Research Article

Comparative Effects Of Low-Intensity Laser Therapy With And Without Kinesio Taping On Pain, Range Of Motion, Functional Disability And Performance In Patients With Knee Osteoarthritis: A Randomized Clinical Trial

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ABSTRACT

Background and Objectives: Knee osteoarthritis (KOA) is a common chronic joint disease affecting cartilage, leading to symptoms like joint pain, stiffness, and swelling. It affects around 34% of adults aged 65 and over, causing significant medical expenses and reduced quality of life. The objective of the study was to compare the effect of Low Intensity Laser Therapy (LILT) and traditional knee exercise (TKE) with and without Kinesio taping (KT) on pain, range of motion, functional disability, and performance in knee osteoarthritis (OA) patients.

Methods: A randomized clinical trial was carried out and a total of 30 diagnosed patients of knee OA with age range between 40-70 years was included in the trial and assigned randomly into two groups. Group A received LILT and KT with traditional exercises (Isometric strengthening exercises for quadriceps and hamstring, active ankle pumping exercises, static and dynamic strengthening exercises) and Group B received LILT with traditional exercises. The treatment plan consists of 12 sessions (three times a week for a total of four weeks). Knee ROM was measured by goniometer, Western Ontario and McMaster Universities index (WOMAC) was used for measuring functional disability with its sub scales (pain, stiffness and function), and physical performance was evaluated by 30 second chair sit to stand test (30CST) in addition to 6-minute walking test (6MWT).

Results Mean age of patients in group A and B was 56.1±7.9 and 52.8 ± 5.8 years respectively. Analysis revealed that there was statistically significant difference in VAS ROM, 6 min walk test, WOMAC and CST scores of both groups after the treatment of 4 weeks with p-value <0.05. Group A showed greater improvement in pain, ROM, physical performance and functional disability than group B.

Conclusion: Positive effects were seen in both groups, but LILT and traditional exercises with KT were found to be more effective in improving pain, knee flexion range of motion, functional disability and physical performance in KOA patients.

Key Words: Knee osteoarthritis, Kinesio tape, Low-level laser therapy, Pain, WOMAC

Introduction

Knee osteoarthritis (KOA) accounts for the majority of osteoarthritis (OA) cases worldwide and is associated with obesity and aging. It is characterized by cartilage loss, bone hypertrophy, subchondral sclerosis, and alterations in the synovial membrane and joint capsules. KOA causes more disability and symptoms than any other joint disorder. Its prevalence is increasing, particularly among middle-aged women (1).

In 2020, there had been approximately 654.1 million people who were of age forty year and above with knee OA globally, with an estimated worldwide incidence of about 203 per 10,000 person-years in adults twenty years old and above. The burden is higher in Asians compared to Europeans and North Americans, with South America having the lowest prevalence. The incidence and prevalence ratios are in men and women is 1.39 and 1.69, respectively (2).

The knee joint consists of the patellofemoral and tibiofemoral joints. OA can affect either or both, with the patellofemoral joint typically affected first. In people with knee pain, OA commonly affects both joints, followed by isolated patellofemoral or tibiofemoral OA. It can occur unilaterally or bilaterally, often affecting the medial side of the knee. Bony enlargement, crepitus, reduced range of motion, joint discomfort, and pain are physical signs of osteoarthritis (OA) in the knee. Symptoms include pain, stiffness, and physical dysfunction, affecting quality of life and daily activities like climbing stairs or housekeeping. Limited range of motion, swelling, quadriceps weakness, and bony spur formation are characteristic features of KOA (3).

Patients with knee osteoarthritis (OA) commonly seek medical attention and rehabilitation due to pain, which is the primary reason for seeking treatment. Early management of knee OA is recommended by various guidelines and public health organizations to modify the disease's course, including its anatomical and clinical features (4).

Conditions like osteoarthritis (OA) can worsen or be worsened by biomechanical malalignment in the knee. To address this, strategies such as exercise, taping, orthosis, and manual treatments are used to correct biomechanical issues in the management of OA (5).

Among the non-pharmacological interventions, low-level laser therapy (LLLT) and Kinesio taping (KT) have gained attention for their potential therapeutic effects in knee OA management. LLLT, also known as cold laser therapy or photo biomodulation, involves the application of low-level lasers or light-emitting diodes to irradiate tissue, purportedly promoting tissue repair, reducing inflammation, and relieving pain (6). Several clinical studies have reported significant improvements in pain, function, and quality of life following LLLT in patients with KOA (7, 8).

Kinesio taping, on the other hand, utilizes elastic therapeutic tape to support and stabilize muscles and joints, potentially alleviating pain and improving function through biomechanical and neurosensory mechanisms (9). Recent systematic reviews and meta-analyses have indicated potential advantages in terms of pain alleviation and functionality improvement, despite the paucity of data supporting the effectiveness of Kinesio taping in knee OA (10, 11).

Up to our best knowledge there is no research done on mild cases of KOA. Previous studies focused only on moderate to severe cases with small sample size. The research was inconclusive about the efficacy of LLLT in treatment of KOA and there is a lack of research in the comparative effects of the LLLT and traditional exercises with and without KT. On other hand the research investigation will add value of combination effects of LLLT and KT with traditional knee exercise that may suggest a comprehensive management for knee OA in future. Therefore, our research focuses on the comparative effects of KT and LLLT. This combination would be a helpful measure that can add benefits of KT, since it is non-invasive and causes almost no adverse side effects. Group A underwent LLLT and traditional exercises with KT, where as group B undergone LLLT and traditional exercises as the baseline group.

Materials and Methods

The study was a Double blinded randomized clinical trial (the outcome measure assessor and the patient were blinded to the hypothesis of the study).

The sample size was calculated through the Epitool Software Version Sergeant ESG 2018.The confidence interval is 0.95 and the variance is taken as 0.8. The sample size was thirty, with fifteen in each group. The sample size was calculated using pain as the outcome measure. All patients who suffer from KOA and fulfilling the inclusion were included in the study. The participants were randomly divided into two groups with grade 1–4 Kellgren-Lawrence, radiographic confirmed knee OA. The participants were randomly divided by using sealed opaque envelopes method. Group A (LLLT**+** TKE+ KT group) and Group B (LLLT**+** TKE only). The Assessor measured the outcome measures before and after the intervention protocol. The study conducted in two specialized centers for the rehabilitation of patients with KOA: Babylon Physical Rehabilitation Center and Al-Imam Al-Sadiq Hospital.

Two groups of patients with KOA were assigned as follows: group A) low level laser therapy+ traditional knee exercises+ KT; group B) Low level laser therapy**+** traditional knee exercises alone. Both the groups performed common traditional exercise protocol. The patients received the treatment protocol under the supervision of the principle researcher. The intervention lasted for four weeks (three sessions per week, for a total of twelve sessions).

Selection criteria

The inclusion criteria of the study were both the male and female patients having unilateral knee osteoarthritis of 1 to 4 grades according to Kellgren-Lawrence with age range between 40-70 years, having pain from 40 mm to 70 mm in VAS scale for more than 3 months.(12)

Patients having history of following conditions were excluded: cancer, hip osteoarthritis, knee joint arthroplasty, ankylosis, receiving anti-depressants, using medication affecting bone and cartilage and usual contraindications for laser therapy such as (patients with cardiac conditions, or patient with long term NSAIDs usage) (7) and the same for kinesio taping such as (skin injury, fever, risk of thrombus, heart condition) .(13)

Data collection procedure

After getting ethical committee approval of TUMS and registering the trial of registry (RCTs) through Iranian Trial Registry IR.TUMS.FNM.REC.1403.164.The participants who fulfill the requirements for inclusion criteria were divided into intervention groups using the basic randomization procedure. Each participant have the chance to select an intervention group at random by picking up a little piece of paper that has number printed on from 1 to 30. The

subjects first assessed by a radiologist and be referred to a physiotherapy clinic following an orthopedic specialist's diagnosis. Orthopedic doctors evaluated radiographic imaging data to provide a radiographic severity level of the KOA based on the Kellgren and Lawrence (1957) scale (14).
After meeting the inclusion criteria, the participants have an examination and interview before providing their informed consent. Then a written informed consent was signed by the participant. All the participants were randomized into two groups: (Low level laser therapy+ traditional knee exercises + Kinesio tape) and (Low level laser therapy+ traditional knee exercises). The participants were divided into two groups using simple randomization. 30 cards were collected inside a bowl As the group A (LLLT**+** TKE+ KT), and group B (LLLT**+** TKE).

Group A received low level laser therapy and traditional exercises(Isometric strengthening exercises for quadriceps and hamstring, active ankle pumping exercises, static and dynamic strengthening exercises) with Kinesio taping (15). Group B received Low level laser therapy with traditional exercises (Isometric strengthening exercises for quadriceps and hamstring, active ankle pumping exercises, static and dynamic strengthening exercises) (15). Furthermore, during the course of the trial, the participants were instructed not to consume non-steroidal anti-inflammatory medicines (NSAIDs) or analgesics in order to prevent the analgesic effects of these medications.
Low level laser Therapy: The intervention involved the use of scan diode laser of a company TheraLAS-30 made in China. Parameter included:
Point Size and Power Density: The size of the laser beam at the focus point was approximately 1 square centimeter (cm^2). With a power of 25mW over an area of 1 cm^2, the power density was also approximately 25mW/cm^2. The laser was operated in continuous wave mode. The laser was operated in continuous wave mode. The wavelength of the laser light was 905 nanometers (nm).
Dose Delivery: A dose of 6 Joules (J) was delivered at each point. The intervention targeted 8 points. This resulted in a total dose of 48 Joules per square centimeter (J/cm^2) over the treatment area.
Target Areas: The laser was directed at specific anatomical points including medial and lateral knee joint lines, epicondyles of the tibia and femur, posterior tendons of the biceps femoris muscle and semitendinosus muscle.(16)

Kinesio Taping Protocol (17) : Kinesio tape in blue and pink colors, made by the company Ares in Iran, was used. The patient was asked to relax and rest for 10 minutes prior the KT was applied to their knees. Patients received therapy using flexible kinesiology tape applied with supportive techniques targeting the quadriceps muscle, patellar alignment, and patellar tendon. The taping was done using the superior Y, inferior Y, and U-strip methods (18).

The superior Y technique: This is a quadriceps-specific method. The tape,was divided in two at one end, forming a 'Y' shape. The top end of the tape begins above the vastus medialis muscle in the center of the thigh. The thigh was slightly flexed, and its 'Y' separation was secured to the superior edge of the patella with about 25% tension. The knee was then flexed fully, and the ends of the tape were attached around the medial and lateral borders of the patella.(19)

The inferior Y technique: The tape started below the tibial tuberosity and was tension-free. It was moved to the inferior margin of the patella with twenty-five percent tension. The knee was fully flexed, and the 'Y' tape was wrapped around the patella's medial and lateral margins. The medial half terminates over the vastus medialis muscle, whereas the lateral part extends over the vastus lateralis.(20)

The U strip technique: The fifteen to twenty centimeters of tape was divided precisely in the middle and adhered to the patella's inferior border. The mechanical correction approach was used with around 50% tension. The patient's knee was flexed, and twenty-five percent of the tension was applied to the medial end in the direction of the vastus medialis, and the lateral end in the direction of the vastus lateralis.(21)

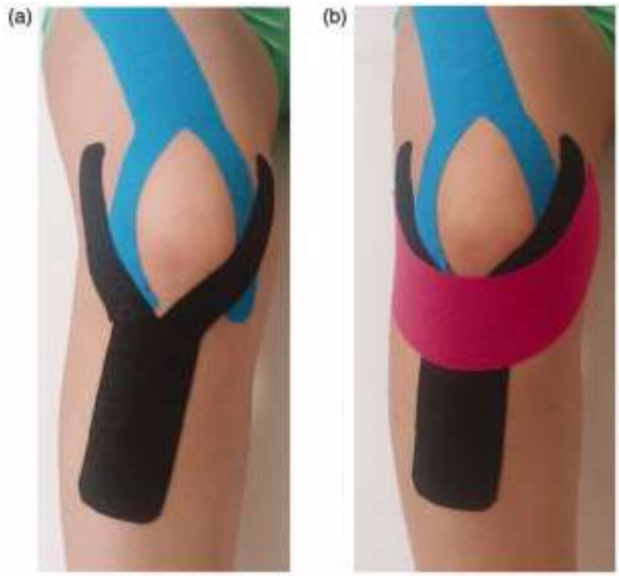

Figure 2: Application of superior and inferior and U shaped kinsio taping

Traditional exercise program: The exercise regimen includes quadriceps strengthening, non-load vastus medialis obliques (VOM) strengthening, hamstring strengthening, and stretching activities. The quadriceps muscle strengthening exercise was carried out supine with the knee extended, holding maximal isometric contraction for 10 seconds and doing ten repetitions of each set for three sets, with a 2-minute rest period after each set. The VOM strengthening was done with the patient reclining supine, knees extended, and the hip in external rotation, which was changed by the foot. The patients were then advised to practice leg raise exercises with alternating hip flexor contraction (breathing out) and relaxation (breathing in).

Data Collection Tools

To measure pain intensity before, during, and after the intervention, as well as at rest and during exercise, a visual analog scale (VAS) with 10-cm (100 mm) horizontal line meter-shaped scales and endpoints labeled 'no pain' and 'worst anguish possible' was utilized (22).

The passive knee extension test was used to assess the joint's range of motion and quality, particularly its "end feel" prior to and following the intervention. The exam can also measure the stiffness of the hamstring muscles. While the patient was lying supine, the hip of the tested leg was flexed at an angle of 90 degrees. On the test table, the other leg stayed flat. With the ipsilateral hip remained in 90-degree flexion, the physician extends the knee until the patient indicates the maximum acceptable strain of the hamstring muscles. Next, the knee angle was computed (23). The knee extension test was performed using a universal goniometer. The goniometer's axis should be positioned at the lateral epicondyle of the femur. The stationary arm should point toward the greater trochanter, whereas the moving arm should point towards the lateral malleolus (24, 25)

The WOMAC is a popular, valid, responsive, and reliable outcome measure for persons with knee osteoarthritis (26). The self-administered questionnaire consists of three subscales, each with twenty-four items: Five distinct regions of pain: standing up straight, walking, using stairs, sleeping, and sitting. Higher WOMAC ratings indicate increased functional limitations, stiffness, and pain. The evaluation area covers activities of daily living, functional mobility, gait, general health, and quality of life. Participants received a conventional paper version of the WOMAC index questionnaire, which they completed both prior to and following the intervention. WOMAC in Arabic was used (27); in order to prevent translation bias and make it easier for Arab patients to read and comprehend without the assistance of a translator. All patients who struggled to self-administer WOMAC evaluation questionnaires due to their inability to read and write were assisted by a caregiver or someone who was unaware of the instruments' purpose. The patient completed 6 MWT in a well-ventilated, silent, hard, and flat corridor with at least 20 m in between. (28). The distance traveled was measured using a measuring/trundle wheel. Muscular strength and endurance were assessed prior to and following the intervention using the 30-second chair sit-to-stand test (30CST). (29)

Statistical Analysis

SPSS version 27 was used for the analysis of the data. Both groups were equal in demographic distribution. The descriptive tests were applied for the analysis of the demographic data. The normality of data was check by Shapiro wilk test. The reference values were taken as 0.05. Data was normally distributed for VAS, Knee flexion ROM, 6 min walk test, and WOMAC. Parametric tests were applied on these variables. CST was not normally distributed so non parametric tests were used for this variable.

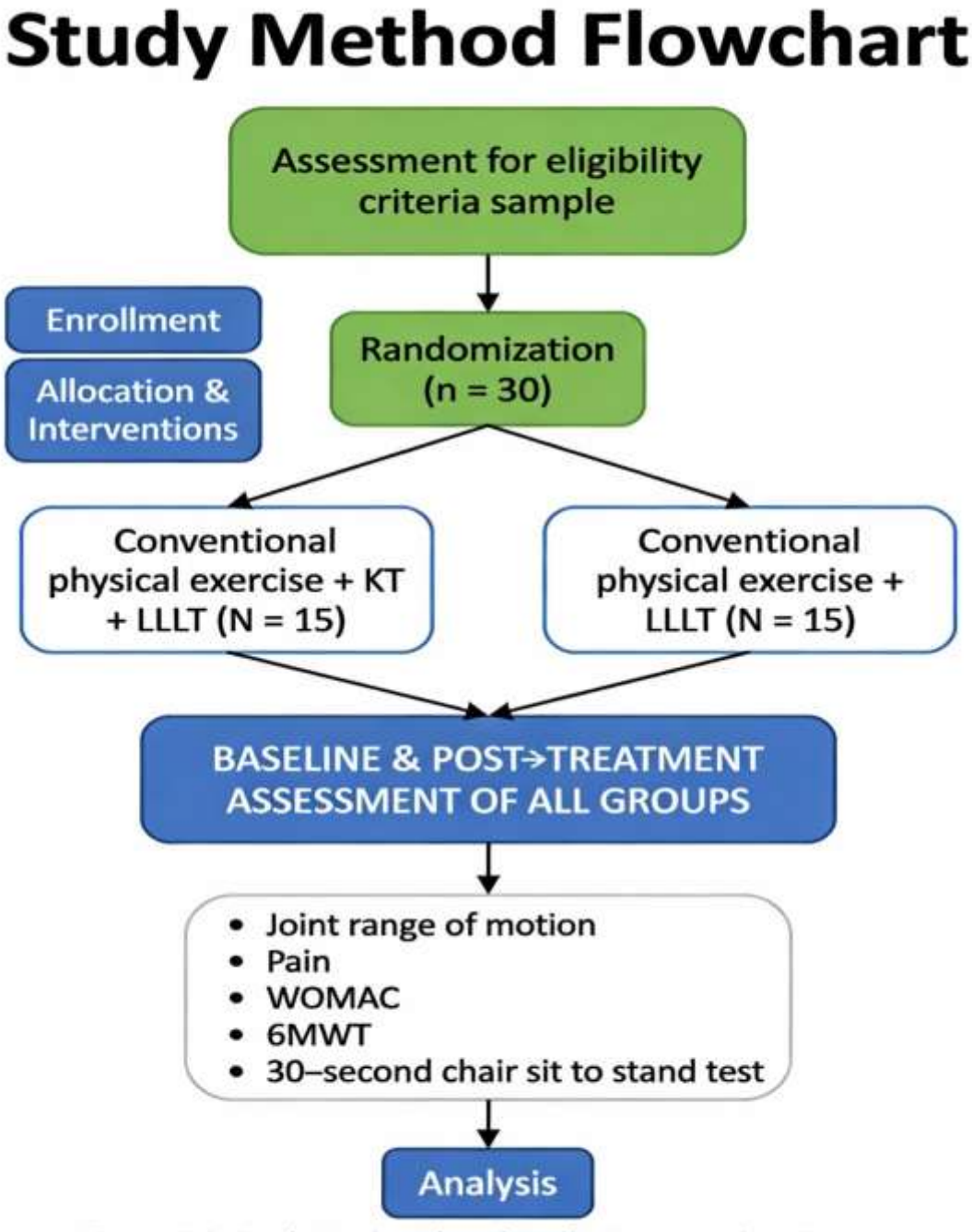

Figure 3.1: Study Design Flowchart for Intervention Groups

Figure 3: CONSORT Flow diagram

RESULTS

The demographic data of age, BMI, and Gender are given below In Table no 1: Participants in Group A had a mean age of 56.1 ± 7.9 years, while those in Group B had a mean age of 52.8 ± 5.8 years. Participants in both groups (Group A and B) were presented with mean BMI of 26.9 **±** 2.9 kg/m² and 25.7 **±** 3.5 respectively. The participants in this study included both males and females, with 12 males (40%) and 18 females (60%).

Table 1: Descriptive Statistics of group A and B

Variables	Group A (n= 15)	Group B (n= 15)	p-value
Age (years)	56.13±7.96	52.86±5.82	0.21
BMI (kg/m²)	26.92±2.98	25.77±3.50	0.34

S.D: Standard Deviation, N: Sample size, f: Frequency

Table 2 shows within group comparison of VAS, ROM, 6 min walk test and WOMAC which was done by using paired sample T-test. P-value showed a statistical significant difference in pre and post treatment values in group A as well as in group B (p-value <0.05).

Table 2: Within group analysis of VAS, Goniometer, 6 min walk test and WOMAC

	Groups	**Mean ± S.D**		Mean difference	P-value (2-tailed)
		Pre	Post		
Visual Analogue Scale (VAS)	A	6.2±1.03	2.1±0.9	-4.1±0.74	0.00*
	B	6.5±0.91	4.8±0.86	-1.73±0.96	0.00
ROM (degrees)	A	121±2.3	129±2.6	8.73±1.94	0.00
	B	120±2.3	124±2.7	4.1±2.7	0.00
6 min walk test	A	380.6±12.5	434.8±11.0	54.2±10.51	0.00
	B	379.3±12.2	400.8±11.8	21.5±9.14	0.00
Western Ontario and McMaster Universities index (WOMAC)	A	45.6±1.6	19.3±2.8	-26.26±3.34	0.00
	B	45.4±1.9	27.7±2.4	-17.73±3.08	0.00

The CST test was assessed two times during study i.e., at baseline and after treatment. Table 3 shows within group comparison of CST which was done by using Wilcoxon sign rank test. P-value showed a statistical significant difference in pre and post treatment values in group A as well as in group B (p-value <0.05).

Table 3: Within group analysis of 30 second chair sit to stand test (30CST)

Groups	Pre-treatment (Mean ± SD)	Post-treatment (Mean ± SD)	Mean Rank (Negative)	Mean Rank (Positive)	p-value
Group A (n= 15)	7.1 ± 0.3	12.0 ± 2.5	5.00	8.21	0.000
Group B (n= 15)	7.3 ± 0.7	8.7 ± 1.2	0.00	6.00	0.003

Table 4 shows the comparison of inter group statistics of pre and post-intervention values of VAS, ROM, 6 min walk test and WOMAC which was done by using Independent T-test. Analysis revealed that there was statistically significant difference in both groups after the treatment of 4 weeks with p-value <0.05. Group A showed greater enhancement in VAS ROM, 6 min walk test and WOMAC scores than group B.

Table 4: Between group analyses of VAS, Goniometer, 6 min walk test and WOMAC

Variable	Group A Mean Change (± SD)	Group B Mean Change (± SD)	Mean Difference (A–B)	p-value
VAS (mm)	–4.1 ± 1.9	–1.7 ± 2.0	–2.4	0.000
ROM (degrees)	+8.0 ± 2.0	+4.0 ± 2.2	+4.0	0.000
6MWT (m)	+54.2 ± 11.8	+21.5 ± 10.9	+32.7	0.000
WOMAC (%)	–26.3 ± 3.0	–17.7 ± 3.1	–8.6	0.000

Table 5 shows between groups comparison of pre and post treatment of CST score. P value of post treatment was <0.05 and results showed statistically significant difference (p <0.05) in both groups after the treatment of 4 weeks. Group A showed greater improvement in CST scores than group B.

Table 5: Between group analysis of 30 second chair sit to stand test (30 CST)

Group	N	Mean Change Score (Post – Pre)	Mean Rank	Z-score	p-value
Group A	15	+4.9 ± 1.2	22.00	–4.14	<0.001
Group B	15	+1.3 ± 0.9	9.00		

DISCUSSION

Results of the present trial revealed that a statistically significant improvement was found in both groups receiving LLLT & traditional exercises with KT and LLLT & traditional exercises. Although, LILT and KT with traditional exercises showed more improvement in pain, knee flexion range of motion, functional disability, walking distance, strength and endurance of the leg muscles in patients suffering with knee OA after the treatment plan consisted of 12 sessions (3 times a week for four weeks).

Laser therapy is widely employed to treat musculoskeletal disorders. The key effects of LLLT are pain alleviation and improved functioning. LLLT appears to modulate the inflammatory, proliferative, and remodeling elements of the healing process. Furthermore, LLLT's analgesic impact is accomplished by the suppression of synaptic activity in 2nd-order neurons, thus the pain processing area of the cortex is not activated (30). On the other hand, Kinesio taping is often used in conjunction with other treatments for musculoskeletal issues, as it promotes healing and regulates natural tissue processes. It effectively relieves pain by reducing pressure on pain receptors while also maintaining and preserving muscle tissue (31). In present research, the combination of LLLT and Kinesio-taping with traditional exercises showed better results in improving pain on VAS (MD: -4.1±0.74) as compared to Low level laser therapy with traditional exercises (MD: -1.73±0.96). Several prior investigations have demonstrated that the efficacy of LILT in alleviation of pain in patients of osteoarthritis. In line with the findings of our study, in 2016 a retrospective review of LILTin knee osteoarthritis by Bozzo et al. concluded 45% average reduction in self-reported pain scores after 4-6 LILT treatments (32). This study (32) supports the pain relieving effects observed by LILT in both groups of our study. Another study by Stausholm et al. (2019) discovered that low-level laser therapy (LLLT) decreases pain and impairment in KOA at 4 to 8 J with 785 to 860 nm wavelengths and at 1 to 3 J with 904 nm wavelengths per treated location (33). Our study concluded that when LLLT used in combination with KT, betters treatment outcomes can be seen in patient of KOA. The enhanced outcomes seen in our KT+LLLT group align with the study of KH Kim et al. they found a substantial improvement in balance, pain threshold, and blood flow in 32 patients with KOA following Kinesio-Taping with Laser Therapy for thirty minutes, 3 times a week for a total of four weeks. The border areas of the layers of soft-tissues are home to dynamic mechanoreceptors such interstitial receptors and Ruffini corpuscles. When the skin is taped with some stretch in a specific direction, the straining of the skin and layers of fascia alters, and afferent stimulation increases (20). Castrogiovanni and colleagues also showed that KT treatments with tension had a more substantial long-term pain alleviating effect in KO when compared to those without tension applications (34). Similarly, MAEH Mohamed et al. did a study to examine the positive effects of adding KT to low level laser treatment in relieving neuropathic pain after mastectomy, corroborating our findings and demonstrating the synergistic impact of these modalities in improving pain and function. Results demonstrated that the Neuropathic Pain Scale and visual analogue scale and were considerably lower in all groups after therapy in favor of group received LLLT and KT, as well as a conventional exercise regimen after 4 weeks (35).

In 2023, S Malik et al. concluded that LLLT combined with exercise therapy (ET) might alleviate pain at 4 to 8 J with a wavelength of 640 to 905nm per spot when used for ten to sixteen sessions at a frequency of two sessions per

week. However, LLLT along with ET is no superior than placebo in increasing ROM, muscular strength, and functioning of KOA (36). Although Malik et al. (36) concluded that LLLT with exercise was not superior to placebo for improving ROM, strength, and function, our study contradicts this by demonstrating statistically significant gains in knee flexion ROM and muscle strength in both groups treated with LLLT, with the improvement being more pronounced in the group treated with LLLT combined with KT and traditional exercises. Our study found a statistically significant improvement in Knee flexion ROM in both groups before and after the treatment of four weeks with a mean difference of 8.73±1.94 in group receiving LLLT and KT with traditional exercises and MD of 4.1±2.7 group receiving LLLT with traditional exercises. The superior outcomes in our KT group may be attributed to the effect of KT to enhances muscular flexibility and strength while increasing proprioception in individuals with diverse musculoskeletal problems (21). In the support of our results, in 2015, Cho et al. study revealed that, the range of joint ROM was improved considerably in the KT intervention group (19). Previous research by González-Iglesias et al. has demonstrated that a KT intervention can improve joint ROM. After the KT treatment, the ROM in various axes increased, and in both instances, sham taping was helpful in enhancing the active range (37). Furthermore, Cho et al. found that using KT not only decreased pain while walking, but also significantly enhanced deep sensation at three angles, which is consistent with past research in this field (19).

In 2019, a systematic review and meta-analysis by MB Stausholm et al. explored whether an LLLT dose-response association exists in KOA. Their findings revealed that LLLT decreases disability and pain intensity in Knee OA at four to eight J with 785 to 860 nm wavelength and 1to three J with 904 nm wavelength per treatment location, supporting the efficacy of the LLLT protocol used in our study as intervention (12). Temesgen et al. conducted a systematic study in 2020 to explore the usefulness of Kinesio Taping in the management of KOA. KT was discovered to improve both pain and physical function of patients with KOA, supporting the findings of our study where KT in combination with LLLT and exercises showed better outcomes (38). In our study Western Ontario and McMaster Universities index (WOMAC) was used for measuring functional disability with its sub scales (pain, stiffness and function) and results revealed that, LLLT and KT with traditional exercises showed a greater reduction in WOMAC scores (MD = -26.26 ± 3.34) compared to LLLT with traditional exercises alone (MD = -17.73 ± 3.08). In contrast to our study, F Tascioglu et al. found that administering a low power laser at 2 different dosages (active laser with three J/per painful spot and active laser with 1.5 /J/per painful spot) five times weekly for ten treatments did not significantly improve knee OA as measured by WOMAC, as well as pain intensity at rest and on activation on VAS (39). Castrogiovanni et al. investigated the influence of KT and exercise on physical limitations in people with knee osteoarthritis; at the end of the experiment, only fifty-seven people remained. Patients got assigned at random to 3 treatment groups. The first group is the exercise group; 2nd group is the exercise group with tensioned KT; and 3rd group is the exercise group without KT applied. Knee pain decreased, and knee joint functionality enhanced. For at least one-quarter of the patients who had KT with exercise, analgesics were taken less often. As a result, the investigators stated that KT therapy of the knee region combined with moderate exercise is a successful method for managing pain and motor deficits in persons with KOA (34). Another meta-analysis done in 2018 by Lu et al. looked at physical activity enhancement and reduction in pain in knee OA patients after using KT. The analysis of the data revealed a considerable improvement in the index of pain, VAS, ROM and WOMAC among the 308 patients who participated in the trial and were administered KT. However, due to the limited clinical data and weak scientific evidence in existing studies, the use of KT is still recommended to be guided by individual patient needs and clinical judgment (40).

PP Alfredo et al. conducted a trial on 40 patients with knee osteoarthritis to investigate the influence of a 3 J LLLT dosage paired with exercise on pain, ROM, functioning, muscular strength, and QOL. The findings suggest that LLLT, when paired with exercise, is beneficial in alleviating pain, enhancing functionality, and physical activity in KOA (41). In our research, a statistically significant improvement was seen in pre and post treatment in functional capacity on Six-minute walking test (6MWT) in both groups. The comparison of intergroup statistics revealed, a greater improvement in walking distance (MD = 54.2 ± 10.51 meters) in group receiving LLLT and KT with traditional exercises compared to Group B (MD = 21.5 ± 9.14 meters) receiving only LLLT with traditional exercises. In another descriptive, prospective study on KOA, H Soleimanpour et al. discovered a substantial reduction in night discomfort, pain when stepping, walking and climbing the steps, circumference of knee, distance through the hip and heel, and knee to horizontal hip to heel distance after delivering LLLT at least three times a week for a total of twelve sessions, further supporting the efficacy of LLLT used in our study (42). Findings of our research showed that LLLT when applied in combination with KT and traditional exercises showed better in functional capacity on Six-minute walking test (6MWT) after 4 weeks as compare to the other group received only LLLT and traditional exercises. Mutlu and

colleagues, who studied the effectiveness of KT for pain and improvement in functioning in individuals with KO, found that the KT and sham-taping groups significantly differed in how much pain was reduced during activities from the first taping application to the 3rd and up to the follow up of one-month (43). Despite the positive outcomes of KT, however, the data that is currently available on the application of KT for KOA pain reduction and functional improvement yields conflicting findings, despite the fact that scientific interest in the management of various pathologies has grown significantly in recent years, as has the number of researchers studying its effectiveness. Poor data quality and several methodological flaws are mostly accountable for this (44).

Jankaew et al. evaluated the beneficial effects of LLLT at 808 and 660 nm wavelengths on strength of muscles and function in forty-seven individuals with KOA. For the duration of eight weeks, two LLLT groups received continuous LLLT with an average power of 300 mW at varied wavelengths at the knee joint for fifteen minutes per session, three days per week. Both of the intervention groups performed better than the control group in terms of muscular strength and functional performance. The 808 nm wavelength group showed greater results in knee extensor strength (45). In our study, the 30 Seconds Chair Sit to Stand Test (30CST) was used to assess the strength and endurance of the leg muscles and results significant difference in both groups receiving LLLT & KT with traditional exercises and LLLT with traditional exercises, before and after the treatment of 4 weeks. While these findings of Jankaew et al. (45) support the efficacy of LLLT in improving lower limb function, we extend the current evidence by demonstrating that the inclusion of KT results in superior gains in muscle strength and endurance, as evidenced by a greater improvement in the 30 Seconds Chair Sit to Stand Test (30CST). This shows that KT may have a synergistic neuromuscular impact when combined with LLLT and exercise. In contrast to our study a study by PP Alfredo et al. found no significant difference in muscular strength and ROM between the treatment and placebo groups in knee OA after delivering a 3 J LLLT dose combined with exercise for 11 weeks (41). The variation in results might be related to methodological variables, such as LLLT dose and wavelength range, the addition of KT in one of our groups, and the outcome instruments used. Whereas Alfredo et al. may have relied on static strength assessments, our use of a functional performance-based outcome (30CST) may have captured neuromuscular alterations more sensitively, and particularly those impacted by proprioceptive and mechanical facilitation using KT. Güner et al. compared the impact of low-power laser vs kinesio-taping on pain, muscular strength, functioning, and electrophysiologic markers in patients of carpal tunnel syndrome. The study indicated that combining kinesio-taping with low-power laser therapy did not produce extra benefits in the short term. However, in the long run, grip and pinch strength increased (46). Although in our study the targeted population was KOA but combination of LLLT & KT with traditional exercises showed better results in improving strength and endurance of the leg muscles.

CONCLUSION

In conclusion, positive effects were seen in both groups, LILT and Kinesio taping with traditional exercises (Isometric strengthening exercises for quadriceps and hamstring, active ankle pumping exercises, static and dynamic strengthening exercises) and LILT with traditional exercises with Kinesio taping was found to be effective in improving all outcomes. But LILT and Kinesio taping with traditional exercises were found to be more effective in improving pain, knee flexion range of motion, functional disability and physical performance in knee osteoarthritis (OA) patients.

Ethics statement and conflict of interest disclosure: All ethical concerns were considered. This study received ethical approval from the Research Ethics Committees of the School of Nursing and Midwifery & Rehabilitation-TUMS as IR.TUMS.FNM.REC.1403.164. Written consent was taken from patients before data collection. The authors do not have any competing interest.

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