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Comparative Effectiveness of Class IV Laser Therapy Versus Conventional Electrotherapy Combined with Strengthening Exercises in Patients with Grade II Knee Osteoarthritis: A Randomized Comparative Study

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Abstract

Background: Knee OA is a common degenerative joint disease (DJD) that is associated with pain, functional impairments and poor mobility. Conservative treatment is commonly achieved using physiotherapy treatments including transcutaneous electrical nerve stimulation (TENS), therapeutic ultrasound and exercise therapy. The use of Class IV laser therapy has been highlighted recently due to its deeper tissue penetration and its photobiomodulatory effects.

Objectives: To compare the effectiveness of Class IV laser therapy along with strengthening exercises with strengthening exercises, TENS, and ultrasound therapy for patients suffering from grade II knee osteoarthritis.

Methods: The study design was a randomized comparative experimental study involving 60 participants with knee osteoarthritis (KOA) Grade II. The participants were randomly distributed in two groups (n = 30 in each group). Group A was treated with Class IV laser therapy and quadriceps/hamstring strengthening exercise program, and Group B was treated with TENS, therapeutic ultrasound and the same strengthening exercise program. Interventions lasted for four weeks. The Visual Analog Scale (VAS) for pain, the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) for functional assessment and knee range of motion (ROM) measured by a universal goniometer were used as outcome measures. Paired and independent t-test were used for pre and post data analysis.

Result: Both groups showed statistically significant improvements in pain relief, functional ability and knee ROM after treatment ($p < 0.05$). Group A, however, had significantly lower VAS and WOMAC scores and had a larger improvement in ROM when compared to Group B ($p < 0.001$). There were positive findings regarding the effectiveness of treatment and the percentage improvement in the Class IV laser therapy group.

Conclusion: Based on the findings, class IV laser therapy and strengthening exercises seem to be more effective than conventional electrotherapy modalities (TENS, ultrasound) and strengthening exercises on pain reduction, function and mobility in patients with Grade II knee osteoarthritis.

Keywords: Knee Osteoarthritis; Class IV Laser Therapy; High-Intensity Laser Therapy; TENS; Ultrasound Therapy; Physiotherapy; WOMAC; Rehabilitation.

1. Introduction

Osteoarthritis of the knee (KOA) is a common chronic musculoskeletal condition and an important contributor to pain, disability and diminished quality of life in the middle-aged and elderly population globally. Progressive degenerative joint disease, which involves the loss of joint function, synovial inflammation, formation of osteophytes, remodelling of subchondral bone and deterioration of articular cartilage [1,2]. With rising life expectancy and the global increase of obesity, the disease burden of knee osteoarthritis is likely to grow substantially, thus posing a major social and economic problem for health care systems [3].

The knee is the largest synovial joint in the human body and is important for weight bearing activities and locomotion including walking, climbing stairs, running, squatting, and maintaining postural stability [4]. Anatomically, the knee joint is composed of the articulating surfaces of the femur, tibia and patellar bone along with the static and dynamic structures such as the cruciate ligaments, collateral ligaments, menisci, joint capsule, quadriceps and hamstring muscles [4]. The knee is especially susceptible to degenerative changes because it is constantly subjected to mechanical loading and repetitive stress, particularly in older age and those with biomechanical abnormalities [5].

Osteoarthritis is no longer viewed as just a cartilage deterioration disease; it is now understood to be a diseased whole-joint with pathological changes occurring in cartilage, subchondral bone, synovium, ligaments, menisci and periarticular muscles [2]. Knee OA is a complex disease where mechanical, biochemical, inflammatory and genetic factors play a role in the progression of the disease [2,6]. Mechanical overload, ageing-induced changes in cartilage metabolism cause disruption of the extracellular matrix homeostasis with consequent degradation of collagen fibres and proteoglycans [6]. The chondrocytes are affected by these changes and express inflammatory mediators like interleukin-1 (IL-1), tumour necrosis factor-alpha (TNF-α) and matrix metalloproteinases (MMPs) that promote cartilage degradation and synovial inflammation [7]. This results in a progressive narrowing of joint space, osteophyte formation, subchondral sclerosis and deformity of the affected joints, all of which lead to pain and functional impairment [1,6].

There are several factors that have been linked to the onset and advancement of knee OA. This is due to loss of cartilage regeneration ability with age, and to the effect of cumulative mechanical stress over time, which is another important factor. Obesity is also an important risk factor, as it applies more compressive forces to the knee joint and causes systemic inflammatory response by the release of adipokines [8]. Knee injuries, such as tears in the ligaments, damage to the meniscus and fractures, may change joint biomechanics and worsen the degenerative process [9]. Other jobs associated with higher risk of osteoarthritis include activities that involve prolonged kneeling, squatting, lifting or repetitive loading [10]. Additionally, periarticular muscle weakness, especially at the quadriceps muscle, and genetic susceptibility play a major part in the onset of the disease and the disease progression [11].

The clinical picture of knee OA includes a slow onset of pain, morning stiffness of less than 30 minutes,

crepitus, swelling, decreased range of motion (ROM) and physical function impairment [12]. Weight-bearing activity often worsens symptoms and rest helps to ease them. As the disease advances, patients become more affected with daily activities like walking, climbing, rising from a chair or standing for long periods [13]. This means that these restrictions often lead to feelings of loss of independence, less participation in social activities and overall poorer quality of life.

The Kellgren and Lawrence (K–L) grading system [14] is a common method for using radiographs to measure the severity of knee OA. Grades IV and I refer to severe joint degeneration and deformity and doubtful/benign OA with minimal radiographic changes, respectively. Definite osteophyte formation with possibly joint space narrowing is termed as Grade II osteoarthritis and is an important stage for conservative treatment as structural changes are present but not severe enough to cause significant disability [14]. During this stage, early physiotherapeutic intervention could help to alleviate symptoms, improve function, and possibly help to decrease the rate of disease progression.

Pharmacological, surgery and conservative management are the current strategies employed in the treatment of knee osteoarthritis. Analgesic and anti-inflammatory drugs may be beneficial in providing symptomatic relief, but if taken for a long period of time can have adverse effects [15]. Surgical procedures like osteotomy and total knee replacement are only used in late-stage OCD when conservative treatment isn't enough [16]. Since it is non-invasive, physiotherapy is a fundamental part of the treatment plans for mild to moderate knee OA as it can help to reduce pain, enhance mobility and functional performance [17].

Exercise therapy is strongly recommended among the physiotherapy interventions as it enhances the strength of muscles, stability of the joint, and functional capacity. There are changes in joint loading, shock absorption and knee stability during movement when strengthening exercises are performed on quadriceps and hamstring muscles [18]. Many electrotherapeutic modalities can be used to help relieve pain and promote a faster recovery, in addition to the exercise therapy.

Transcutaneous Electrical Nerve Stimulation (TENS) is a commonly used non-invasive electrotherapy technique that has been shown to have analgesic effects via activation of sensory nerve fibres and modulation of pain transmission based on the gate control theory [19]. Another widely utilized modality is therapeutic ultrasound, which has thermal and mechanical effects, enhances local circulation, encourages tissue healing and decreases joint stiffness [20]. There is some long-term evidence of beneficial effects for both modalities in patients with knee osteoarthritis, but there is no consistency [21].

In the more recent past, Class IV laser therapy (also known as high-intensity laser therapy (HILT)) has become an innovative therapeutic approach in the field of musculoskeletal rehabilitation. Class IV laser therapy allows for greater penetration into deeper tissues, allowing for a more photobiomodulatory effect in deeper musculoskeletal structures, unlike low level laser therapy [22]. Laser therapy has been shown to increase tissue healing, release of inflammatory mediators, cellular metabolism, production of adenosine triphosphate (ATP), microcirculation and mitochondrial activity [23]. These physiological processes can play a role in knee OA pain alleviation, joint mobility and improved functional recovery [24].

There have been many studies examining the effect of laser therapy, TENS, ultrasound therapy and strengthening therapy alone, but few studies have compared their efficacy in patients with Grade II knee OA [21–24]. Moreover, there has been a lack of studies to date that have examined the effects of these interventions on standardized measures of pain intensity, functional disability and joint mobility simultaneously. Hence, it is clinically relevant to identify what is the best physiotherapy intervention and how to optimize rehabilitation outcomes.

The current study was conducted to evaluate the efficacy of Class IV laser therapy with strengthening exercises as compared to TENS, ultrasound therapy and strengthening exercises in Grade II KOA patients. This study might offer evidence for physiotherapists to inform the choice of rehabilitation interventions that are aimed at decreasing pain, increasing functional ability and improving knee joint mobility for people with knee OA.

2. Materials and Methods

2.1 Study Design

A randomized comparative experimental study with a pre-test and post-test design was conducted.

2.2 Participants

Participants were recruited if they were diagnosed with Grade II knee osteoarthritis (KL) class on the basis of the Kellgren–Lawrence classification. Only those who fulfilled the inclusion and exclusion criteria and gave informed consent could participate.

2.3 Randomization and Group Allocation

Participants were randomly assigned to one of two treatment groups:

Group A (Experimental Group):

- Class IV laser therapy
- Quadriceps strengthening exercises
- Hamstring strengthening exercises

Group B (Control Group):

- TENS therapy
- Therapeutic ultrasound
- Quadriceps strengthening exercises
- Hamstring strengthening exercises

Each group consisted of 30 participants.

2.4 Outcome Measures

The following outcome measures were recorded before and after the intervention period:

1. Visual Analog Scale (VAS) for pain assessment.
2. WOMAC Index for functional disability.
3. Knee Range of Motion (ROM) measured using a universal goniometer.

2.5 Intervention Protocol

The treatment sessions were supervised for four weeks. Both groups performed strength training exercises which were standardized to reduce confounding effects and consistency of rehabilitation.

2.6 Statistical Analysis

Data was analysed from a statistical point of view through statistical software. Within-group comparisons were done using paired t-tests and between-group comparisons were done using independent t-tests. A p-value of < 0.05 was considered as statistically significant.

3. Results

3.1 Participant Characteristics

Sixty people with a diagnosis of grade II OA of the knee finished the study. The participants were randomly distributed to two groups (30 participants in each Group) as follows: Group A (Class IV Laser

Therapy + Strengthening Exercises) and Group B (TENS + Ultrasound Therapy + Strengthening Exercises). None of the participants withdrew in the intervention period.

Table 1. Demographic Characteristics of Participants (N = 60)

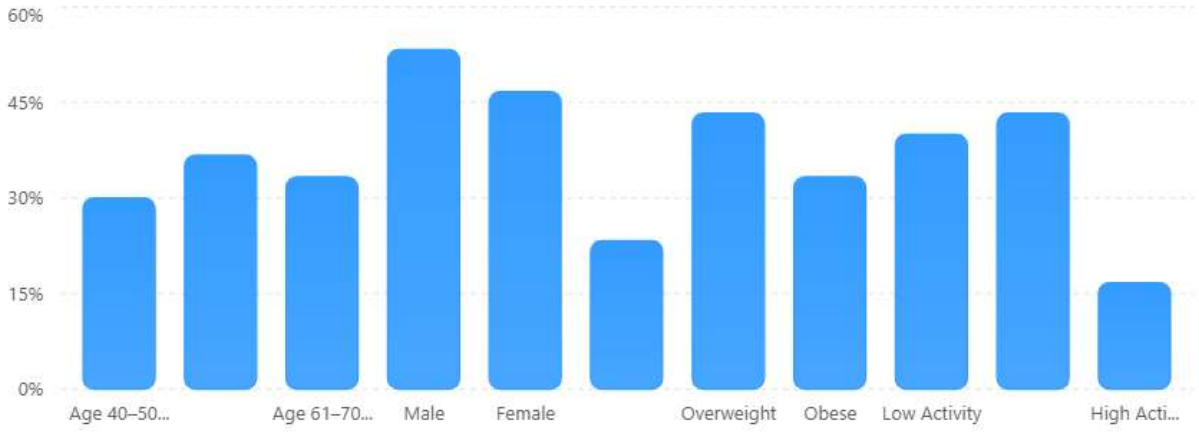
Variable	Category	Group A (n=30)	Group B (n=30)	Total (%)
Age	40–50 years	9	9	30.0
	51–60 years	11	11	36.7
	61–70 years	10	10	33.3
Gender	Male	16	16	53.3
	Female	14	14	46.7
BMI	Normal	7	7	23.3
	Overweight	13	13	43.3
	Obese	10	10	33.3
Physical Activity	Low	12	12	40.0
	Moderate	13	13	43.3
	High	5	5	16.7

Groups were successfully randomized with a similar demographic distribution. Most of the participants were in the age group 51-60 (36.7%), suggesting that symptomatic knee OA is more common in middle-aged than in other age groups. The vast majority were overweight or obese (76.6%) which was consistent with the well documented link between more weight and progressive OA. Treatment comparisons were made after controlling for the confounding effects of demographic variables due to their equal distribution.

Figure 1. Demographic Characteristics of Participants

Demographic characteristics of participants

Distribution of participants according to age group, gender, BMI category, and physical activity level (N = 60).



3.2 Within-Group Comparison of Outcome Measures

After the four-week treatment protocol, both groups of interventions showed statistically significant improvements in pain, functional ability and knee ROM.

Table 2. Within-Group Comparison of Outcome Variables

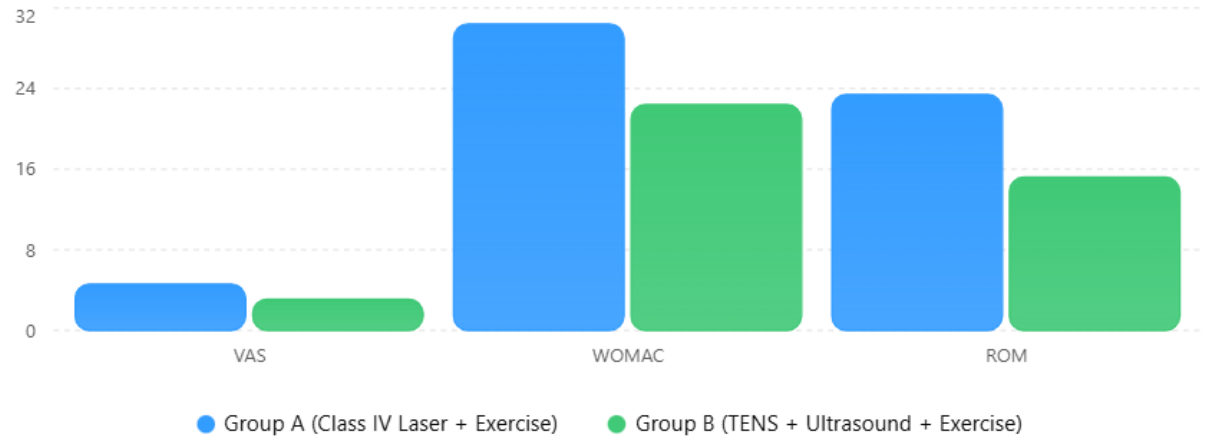
Outcome	Group	Mean Difference	t-value	p-value
VAS	Group A	4.6	9.12	<0.001
	Group B	3.1	7.22	<0.01
WOMAC	Group A	30.4	10.45	<0.001
	Group B	22.4	8.10	<0.01
ROM	Group A	23.4°	8.98	<0.001
	Group B	15.2°	7.18	<0.01

The paired t-test analysis showed that significant changes took place within each group following treatment. Larger mean changes were seen for Group A on all of the outcome measures, however. The pain and disability reduction were greater indicating that the Class IV laser therapy helped to provide additional therapeutic benefits over the traditional electrotherapy modalities and the knee mobility improvement was larger.

Figure 2. Comparison of Mean Improvements in Outcome Variables Between Group A and Group B

Mean Improvements in Outcome Variables

Comparison of mean improvements in pain (VAS), functional ability (WOMAC), and knee ROM between intervention groups.



3.3 Pain Outcomes (VAS)

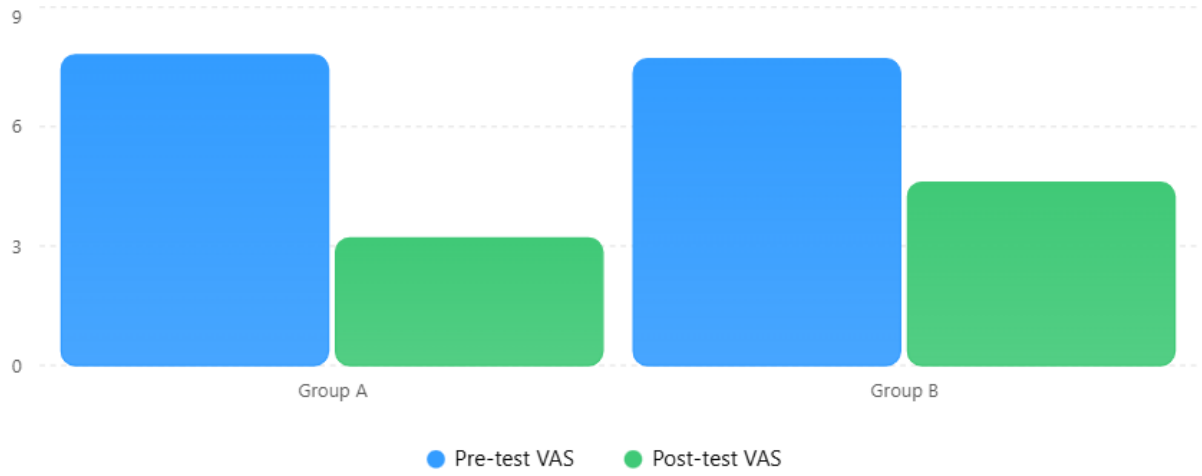
Table 3. Comparison of VAS Scores Between Groups

Group	Pre-test Mean ± SD	Post-test Mean ± SD	Mean Difference	p-value
Group A	7.8 ± 1.1	3.2 ± 0.9	4.6	<0.001

Group	Pre-test Mean ± SD	Post-test Mean ± SD	Mean Difference	p-value
Group B	7.7 ± 1.0	4.6 ± 1.1	3.1	<0.01

Both groups had the same intensity of pain at baseline. A significant decrease in VAS scores was seen after intervention. The pain intensity decreased by 58.9% in Group A and by 40.3% in Group B. The results of the present study suggest that a higher level of reduction is achieved in Group A, suggesting that the photobiomodulation mechanisms, reduction of inflammatory mediators and improvement in the healing process of the tissue may be more pronounced with Class IV laser therapy.

Figure 3. Comparison of Pre-test and Post-test VAS Scores Between Groups
Pre-test and Post-test VAS Scores
Comparison of pain intensity before and after intervention in Group A and Group B.



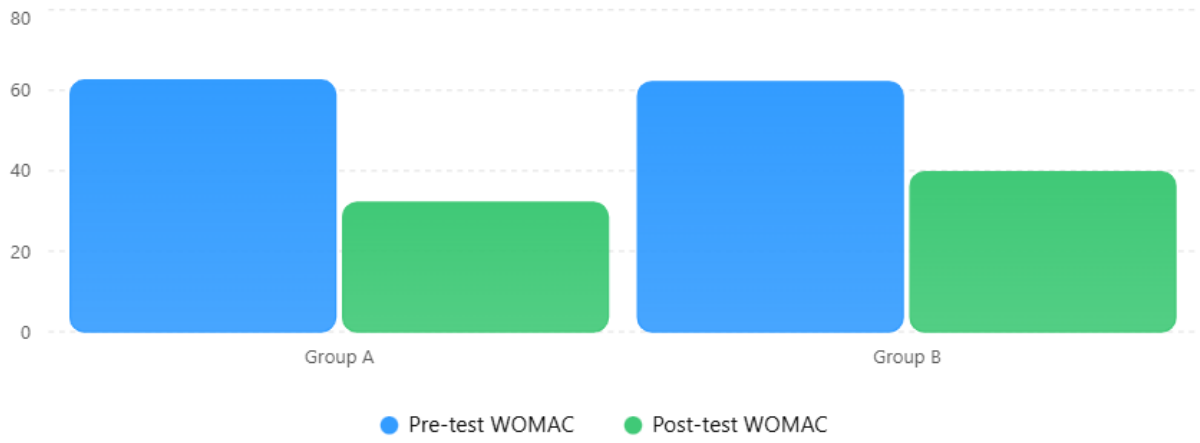
3.4 Functional Outcomes (WOMAC)

Table 4. Comparison of WOMAC Scores Between Groups

Group	Pre-test Mean ± SD	Post-test Mean ± SD	Mean Difference	p-value
Group A	62.5 ± 5.4	32.1 ± 4.2	30.4	<0.001
Group B	62.1 ± 5.8	39.7 ± 5.1	22.4	<0.01

Both groups experienced statistically significant functional gains after treatment. Group A had more improvement in their WOMAC score (48.6%) than Group B (36.1%) did, however. Results showed that those with Class IV laser therapy had better outcomes for pain, stiffness and physical function. Better WOMAC scores indicate better walking, climbing stairs, standing and transferring ability.

Figure 4. Comparison of Pre- and Post-Intervention WOMAC Scores Between Groups
Comparison of WOMAC Scores Between Groups
Pre- and post-intervention WOMAC scores in Group A (Class IV Laser Therapy + Strengthening Exercises) and Group B (TENS + Ultrasound + Strengthening Exercises).



3.5 Knee Range of Motion Outcomes

Table 5. Comparison of ROM Scores Between Groups

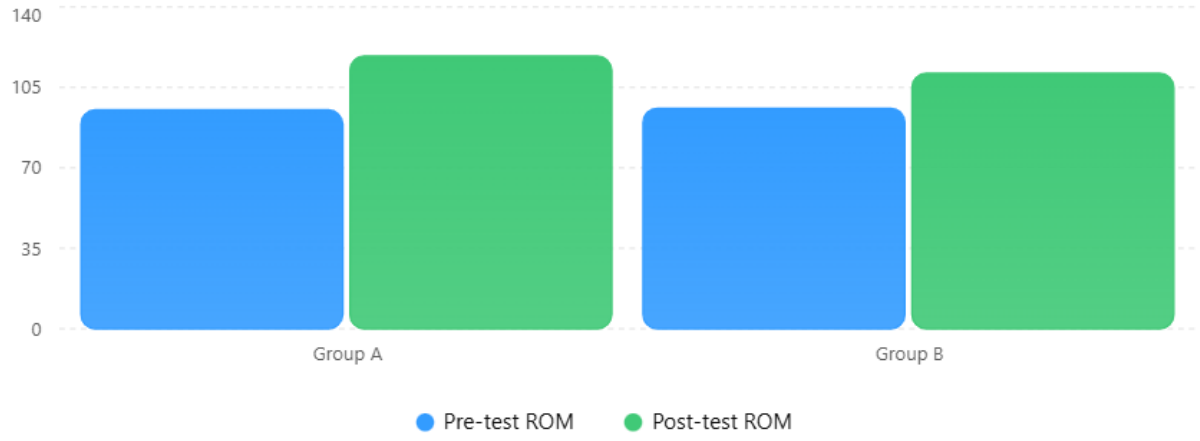
Group	Pre-test Mean ± SD	Post-test Mean ± SD	Mean Difference
Group A	95.2 ± 6.3	118.6 ± 5.2	23.4
Group B	95.9 ± 5.9	111.1 ± 5.8	15.2

ROM of the knee significantly improved in both groups after intervention. The mean change for participants receiving Class IV laser therapy was 23.4° while for those receiving conventional electrotherapy, the change was 15.2°. The increase seen in the group A could be due to the decrease in pain experienced, as well as improvement in tissue extensibility and joint mobility as a result of the effects of laser therapy.

Figure 5. Changes in Knee Range of Motion (ROM) Before and After Intervention

Changes in Knee Range of Motion Before and After Intervention

Comparison of pre-test and post-test knee ROM scores between Group A (Class IV Laser Therapy + Strengthening Exercises) and Group B (TENS + Ultrasound + Strengthening Exercises).



3.6 Magnitude of Treatment Effectiveness

Table 6. Effect Size Analysis

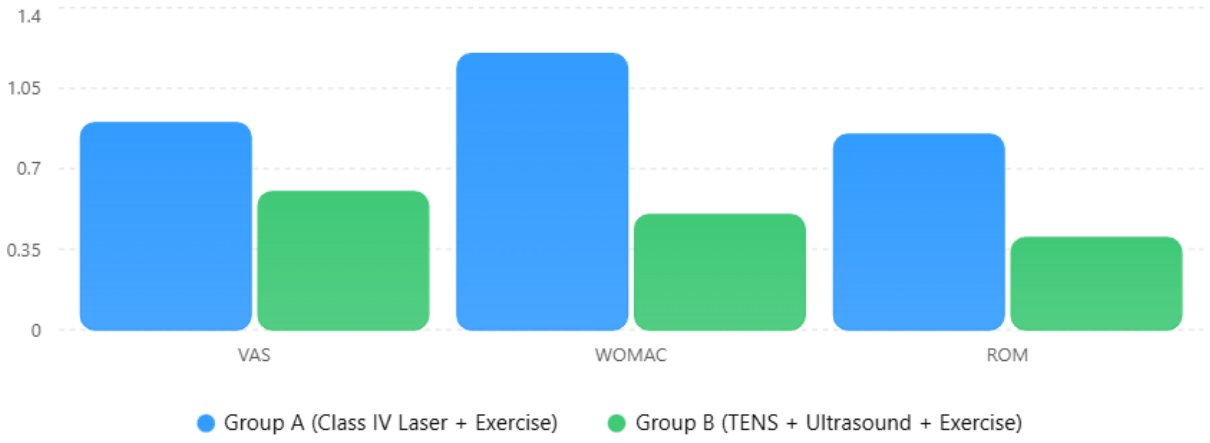
Group	VAS	WOMAC	ROM	Interpretation
Group A	0.90	1.20	0.85	Large
Group B	0.60	0.50	0.40	Moderate

Based on the standard of effect size analysis, the intervention given to Group A resulted in large clinical effect for all the outcome variables. Moderate effect sizes were seen in Group B, in contrast. The greatest effect size was found with WOMAC (1.20) which indicated significant improvement in overall knee function for participants who received Class IV laser therapy. The results of this study further reinforce the statistical results and substantiate the superior clinical effectiveness of laser therapy and strengthening exercises.

Figure 6. Effect Size Comparison Between Intervention Protocols

Effect Size Comparison of Treatment Protocols

Comparison of effect sizes for pain (VAS), functional ability (WOMAC), and range of motion (ROM) between Group A and Group B.



Both treatments were effective in decreasing pain and increasing ROM at the knee and functional ability in patients with Grade II knee osteoarthritis. Patients who received Class IV laser therapy and strengthening exercises, however, all had better results than those who received TENS, ultrasound therapy and strengthening exercises. The intervention led to higher effect sizes, greater improvements in ROM, and higher reductions in VAS and WOMAC scores, suggesting superior therapeutic efficacy and clinical relevance.

5. Discussion

The present study aimed to compare the effectiveness of the use of Class IV Laser Therapy and strengthening exercises in patients with Grade II knee osteoarthritis with that of TENS, ultrasound therapy, and strengthening exercises. The main outcomes measured included visual analog scale (VAS) pain scoring, universal goniometer knee joint range of motion (ROM), and WOMAC Index functional disability. The results showed that both groups (Class IV laser therapy and conventional electrotherapy

modalities) had statistically significant improvements in all parameters evaluated; however, subjects receiving Class IV laser therapy showed greater improvements in pain, functional improvement and knee mobility than subjects receiving conventional electrotherapy modalities.

Demographic Characteristics

The demographic analysis showed that most of the participants were in the age group of 51-60 years followed by the age group 61-70 years. The results are also in line with the epidemiological observations made by Hunter and Bierma-Zeinstra (2019) who found that age was one of the strongest epidemiological risk factors for the development and progression of knee OA. Articular cartilage degeneration with age, chondrocytes losing their ability to regenerate and the cumulative mechanical stress play a significant role in the onset and progression of the disease.

Many of the respondents in the current study were overweight or obese. Bliddal et al. (2014) reported a strong correlation between severity of osteoarthritis and body weight, which is similar. As body weight increases, so do compressive forces in the tibiofemoral joint, and body weight also activates the adipokine mediated pathways which result in chronic, low-grade inflammation. These factors contribute to cartilage degeneration and deteriorate functional impairment.

To compare outcome variables before and after starting/finishing the program.

Before any intervention, the baseline comparison of VAS and WOMAC and ROM scores showed no statistically significant differences between the two VAS, WOMAC, and ROM scores indicating that the two groups were comparable at the beginning of the study. This homogeneity will increase the internal validity of the study and indicate that the differences of the studies post treatment are likely to be related to the treatment protocols rather than differences between groups prior to the treatment.

A similar baseline comparability was observed in the experimental and control group in the studies by Thomas and Reddy (2022) and by Rao et al. (2021) which administered laser therapy and conventional physiotherapy interventions, respectively.

Improvements that occur within each group after intervention

This study showed statistically significant decreases in pain, and increases in functional ability and knee ROM in both treatment groups. The results show that both intervention groups were clinically effective for the management of grade II knee OA.

This improvement seen in Group B can be attributed to the known therapeutic effect of TENS, ultrasound therapy and strengthening exercise. Based on the gate control theory by Melzack and Wall (1965), TENS stimulates sensory afferent fibres, which activates pain inhibitory mechanisms and thus results in analgesia (Johnson, 2020). Likewise, ultrasonic therapy has beneficial effects on the local circulation, healing of tissues and decreasing the joint stiffness because of thermal and mechanical effects (Draper & Prentice, 2021).

The efficacy of strength training exercises seen in both groups occurred in parallel with the results of Fransen et al. (2015) who found that exercise therapy was effective in reducing pain, physical function and improving quality of life in people with knee OA. Similarly, Deshmukh, Rao, and Kulkarni (2017) found that strengthening and balance exercises enhance joint stability and functional mobility in elderly patients with O.A.

The Visual Analog Scale (VAS scores) were used to measure pain reduction

The present study revealed that Group A had a significantly greater reduction in pain (4.6 points on the VAS) when compared with Group B (3.1 points on the VAS). The results of this study indicate that laser therapy is more effective than traditional electrotherapy treatments for pain relief.

PBM effects may be responsible for the greater pain reduction with Class IV laser therapy. High intensity laser therapy has a stimulating effect on the activity of mitochondria, stimulates the production of ATP, improves metabolic processes in cells, increases microcirculation and decreases inflammatory mediators in the affected tissues. These physiological reactions lead to reduced nociceptive signalling and promotion of tissue repair.

Present results corroborate the results of Rao et al. (2021) who found a significant decrease in pain intensity after high intensity laser therapy and strengthening exercises in KN participants. Likewise, Mehta and Kulkarni (2020) found that laser therapy was more effective and quicker for producing an analgesic effect than traditional physiotherapy treatments.

Thomas and Reddy (2022) further reported that the pain score in the participants receiving Class IV laser therapy was significantly lower than those under traditional rehabilitation therapy. They found that laser therapy not only alleviated pain, but also enhanced the engagement of people in exercise-based rehabilitation programs.

Functional Improvement (WOMAC Scores)

Both groups had significant improvements in functional disability with the WOMAC Index, but the improvement was greater in Group A. This improvement in WOMAC scores provides more evidence for better functional recovery and performance of activities of daily living in the laser therapy group.

The combination of pain reduction, muscular strength and joint mobility may account for the improvement in the WOMAC scores. With reduced pain, patients are more willing and able to engage in functional activities like walking, climbing stairs, standing and transferring from a sitting to a standing position.

The results of the present study corroborate the Nair and Joseph (2022) findings of a significant difference in improvement scores for the patients undergoing Class IV laser therapy and ultrasound therapy, according to the WOMAC scores. They found that laser therapy was more effective in decreasing disability and overall functional performance.

Likewise, Patil et al. (2020) showed that strengthening exercises significantly improved functional mobility and disability in people with knee OA. Their results confirm the role of exercise therapy as a key element of the rehabilitation program. This is corroborated by the results of the study conducted by Kulkarni et al., (2018) which showed that the holistic physiotherapy approach enhances function and physical performance in osteoarthritis patients leading to enhanced functional independence.

Progress in ROM (range of motion)

In the present study, both groups showed significant improvement in knee joint ROM, with Class IV laser therapy showing a greater improvement. This improved ROM can be attributed to decreased pain, muscle guarding, soft tissue extensibility and inflammation around the knee joint.

Laser therapy has been shown to speed the healing of the tissue and enhance the circulation in the periarticular tissues. These physiological changes may lead to increased flexibility and efficiency of movement, which is beneficial in enhancing ROM.

The present study's results are also corroborated by those of Iyer, Nair and Thomas (2021), who cited the significant improvements in knee mobility after Class IV laser therapy in patients suffering from osteoarthritis. The authors proposed that laser-induced photobiomodulation stimulates tissue repair mechanisms and aids restoring joint movement.

Similarly, Rao et al. (2021) found significant enhancements in ROM and gait function following high-intensity laser therapy. Kulkarni et al. (2018) also found that physiotherapy modalities along with

strengthening exercises enhanced physical performance in the patients of osteoarthritis and also improved the flexibility of the joints.

Between-Group Comparison

All outcomes' measures showed highly significant differences between the groups with Group A showing the best results. The results indicate that the combination of class IV laser therapy with conventional physiotherapy is more effective than conventional physiotherapy alone, despite the fact that conventional physiotherapy is also effective.

This increased effectiveness may be due to the deeper penetration seen when using laser therapy as opposed to TENS or ultrasound therapy. TENS mainly works through neural pain modulation, whereas Class IV laser therapy affects cellular metabolism, inflammatory pathways, circulation and tissue healing processes, all at once. Class IV laser therapy has a comprehensive effect on cellular metabolism, inflammatory pathways, circulation and tissue healing processes, while TENS works mainly through neural pain modulation. The mechanism of action is multifactorial, which is responsible for its better therapeutic efficacy.

The present findings corroborated with those of Nair and Joseph (2022) who found better clinical outcomes after laser therapy than ultrasound therapy and Rao et al. (2021) who observed greater improvements after laser therapy than the TENS-based rehabilitation protocols.

Clinical Significance

The percentage improvement and effect size analyses also validated the clinical superiority of class IV laser therapy. Such results have clinical significance because they demonstrate statistically significant changes as well as clinically relevant improvements in function and patient quality of life when using laser therapy.

The findings are congruent with the existing guidelines focusing on multimodal rehabilitation strategies for knee OA. Exercise therapy and evidence-based physical modalities are recommended as primary treatment modalities for patients with mild to moderate OA (Kolasinski et al., 2020). The findings of the present study add to the evidence for the use of class IV laser therapy as an adjunctive therapy in the treatment of grade II knee osteoarthritis in the rehabilitation setting.

Overall, the results indicated that class IV laser therapy with strengthening exercises is a more complete therapeutic option than traditional electrotherapy modalities, resulting in a greater reduction in pain, increase in functional performance and mobility of the knee joint.

5. Clinical Implications

Class IV laser therapy could be used as an adjunct therapy for the recovery of Grade II knee osteoarthritis.

Laser and strengthening exercises could work hand in hand to improve treatment results.

High intensity laser (HIL) therapy may be added to evidence-based treatments by physiotherapists for patients who present as having persistent pain and functional restriction.

6. Limitations

- Relatively small sample size.
- Short intervention duration.
- Absence of long-term follow-up.
- Single-centre study design.

7. Future Recommendations

Further, larger and multicentre randomized controlled trials with longer follow-up are suggested. Future studies should explore the optimal parameters of laser dosage and examine the long-term effects/structural changes of laser treatment on osteoarthritic joints.

8. Conclusion

In patients with Grade II knee osteoarthritis, each intervention successfully improved pain and functional ability and knee range of motion. Class IV laser therapy, however, proved to be most effective with strengthening exercises than other combinations, such as TENS and strengthening or ultrasound and strengthening exercise. The results confirm the use of Class IV laser therapy in physiotherapy rehabilitation programmes in the conservative treatment of knee osteoarthritis.

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