

<https://doi.org/10.48047/AFJBS.6.15.2024.13111-13119>



African Journal of Biological Sciences

Journal homepage: <http://www.afjbs.com>



Research Paper

Open Access

Effects of Pulsed Ultrasound with Exercise in Comparison to Low Level Laser Therapy With Exercise in Persons Having Knee Osteoarthritis

Krishnanggi Saikia¹, Dr. Manisha Madhukar Tonape²

¹Intern, Department of Physiotherapy, The Assam Kaziranga University

²Associate professor and HOD, Department of Physiotherapy, The Assam Kaziranga University

Volume 6, Issue 15, Oct 2024

Received: 15 Aug 2024

Accepted: 25 Sep 2024

Published: 21 Oct 2024

doi: [10.48047/AFJBS.6.15.2024.13111-13119](https://doi.org/10.48047/AFJBS.6.15.2024.13111-13119)

Abstract:

Knee OA slowly progressing and primarily non-inflammatory degenerative disorder of the synovial joints is portrayed by joint agony and solidness, which every now and again causes actual handicap, and influences personal satisfaction and working ability. Conventional treatments include physical therapy treatment like exercise program and electrotherapy modalities (Therapeutic Ultrasound, Interferential Therapy, Transcutaneous electrical nerve stimulation, shortwave diathermy, LASER, Infrared radiation) in symptoms of improving knee osteoarthritis. Ultrasound can help relieve pain and improve physical function by using high frequency sound waves to create vibrations that reach deeper tissues. Low level laser therapy is a non invasive technique that helps in Knee OA by reducing pain, inflammation and tissue restoration. The present study was done to compare and evaluate the effectiveness between Low Level Laser Therapy with exercise and Ultrasound with exercise in Knee OA patient. In this study, 30 patients were recruited based on inclusion and exclusion criteria. Two groups were made, each of 15 patients who were treated with 2 different treatments (Low Level Laser therapy with exercise that is group A and Pulsed Ultrasound therapy with exercises that is group B) for total 10 days. The pre assessment was taken on the 1st day and the post assessment was taken on the 12th day where pain was assessed using Numerical pain rating scale (NPRS) and function was assessed using Western Ontario and McMaster University Osteoarthritis Index (WOMAC). It was found that low level laser therapy along with exercises showed greater effect than pulsed ultrasound along with exercises. The improvements can be attributed to the analgesic effect and increase of tissue regeneration effect in laser combined with exercise which helped in prolonged positive effects in reducing pain and improving function in persons having knee osteoarthritis.

Keywords:

Knee Osteoarthritis, Low Level Laser Therapy, Ultrasound, Numerical pain rating scale, Western Ontario and McMaster University Osteoarthritis Index.

List of Abbreviation:

KOA- Knee osteoarthritis

SLR- Straight leg raise

US- Ultrasound

LIPUS- Low Intensity Pulsed Ultrasound

LLLT- Low Level Laser Therapy

ROM- Range of motion

WOMAC- Western Ontario and McMaster Universities Osteoarthritis Index

NPRS- Numerical pain rating scale

ITB- Iliotibial Band Syndrome

Introduction:

Knee Osteoarthritis is a chronic degenerative joint disease which causes degeneration of the articular cartilage that decreases the synovial fluid that lubricates the knee joint [1]. Knee OA is portrayed by joint agony and solidness, which every now and again causes actual handicap, and influences personal satisfaction and working ability. The risk factors for knee and hip OA include heredity, aging, sex (female), race, occupation (physical labour), obesity, hypertension, aberrant joint strength lines, weak muscle strength, high-intensity exercise, and a history of joint damage [2]. Knee osteoarthritis is the commonest form of osteoarthritis which leads to pain, joint stiffness, muscle weakness, joint deformity, and restricted range of motion due to which activities in daily life limited and impairs quality of life. Pain around the joint is the most typical sign of OA. Pain can be dull, acute, ongoing, or sporadic. Mild to excruciating pain can exist. The range of motion may be reduced. Muscle weakness and grinding or popping noises could be heard [3].

Conventional treatments include pharmacological, non-pharmacological and surgical interventions, among which non-pharmacological treatments include physical therapy interventions, lifestyle modifications [4]. The physical therapy treatment includes exercise program and electrotherapy modalities (Therapeutic Ultrasound, Interferential Therapy, Transcutaneous electrical nerve stimulation, shortwave diathermy, LASER, Infrared radiation) in improving knee osteoarthritis.

Recently there has been seen increase use of low level laser therapy to treat osteoarthritis. Low level laser therapy has clinical benefits in pain reduction and functional improvement [5]. Low level laser therapy has monochromatic light source and analgesic effect which helps in anti-inflammation over the area [6]. Low level laser therapy combined with exercise results in positive outcomes in reducing pain; improve function, range of motion and quality of life [7]. In a systemic review it was found that low level laser therapy neither showed early nor later benefits in pain reduction and function [8]. The effect of application of low level laser therapy on knee osteoarthritis patients with quadriceps weakness or atrophy showed positive results by reducing the muscle weakness and improving pain, increasing muscle strength, improving the functional activity by increasing the walking speed in knee osteoarthritis patients.(8). Also short term efficacy of low level laser therapy can be done to reduce pain and improve

function in knee osteoarthritis with the parameters of 904 wavelength, 700Hz frequency, gallium arsenide laser for 50 seconds with 3J dose [9].

Pulsed ultrasound is also one of the most used modality in treating knee osteoarthritis. A study showed that Pulsed Ultrasound was more effective than continuous ultrasound as Pulsed ultrasound showed positive results in reducing pain as well as in improving knee function but in continuous mode ultrasound only pain relief was seen and there was no any significant improvement in functional activity, ROM, strength [10,11].

Several studies had shown exercise is the core treatment for knee osteoarthritis. stretching and strengthening exercises is effective in improving pain, function and strength gain as due to pain there can be seen muscle weakness around the knee joint [12]. Quadriceps isometrics with hip abductor isometrics helps in reducing pain, improves function, disability [1]. A study on strengthening of hamstring and quadriceps with stretching of hamstring showed positive results in improving pain, stiffness, physical function than the group that only received strengthening of quadriceps and stretching of hamstring which concluded that due to balance in the treatment protocol in both the muscle the first group showed positive results, improve in ROM was due to stretching which led to increased muscle flexibility [13].

There are not sufficient studies done on the comparison of effects of pulsed ultrasound and low level laser therapy in person having knee osteoarthritis. Also the studies which are done presents disputes. Between the effects of the modalities and results vary on which of the modality is beneficial for the treatment. This study has been done to evaluate the effectiveness of low level laser therapy along with exercises and pulsed ultrasound along with exercise in pain reduction and improving functional activity in knee osteoarthritis.

Methods and Materials:

1. **STUDY DESIGN:** Comparative
2. **SAMPLE SIZE:** 30 Participants
3. **SAMPLING METHOD:** Convenient sampling technique.
4. **TREATMENT DURATION:** 10 days.

Materials:

1. Plinth
2. Goniometer
3. Pillow/ towel
4. Pen
5. Paper
6. Cotton/ tissue paper
7. Bed sheet
8. Low Level Laser

9. Pulsed Ultrasound (frequency of 1 MHz)

Inclusion Criteria:

1. Participants having knee OA with age group of 40 to 60 years.
2. Participants of pain scale between moderate to severe.
3. Both males and females.
4. Participants those are willing to participate in the study & take treatment.

Exclusion Criteria:

1. Pain with less than or equal to 4.
2. Participants who went through recent trauma/fractures in lower limb, with recent surgery to knee or below hip.
3. Participants that are currently using intra articular corticosteroids/ painkillers and also used within 6 months of treatment.
4. Participants with neurological deficits, any tumor, implant around leg or varicose veins
5. Participants who are not interested in the study.

Procedure:

The study was done with 30 participants who matched with the inclusion and exclusion criteria. Everything about the treatment safety and protocol were explained to the participants. Consent from was signed by all the participants.

Assessment was done for all participants by assessing pain with NPRS, and function by WOMAC on the first and last day of the study and treatment was given for 10 days for both the groups. Pulsed Ultrasound combined with exercise (Group A) was given to 15 patients and the low level laser therapy with exercises (Group B) was given to other 15 patients.

Group A was given Pulsed Ultrasound with exercise as mentioned above. The ultrasound machine was set up in pulsed mode with frequency of 1 MHz and power of 2W/cm². The participants were in supine position and ultrasonic gel was applied over the affected area. Then the ultrasound was applied in circular motion to the medial and lateral aspects of the knee. Ultrasound was given for 8 minutes each session for 10 days.

Group B was given Low Level Laser Therapy with exercise as mentioned above. The laser that was used during the treatment was a scanning low level laser therapy. The participant was said to lie down supine with their knee flexed to 30 degree. Then the laser was given with the wavelengths of 1 MHz for 3 minutes, then again 16 MHz for 3 minutes and then 17 MHz for 3 minutes. In this way 3 times laser is given to the patients for total 9 minutes for 10 days.

Both the groups were given common exercises along with the modalities. The exercises that were given are:

1. Straight leg raise: The participant is asked to lie supine. Bend unaffected knee, foot on the floor. Keep the affected leg straight toes pointed up and rise for around 5 seconds. And repeat it 10 times.

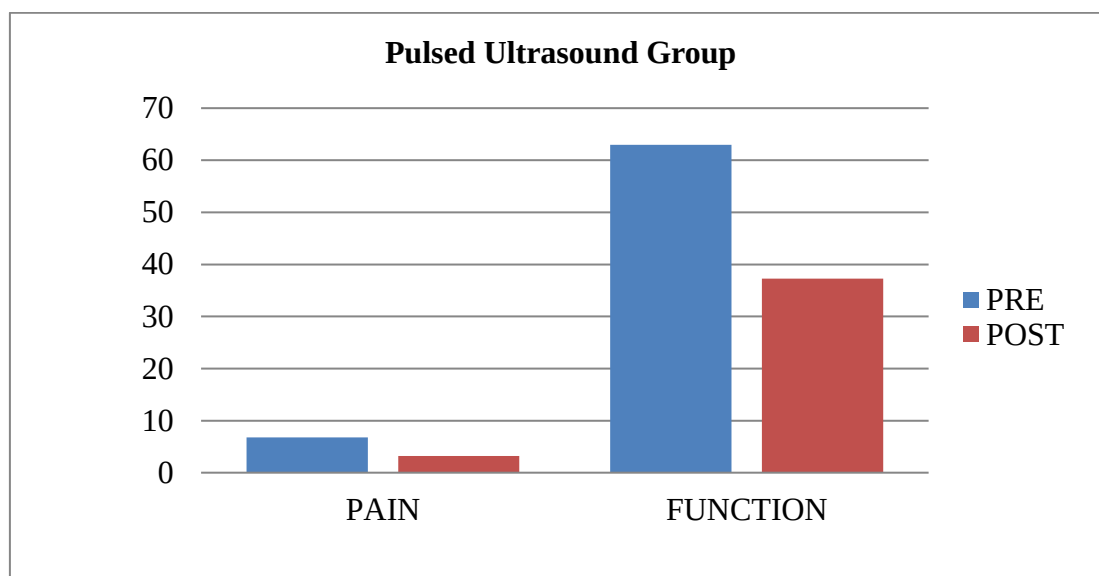
2. Quadriceps isometric exercise: The participant is asked to lie supine. Under the knee a pillow should be given or a towel folded up. Then the participant is told to press the pillow as hard as they can for 5 seconds. 10 repetitions should be done.
3. Supine heel slides: The participant is asked to lie supine with legs straight. Then bend the knee and slide the heel up by flexing the knee and the slide the heel back down.
4. Pillow squeeze: The participant is asked to lie supine. Then flex both the knees and a pillow is placed between them, then with both the knees the pillow is asked to squeeze as hard as the participant can. The pillow should be squeezed for 5 seconds and 10 repetitions should be done.
5. Seated knee extension: The participant is asked to gently seat in a chair. Then extend the affected knee while sitting and hold for 5 seconds. 10 repetitions should be done.
6. Hamstring stretching: The participant was asked to lie supine with knees straight at first, then loop a bed sheet around the affected foot and let the participant hold the bed sheet's end. Then use the bed sheet to pull your leg straight up for 30 seconds. 2-3 repetitions should be done.

Data Analysis & Results:

Table 1: Pre and post value results for the effects in Group A:

Group A	Pre	Post	P Value
Pain	6.8±1.24	3.2±0.26	P < 0.05
Function	62.99±10.10	37.26±5.11	P <0.05

Graph 1: Pre and post results for the effects in Group A:

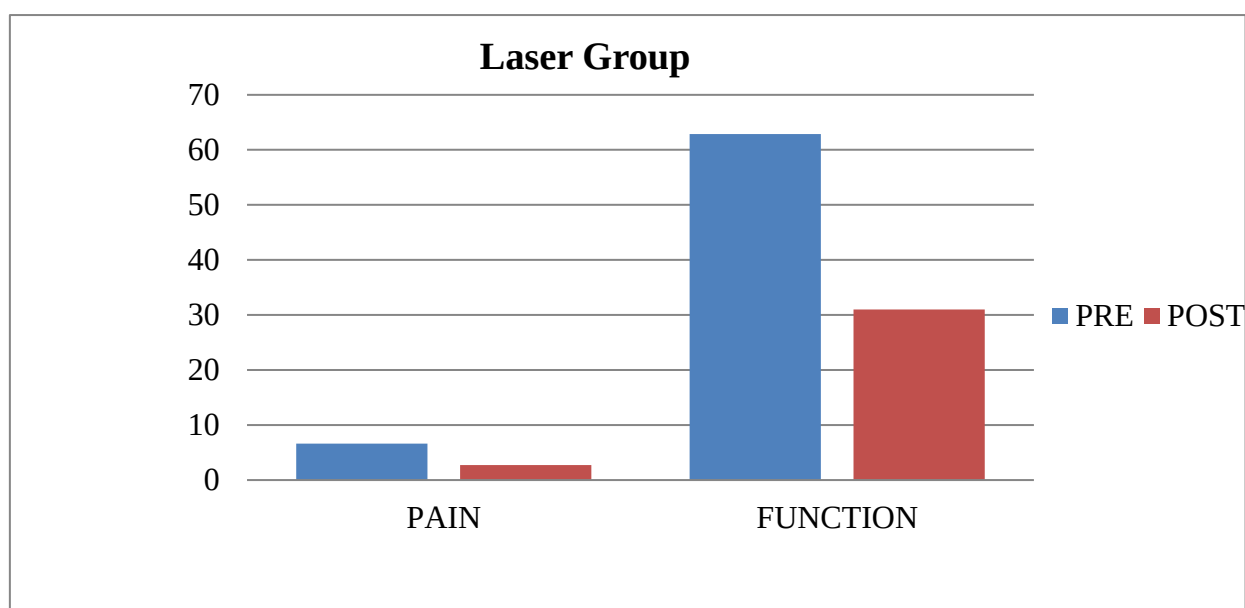


Graph 1 showed the pre and post values of the participants that was given Pulsed Ultrasound with exercise for pain and function. The graph showed above resulted in significant decrease in pain measured using Numerical Pain Rating Scale (NPRS) and improvement in function using Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) of persons having knee osteoarthritis. The mean and standard deviation in terms of pain prior to the treatment was 6.8 ± 1.24 and post to treatment was 3.2 ± 0.26 . in terms of function, the mean and standard deviation prior to the treatment was 62.99 ± 10.10 and post to the treatment was 37.26 ± 5.11 . Both the pre and post test values are statistically significant as $P < 0.05$.

Table 2: Pre and post results for the effects of Group B:

Group B	Pre	Post	P Value
Pain	6.6±1.18	2.7±0.65	P < 0.05
Function	62.89±10.11	31.02±6.30	P < 0.05

Graph 2: Pre and post results for the effects in Group B:

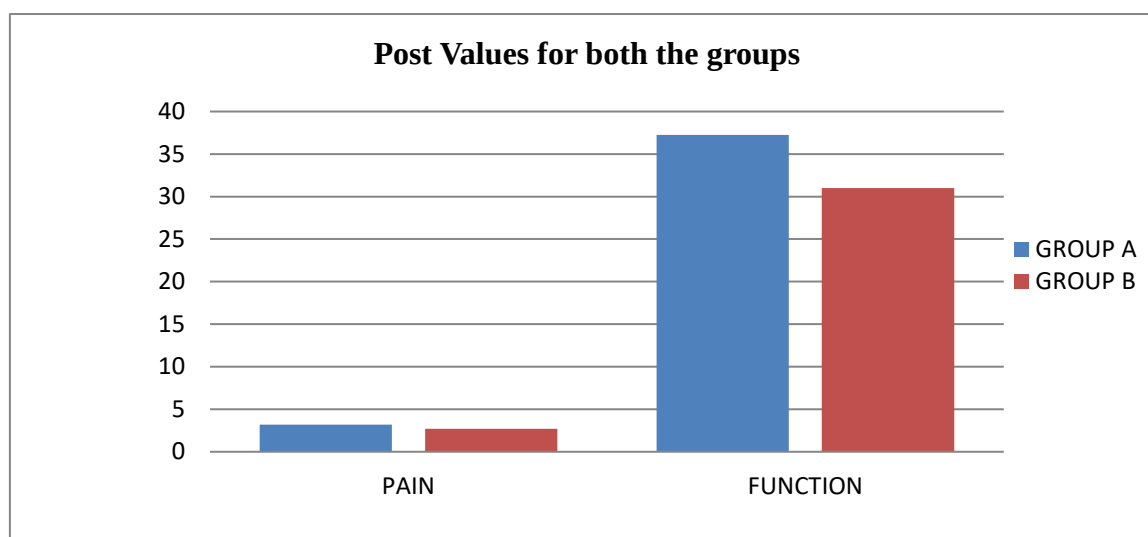


Graph 2 showed the pre and post values of the participants that was given Low Level Laser Therapy with exercise for pain and function. The graph showed above resulted in significant decrease in pain measured using Numerical Pain Rating Scale (NPRS) and improvement in function using Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) of persons having knee osteoarthritis. . The mean and standard deviation in terms of pain prior to the treatment was 6.6 ± 1.18 and post to treatment was 3.2 ± 0.65 . In terms of function the mean and standard deviation prior to the treatment was 62.89 ± 10.11 and post to the treatment was 31.02 ± 6.30 . Both the pre and post test values are statistically significant as $P < 0.05$.

Table 3: Post Results for the effects of both the groups:

Parameters	Group A	Group B	P value
Pain	3.2±0.26	2.7±0.65	P <0.05
Function	37.26±5.11	31.02±6.30	P <0.05

Graph 3: Post results for the effects in both the Groups:



Graph 3 shows the post treatment mean values for both Group A and Group B in terms of pain (NPRS) and function (WOMAC). Using NPRS for pain the post mean and standard deviation values of Group A is 3.2 ± 0.26 and Group B is 2.7 ± 0.65 with a mean difference of 0.5, while WOMAC for function, the post mean and standard deviation values of group A is 37.26 ± 5.11 and for Group B is 31.02 ± 6.30 with a mean difference of 6.24. Both the groups are statistically significant with a p value of <0.05 .

Discussion:

The present study aimed to investigate the pain and function in persons having knee osteoarthritis by comparing the effects of Pulsed Ultrasound and exercise with Low Level Laser Therapy and exercise. Two groups were made where the first group was given Pulsed Ultrasound with exercise while the other group was given Low Level Laser Therapy with exercise for pain assessed by NPRS and function that was assessed by WOMAC. The study was done for 12 days where the first day and the last day assessments were done and for 10 days treatment was given. Both the groups showed statistically significant improvement within the groups. The study showed statistically significant improvements in Group B which was given low level laser therapy with exercise in pain reduction as well as in functional improvement as compared to Group A which was given pulsed ultrasound with exercise.

In group A, where Pulsed ultrasound with exercise was given and there has been seen significant improvement in pain reduction with a mean difference of 3.6 and functional improvement with a mean difference of 14.73 as pulsed ultrasound has non-thermal effects that increase tissue metabolism, enhance fibrous tissue extensibility and reduce pain [10].

In Group B, where Low level laser therapy with exercise was given and there has been seen significant improvement in pain reduction with a mean difference of 3.9 and functional improvement with a mean difference of 30.77. Laser works as an anti inflammation and when combined with exercise gives better results [6].

When in comparing both the groups (Group A & Group B) there has been seen slight improvement in pain reduction in group B as compare to group A but Group B had shown a greater effect in functional improvement than Group A. Low level laser helps in increasing tissue regeneration with analgesic effect that helps in faster pain reduction.

In a systemic review done by Leticia Ferronato et al. (2017) out of 6 reviews 5 studies proved laser was effective in decreasing pain and improving functional activity. The study also said that due to the analgesic effect present Patricia Pereira Alfredo et al. 2011 in laser it works as an anti inflammation when applied over the articular capsule and the exercise program given was similar for all the participants includes 10 minutes of warming up with 5 minutes of stretching, and strengthening exercises for 8 weeks 3 sessions a week, whereas the study suggested that the analgesia induced by laser helped in better performance of exercise program which helped into have prolonged analgesic effect [6,11]. In a double blind clinical trial by Vanessa Ovanessian Fukuda et al. (2011) evaluated the effects of LLLT in pain and functional improvement in persons having knee osteoarthritis, where 9 sessions of AsGa laser with wavelength of 904 nm, frequency 700Hz was given. The study showed significant positive results in decreasing the pain scale and increasing functional ability than the placebo group which supports the present study [9]. Cyuan-Fong Li et al. (2019) demonstrated in their study that single bout low level laser therapy over quadriceps is effective in reducing pain, gain strength and improve function in persons having knee OA [8]. In a randomized control trial done by Sarah Rubia Ferrira de Meneses et al. (2015) studies on low level laser therapy with exercise or only exercise where it was found both the interventions were effective in reducing pain, improve mobility function in knee OA but only the combined group was more effective in quadriceps shortening [14].

Ashraf Ramadan Hafez et al. (2014) reviewed on the management of knee osteoarthritis exercise like strengthening and stretching helps in reducing pain, disability and improve function and strength [12]. A study conducted by Sumit Raghav et al. (2023) on integrated exercise in pain and disability in persons having knee osteoarthritis where one group was given integrated exercise program that includes quadriceps isometric and hip abductor isometric exercise and the other group was given only quadriceps isometric exercise; both the groups were given exercise for 6 days a week for 3 weeks. The study results were found effective in reducing pain and improve function but the combined exercise group was found to be more effective which supports the present study [1].

In this study, there were positive results from both the groups in improving pain and function. Group B showed more positive outcomes in comparison to Group A as in Group B laser with exercise was given where we can say that due to the analgesic effect and increase of tissue regeneration effect in laser combined with exercise helped in prolonged positive effects in reducing pain and improving function in persons having knee osteoarthritis.

Conclusion:

This study concludes that Low level laser therapy along with exercise was effective in reducing pain and improving function in persons having knee osteoarthritis in comparison to the Pulsed ultrasound.

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