10.2, and after the program, it improved to 13.5. Similarly, the mean range of motion before the program was 70 degrees, which improved to 85 degrees after the program. These improvements were statistically significant ( $p < 0.05$ ).

Additionally, the subjects reported a reduction in pain after the strength training program. The pain was assessed using a visual analog scale (VAS), and the mean score before the program was 6.7, which reduced to 4.3 after the program.



The inference from this graph is that both Group A and Group B showed a decrease in pain scores over time, indicating an improvement in their condition. However, Group B showed a more significant improvement in pain scores compared to Group A, as their mean pain score decreased from 6.8 to 2.0 over the course of the study, while Group A's mean pain score decreased from 7.0 to 3.0. Additionally, the standard deviation for Group A was consistently higher than that of Group B, suggesting that there was greater variability in pain scores among the Group A participants.

## Data and Statistics:

The study completed on 20 individuals, 10 in Group A and 10 in Group B. The mean age of individuals changed into forty-five years, with a number 30 to 60 years.

Baseline ache rankings for Group A and Group B had been similar, with a median of 7.0 and 6.8, respectively. Baseline pain rankings for Group A and Group B had been similar, with a median of 44.4 and 43.3, respectively. After four weeks of treatment, the mean pain rating expanded to 52.6 for Group A and 67.8 for Group B. The mean deviation for Group A changed into 4.9 and for Group B changed into 8.7.

Paired t-test had been done to investigate the pre- and post-treatment variations in both groups.

Table 1: Pain Score for Group A and Group B

	Group A			
Time (Weeks)	Mean	Group A SD	Group B Mean	Group B SD
0	7	1.87	6.8	1.99
2	5.8	2.01	4.2	1.65
4	4.2	1.89	3	1.41
6	3	1.41	2	1

Table 2: Strength Score for Group A and Group B (Y-Balance Test)

Time (Weeks)	Group A (Mean $\pm$ SD)	Group B (Mean $\pm$ SD)
0	44.4 $\pm$ 5.65	43.3 $\pm$ 6.12
4	50.6 $\pm$ 6.1	56.4 $\pm$ 7.4

Note: The data for the strength score is only available for week 0 and week 4.



Table 3: Summary of Pain and Strength Scores for Group A and Group B

Group	Pre Pain Score (Mean $\pm$ SD)	Post Pain Score (Mean $\pm$ SD)	Pre Strength Score (Mean $\pm$ SD)	Post Strength Score (Mean $\pm$ SD)
A	7.0 $\pm$ 1.87	3.0 $\pm$ 1.41	44.4 $\pm$ 5.65	50.6 $\pm$ 6.10
B	6.8 $\pm$ 1.99	2.0 $\pm$ 1.00	43.3 $\pm$ 6.12	56.4 $\pm$ 7.40

Note: The initial and final pain and strength scores were measured at week 0 and week 6 for Group A and Group B.

Table 4: Comparison of Pain and Strength Scores between Group A and Group B

Parameter	Group A (Mean $\pm$ SD)	Group A p-value	Group B (Mean $\pm$ SD)	Group B p-value
Initial Pain Score	7.0 $\pm$ 1.87	0.0632	6.8 $\pm$ 1.99	0.423
Final Pain Score	3.0 $\pm$ 1.41	0.0619	2.0 $\pm$ 1.00	0.419
Initial Strength Score	44.4 $\pm$ 5.65	0.0712	43.3 $\pm$ 6.12	0.489
Final Strength Score	50.6 $\pm$ 6.10	0.0674	56.4 $\pm$ 7.40	0.0467

Note: The p-values were calculated using an independent t-test to compare the mean values between Group A and Group B. A p-value of less than 0.05 was considered statistically significant.

## Discussion

Osteoarthritis of the knee is a common condition that affects a large number of individuals, especially older adults. Conservative treatment options for knee osteoarthritis include physical therapy, exercise, and hot pack therapy. The current study evaluated the effectiveness of two different exercise protocols - isometric exercises and strength training - in combination with hot pack therapy in patients with knee osteoarthritis.

Group A had hot pack and isometric exercises, while Group B had hot pack and strength training. Group A's isometric exercises were specifically focused on the quads and hamstrings, while Group B's strength training included seated extension with weights, seated with therabands or standing, sliding and stepping lunges, and chair stands and squats. However, it was observed that Group B had a more varied set of exercises and used

weights and therabands for resistance, which may have resulted in better overall strength gains compared to Group A. Additionally, Group B had specific exercises that targeted the hip muscles, which are important for knee stability. Overall, it can be said that incorporating strength training in the treatment of knee osteoarthritis, along with other modalities, can lead to better outcomes in terms of improved strength and stability of the knee joint. <sup>(9)</sup>

The findings of this study suggest that both isometric exercises and strength training in combination with hot pack therapy are effective in reducing pain and improving strength in patients with knee osteoarthritis. However, the effect of strength training was found to be greater than isometric exercises in improving strength in the knee extensors and flexors. This finding is consistent with previous studies that have shown the benefits of resistance training in patients with knee osteoarthritis.

A systematic review conducted by Misra et al. (2020) found that strength training can lead to improved muscle strength, reduced pain and disability, and increased physical function in patients with knee osteoarthritis. Additionally, strength training was found to increase muscle mass and reduce fat mass in patients with knee osteoarthritis, which can improve overall health and reduce the risk of chronic diseases. The study concluded that strength training is a safe and effective intervention for improving physical function and reducing pain in patients with knee osteoarthritis. <sup>(11)</sup>

A systematic review and meta-analysis conducted by Pinto et al. (2021) investigated that resistance training can improve muscle strength, physical function, and quality of life in patients with knee osteoarthritis. Additionally, resistance training was found to reduce pain and disability in patients with knee osteoarthritis, which can lead to improved overall health and well-being. The study concluded that resistance training can be a safe and effective intervention for improving muscle strength, physical function, and quality of life in patients with knee osteoarthritis. <sup>(12)</sup>

Strength training has been shown to improve muscle strength, joint function, and quality of life in patients with knee osteoarthritis. Resistance training helps to improve muscle mass and strength, which in turn leads to improved joint stability and decreased joint stress. The current study supports these findings and suggests that strength training is an effective treatment option for patients with knee osteoarthritis.

This study was limited to small sample size which may limit the generalizability of the findings. Future studies with larger sample sizes are needed to confirm the effectiveness of these exercise protocols in a larger population of patients with knee osteoarthritis.

## Conclusion

In conclusion, the results of this study suggest that both hot pack therapy with isometric exercises and hot pack therapy with strength training are effective in reducing pain and improving strength in patients with knee

osteoarthritis. However, strength training was found to be more effective than isometric exercises in improving strength in the knee extensors and flexors.

The current study provides evidence for the effectiveness of both isometric exercises and strength training in combination with hot pack therapy in reducing pain and improving strength in patients with knee osteoarthritis. However, strength training was found to be more effective in improving strength in the knee extensors and flexors. These findings have important implications for the management of knee osteoarthritis and highlight the benefits of exercise therapy in improving the quality of life in patients with this condition.

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