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ORIGINAL ARTICLE

Comparative Effectiveness of Low-Level Laser Therapy and Quantum Acoustic Waves in Patients with Chronic Low Back Pain

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ABSTRACT
Background: Low Back pain (LBP) is a primary source of years lived with bad health condition, with an expected 70–85 percentage of the people to experience LBP at some moments in their lives. It is typically defined as backache, muscle tightness above the inferior gluteal folds and below the costal border with or without radiating pain in leg. The most prevalent issue and a major contributor to morbidity in adults is low back pain (LBP). Acute LBP is pain that lasts less than 3 months, while chronic LBP is pain that lasts more than 3 months. Nearly two thirds of adults experience it at some point in their lives. LDH, or lumbar disc herniation, is one of the most frequent causes of LBP.
Objective: This study was intended to relate the effects of low-level-laser therapy and quantum acoustic waves on low-back-pain (LBP).
Methods: It was a quasi-experimental study conducted at KKT orthopedic spine center and laser pain management rehab clinic, Multan from February, 2023, to April, 2023. There were two groups in total. One group was provided with low-level-laser therapy along with routine physiotherapy and the other with quantum acoustic wave along with routine physiotherapy. Assessment on 6th and 12th session was taken and measurements of Numeric Pain Rating Scale, Oswestry low back pain questionnaire and range of motion with goniometry were recorded before and after the treatment. SPSS-27 was used to analyze the data**.**
Results: There were a total of 48 patients. 24 patients were given to low level laser group and 24 patients to quantum acoustic waves group. The mean age of patients was 30-70, Severity of pain in quantum acoustic waves group decline considerably related to low-level-laser therapy group at the end of the treatment session (p-value=<0.01).
Conclusion: Mutually low-level-laser therapy and quantum acoustic waves lessens severity of pain but quantum acoustic waves caused lessening of pain severity more than low-level-laser therapy whereas, both presented major effects on range of motion ROM.
Keywords: Back Disability Index; Khan Kinetic Treatment; Low level laser therapy; Low back pain

INTRODUCTION
According to estimates (Al-Salamah and Bartel, 2022) 70–85 percent of the population, low back pain (LBP) will affect 70–80 percent of individuals at some point in their life. Back discomfort, muscular tightness above the inferior gluteal folds and below the costal boundary, with or without radiating pain in the leg, is the usual symptoms. The most prevalent issue and a major contributor to morbidity in adults is low back pain (LBP). Acute LBP is pain that lasts fewer than three months, while chronic low back pain(LBP) is pain that lasts additional three months (Chour et al., 2007 & Yousefi et al., 2009). It disturbs about 2/3 of individuals at specific period in their life. LDH, or lumbar disc herniation, is one of the greatest recurrent reasons of LBP. It frequently lowers the quality of life for persons with musculoskeletal system issues. The community's financial expenses associated with persistent LBP make it a significant health issue. (Unlu Z et al., 2008)

The American College of Physicians and the American Pain Society place a strong emphasis on non-pharmacological treatment alternatives for LBP, including patient education programs, back schools, exercise programs, massage, spine manipulation, acupuncture, lumber supports and physical therapy. Many regions of the universe, including US, Europe, and Far East, use low-level laser treatment (LLLT). The Food and Drug Administration has not yet accepted it for any indication. (Awad et al., 2006) A laser is a highly concentrated electromagnetic beam of light that is non-contact, non-ionizing, monochromatic, and polarized. In addition to its anti-inflammatory and non-thermally and nondestructively altered cellular function, low-level laser therapy (LLLT) has myorelaxant, analgesic, ligament repair, tissue mending, fibroblast proliferation, and bio stimulant reactions (Enwemeka t al., 2004). The precise mechanism of pain reduction is still unknown, despite the fact that LLLT (low level laser therapy) has been utilized to manage both chronic and acute pain (Yakut et al., 2004).

LLLT is utilized as an substitute non-invasive action for musculoskeletal system pain that is both acute and chronic. Its analgesic efficacy is still unclear and debatable (Tennant et al., 2001). By altering the peripheral nociceptive afferent contribution to the central nervous system, LLLT (low-level laser therapy) lessens the experience of localized pain (Brosseau et al., 2000). Walker has demonstrated that an enhanced urine clearance of 5-hydroxyindoleacetic acid, a byproduct of serotonin metabolism, is related to the efficiency of low level laser therapy (LLLT) in the treatment of chronic pain. The growth of endorphins and adenosine triphosphate are highlighted. Additionally, it has been discovered that the biostimulation impact of lasers increases cell metabolism. (Waker et al., 2000)

Studies have shown benefits in terms of enhanced cellular oxygenation, matrix formation, and chondrocyte and fibroblast proliferation. According to Gur A et al. (2003), LLLT may also have anti-inflammatory, anti-edematous, and spasmolytic effects.

The Laser treatment's objectives are to lessen discomfort, enable patients to recommence their regular deeds, and improve feature of life. The majority of the time, pharmaceutical and non-pharmacological approaches combined. The most vital signs of specific LBP are pain and disability (Koes, Van Tulder, & Thomas, 2006). Between 60% and 80% of people have back discomfort at selected point in their life. Up to 30% of people who have acute low-back pain go on to face chronic low back pain LBP. The negative effects on people, society, and families make effective controlling of this widespread but non-threatening illness a priority. Maximum individuals will at some period experience severe LBP but in many people, it resolves with slight management. Low-Back pain LBP is the foremost reason of job-related incapacity globally and the utmost cause of absents form work. At the moment our lives become more inactive, this condition is not likely to change. The causative factors for development of chronic LBP are occupational and psychosocial(Cohen, Argoff, & Carragee, 2008). Additional frequently described risk factors contain less awareness of postures, tension, anxiety, job disappointment, depression and work-related stress. LBP has massive influence on personalities, relations, communities, managements and productions all over the universe (Hoy, Brooks, Blyth, & Buchbinder, 2010). Mostly LBP low-back pain is related to specific recognizable spinal pathologies and moreover this problem is mounting together with the growing and ageing populace (Buchbinder et al., 2018).

According to van Tulder (2005), low-back pain (LBP) and associated incapacities are significant public fitness issues as well as significant contributors to medical costs, absenteeism, and disability. Back discomfort affects 60 to 80% of persons at various point in their life (Waddell, 2004). Only 5% of all persons who report backache may be diagnosed as having nerve origin pain (based on stringent diagnostic standards), with the remainder experiencing nonspecific LBP (low back pain), which is demonstrate as backache with or without referred pain in leg. Up to 30% of people who experience acute LBP go on to experience chronic LBP. An extensive study effort has been made over the past 15 years to pinpoint efficient management techniques for LBP low-back pain (Nachemson, 2000).

METHODS

It was a quasi-experimental study conducted at KKT orthopedic spine center, Multan & laser pain management rehab center, Multan after approval 48 patients were registered in this study. Each group was allotted 24 patients. All patients were well-informed about the management protocol and educated consent was received. Consent form was signed by the patients. Screening of individual was done by gross physical examination and inclusion and exclusion criteria were followed. Age group from 30 years to 70 years was followed. Explanation of whole procedure was given to patient/client as it is an invasive procedure.

Data entry and analysis was done by using SPSS 22. Quantitative variables were presented by using mean ± SD. Qualitative variables were presented by using frequency table and appropriate graphs where applicable. Shapirowilk test was applied to check normality of data, and then data was analyzed using Friedman Test for within group analysis and Kruskalwallis Test for between group analyses. Independent T test was applied to see the significance of demographics between both groups. P-value ≤ 0.05 was taken as significant.

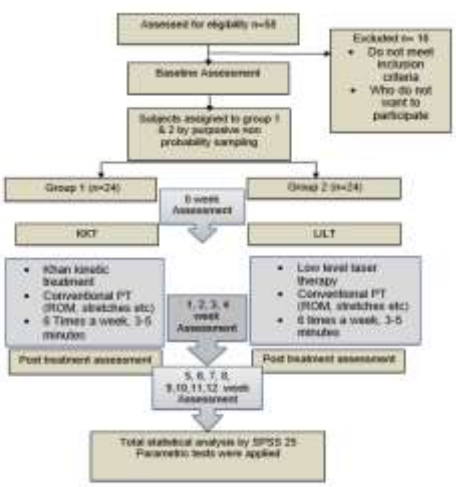

Figure 1: CONSORT diagram

RESULTS

Demographic Detail: The demographic data was analyzed for patients who were assigned to KKT group and LLLT group. The distribution of male and female were almost similar in both group, 14 (male) and 10 (female) in group 1 receiving KKT and 15 (male) and 9 (female) in group 2 receiving LLLT. Cause of pain and mechanism of injury is mentioned in Table 3. Apart from that, in group 1, obesity was prevalent and in group 2, overweight participants were more. In both group half patients reported pain in flexion position and half reported pain in extension position. There were also some patients who reported pain in both position. Gradual onset of pain was common in both groups. Besides that, some patients reported pain duration less than 6 months, while half patients reported LBP from more than 6 months. Detailed analysis is mentioned in table 3.

Table 3: Demographics

Variables	KKT Group 1 n=24	LILT Group 2 n=24	P value
Age (years) Mean ± S.D	48.3±14.6	49.3± 12.7	0.366
Baseline VAS score	7.1±0.3	7.0±0.5	<0.001
Baseline ODI score	25.8±2.7	27.8±3.8	0.014
Baseline degree of Lumbar Flexion	31.7±1.6	32.2±2.5	<0.001
Baseline degree of Lumbar Extension	8.7±0.7	9.0±0.7	<0.001
Gender			
Male	14 (58.3%)	15 (62.5%)	0.572
Female	10 (41.7%)	9 (37.5%)	
BMI			
Underweight	6 (25%)	0 (0%)	
Normal	3 (12.5%)	7 (29.8%)	0.001
Overweight	5 (20.8%)	11 (45.8%)	
Obese	10 (41.7%)	6 (25.0%)	
Pain Position			
Flexion	10 (41.7%)	11 (45.8%)	
Extension	9 (37.5%)	9 (37.5%)	0.923
Both	5 (20.8%)	4 (16.7%)	
Pain Duration			
Less than 6 months	13 (54.2%)	12 (50.0%)	0.690
More than 6 months	11 (45.8%)	12 (50.0%)	
Pain Onset			
Gradual	16 (66.7%)	13 (54.2%)	0.131
Sudden	8 (33.3%)	11 (45.8%)	
Cause of Pain			
Trauma	3 (12.5%)	5 (20.8%)	
Unknown	4 (16.7%)	6 (25.0%)	
Muscular Imbalance	3 (12.5%)	3 (12.5%)	0.653
Degenerative Changes	3 (12.5%)	4 (16.7%)	
Disc Bulge	4 (16.7%)	2 (8.3%)	
Healed Vertebrae Fracture	3 (12.5%)	2 (8.3%)	
SI Ligament strain	4 (16.7%)	2 (8.3%)	
Mechanism of Injury			
Fall	4 (16.7%)	4 (16.7%)	
RTA	4 (16.7%)	4 (16.7%)	
Sport Injury	5 (20.8%)	4 (16.7%)	
Trauma	5 (20.8%)	4 (16.7%)	0.765
Degenerative changes	2 (8.3%)	4 (16.7%)	
Strain Injury	2 (8.3%)	2 (8.3%)	
Unknown	2 (8.3%)	2 (8.3%)	
Medicine			
NSAIDS only	8 (33.3%)	8 (33.3%)	
NSAIDS+ Muscle Relaxant	9 (37.5%)	12 (50.0%)	0.088
No medications	7 (29.2%)	4 (16.7%)	

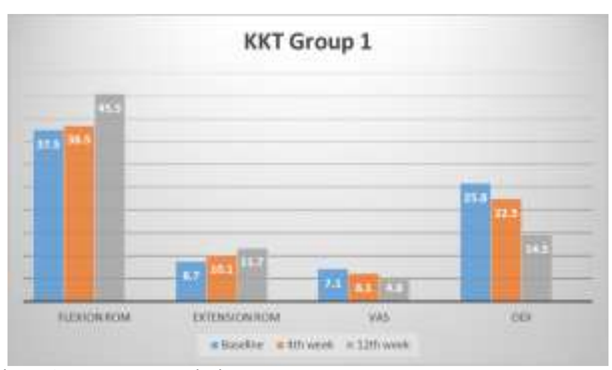

Figure 2: KKT group analysis

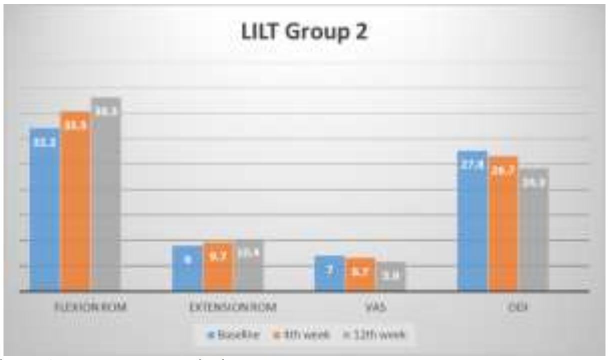

Figure 3: LLLT group analysis

4.4 Kruskalwalis Test for Between Group Analysis: As the data was not normally distributed (p value <0.05), Kruskalwallis Test was applied for between groups analysis. Range of motion of lumbar flexion was measured by using goniometer (normal ROM of flexion in lumbar region is 50 degree). Baseline reading was recorded for both group 1 (KKT) and group 2 (LLLT). Second reading was taken after 4th week and third reading was taken at 12th week of therapy. Both groups presented momentous development in flexion range of motion, but effects in KKT group were more marked. After analysis the result came significant for both baseline readings, 4th week readings and 12th week readings when between groups analysis was performed, with p value < 0.001.

In order to analyze disability caused by lower back pain, Oswestry disability index was used, on which patient can get score between 0 and 50. Higher score indicates disability. Lower scores are considered good. Score 0-4 indicates no disability, 5-14 indicates mild disability, 15 -24 score indicates moderate disability; 25-34 indicates severe disability and 35-50 score means complete disability. This parameter was also recorded on three occasions; baseline assessment from both groups was recorded before therapy began. Second assessment was recorded on 4th week of therapy and 3rd assessment was recorded on 12th week of therapy. Between groups analysis showed significant association for 4th week reading and 12th week reading, with p value less than 0.001. Both therapies showed significant reduction in disability scores but KKT showed more profound reduction in disability compared to LLLT group.

Detailed analysis for both groups, receiving LLLT and KKT therapy is given in table 5.

Table 5: Between Group Analysis

Variable	Group	Mean ± S.D	Median (IQ)	Mean Rank	P-value
ROM Flexion at baseline	KKT Group 1	31.7± 1.64	31 (1.0)	24.94	<0.001
	LLLT Group 2	32.2 ± 2.5	30 (5.0)	24.06	
ROM Flexion at 4th week	KKT Group 1	38.5± 1.61	39 (2.0)	33.96	<0.001
	LLLT Group 2	35.5 ±1.5	36 (3.0)	15.04	
ROM Flexion at 12th week	KKT Group 1	45.5± 0.97	45 (1.75)	36.5	<0.001
	LLLT Group 2	38.3 ± 1.2	10 (1.0)	12.5	
ROM Extension at baseline	KKT Group 1	8.7± 7.3	9 (1.0)	22.38	0.260
	LLLT Group 2	9.0 ± 0.7	9 (2.0)	26.63	
ROM Extension at 4th week	KKT Group	10.1± 0.9	11 (2.0)	27.13	0.164
	LLLT Group 2	9.7 ± 0.7	10 (1.0)	21.88	
ROM Extension at 12th week	KKT Group 1	11.7 ± 0.6	12 (1.0)	34.19	<0.001
	LLLT Group 2	10.4 ± 0.5	10 (1.0)	14.81	
VAS at baseline	KKT Group 1	7.1 ± 0.3	7 (0.0)	26.17	0.276
	LLLT Group 2	7.0 ± 0.5	7 (0.0)	22.83	
VAS at 4th week	KKT Group 1	6.1 ± 0.3	6 (0.0)	17.42	<0.001
	LLLT Group 2	6.7 ± 0.5	7 (0.75)	31.58	
VAS at 12th week	KKT Group 1	4.8 ± 0.7	5 (1.0)	15.58	<0.001
	LLLT Group 2	5.9 ± 0.5	6 (0.0)	33.42	
ODI at Baseline	KKT Group 1	25.8 ± 2.7	26 (5.0)	21.04	0.086
	LLLT Group 2	27.8 ± 3.8	27 (7.5)	27.96	
ODI at 4th week	KKT Group 1	22.5 ± 2.04	23 (4.0)	16.54	<0.001
	LLLT Group 2	26.7 ± 3.7	27 (7.0)	32.46	
ODI at 12th week	KKT Group 1	14.9 ± 0.88	15 (1.0)	12.50	<0.001
	LLLT Group 2	24.3 ± 3.6	25 (8.0)	36.50	

DISCUSSION

In order to show the efficiency of quantum acoustic waves in chronic low-back-pain and to check the efficacy of low-level-laser management in chronic low-back-pain to lessen pain and disability, this quasi experimental study was conducted. The demographic data was analyzed for patients who were assigned to KKT group and LLLT group. The distribution of male and female were almost similar in both group, 14 (male) and 10 (female) in group 1 receiving KKT and 15 (male) and 9 (female) in group 2 receiving LLLT. Apart from that, in group 1, obesity was prevalent and in group 2, overweight participants were more. In both group half patients reported pain in flexion position and half reported pain in extension position. There were also some patients who reported pain in both position. Gradual onset of pain was common in both groups. Besides that, some patients reported pain duration less than 6 months, while half patients reported LBP from more than 6 months.

In our study, the result came significant for ROM of flexion in lumbar spine, with p value < 0.001. Both groups receiving KKT and LLLT showed significant improvement in flexion range of motion, but effects in KKT group were more pronounced. Flexion baseline reading in KKT group was 31.7± 1.64, after 12 weeks of therapy 45.5± 0.97 of lumbar flexion was recorded. Lumbar flexion of KKT group and LLLT group significantly differ from each other with p value < 0.001. In a study by Geoffery et al, Using KKT therapy, the management group both had decreased self-reported LBP ratings (P 0.001) and shown a significant favorable tendency toward reducing their pain medication dosage (P = 0.054). Only the ROM range-of-motion evaluation questionnaire (range of motion, total activity, and recreation/work activities) (P = 0.046, P = 0.061, P = 0.052, respectively) found changes in these parameters. Initial findings indicate that KKTT may be a successful therapy for LBP, may enhance ROM range-of-motion, and may reduce the need for painkillers, albeit we must wait for blinded and randomized placebo controlled studies. (Geoffery et al., 2007) Moreover, the result for ROM of lumbar extension also came significant for both groups receiving therapies, with p value < 0.001. Both groups presented noteworthy progress in extension range of motion, but effects in KKT group were relatively better. Extension baseline reading in

KKT group was 8.7± 7.3, after 12 weeks of therapy 11.7 ± 0.6 of lumbar extension was recorded. KKT contributes to increase range of motion and reduce pain. (G. T. Desmoulin, Yasin, & Chen, 2007)

In present study, pain was recorded from level 4 to 10. The analysis showed that both groups showed reduction in pain severity, but KKT group showed significant reduction in pain compared to LLLT group. Baseline pain severity for KKT group was 7.1 ± 0.3 and after continuing therapy for 12 weeks, the pain severity reduced to 4.8 ± 0.7. For VAS the analysis also showed significant association with p value less than 0.001. KKT offers a precise and safe alternative by using sound waves to treat the patient. This case study involves an adult patient who is middle-aged and received KKT for LBP moving to both inferior limbs. It is consistent with previous research. After having 18 sessions in an era of 13 weeks, the patient reported improvements in his pain ratings, disability, sleep, mood and value of life, and work performance.No negative effects were seen. On MRI imaging, the lumbar spine showed improvement. (Desmoulin G et al., 2007) Another study has revealed that the effect of sound waves on musculoskeletal is not only consequences in decline of pain and keeping alignment of spine but also comprises elevated key proteins for spinal well-being and providing a suitable environment for cells that promotes ligament repair (Alsalamah & Bartel, 2022). KKT is an effective way of treating low back pain. Moreover, it reduces the dose of pain killers and improves life style or daily activity of a person (G. T. Desmoulin, Yasin, & Chen, 2007).

Abu Omar et al., conducted the plan of treatment for the patient, which was 12 sessions of KKT on every substitute days monitored by six, then once weekly, follow up sessions, physician also recommended him some lifestyle alterations. The patient's Visual Analogue Scale pain score decreased to 3.51 at the last treatment from 9.85 at 1st session and 4.48 by the ending follow up treatment. After finishing his recommended sessions, imaging in MRI presented resolve of cervical disc bulges. After rereading all the slices of MRI, orthopedic surgeon observed betterment in disc hydration in all spine discs of cervical, a decrease in compression of spine cord at the level of C4-C5 and also C5-C6 and no cervical stenosis can be seen. Patient had not experience any opposing events associated to the treatment. (Abu Omar et al., 2022)

Another study by Barthel et al., at the initial assessment, the patient showed a 9 score of Visual Analogue Scale for pain out of 10 and Roland Morris cumulative score of showed 13 points. Imaging in MRI of the lumbar spine presented the occurrence of disc bulges at multilevel with slight stenosis in spinal canal. Specifically at the level of L2 and L3 through L4 and L5 a posterior disc bulge is noticed destroying the epidural fat depressing the thecal sac and intruding on lateral neural foramina and recesses. During the progression of the KKT treatment sessions, the patient stated steady reduction in pain. The 6 painful tender 6 at the early assessment were decreased to 5 at 9th session, at session 13 it further reduced to 4, and finally comes to 0 at 18th session. 9.5 was his pain score at the starting assessment and that was decreased to 2.5 at the final session of treatment. The 1st Rolland Morris score of 13 was also reduced to 3 at the last session. The patient described improvement in his activity of daily life and in sleep as well. He was similarly capable to perform well at work because of his decreased pain. In adding, the patient presented a correction in alignment of his spine and body as observed by clinician. Pelvic and shoulder tilt progressively enhanced and stabilized lasting neutral on the 10th treatment onward. Cervical ranges returned to normal function by the 13th session and same is the case with the coordination of upper limb. When the treatment sessions completed, the MRI of the patient presented some resolution of L3 andL4 and L4 and L5 damage. No opposing effects associated to the treatment were practiced by the patient. (Alsalamah & Bartel, 2022)

A study on Forty eight subjects conducted that includes 28 male and 20 female, were engaged. The ages of these subjects were between 18 and 77 and had a repeated history of fluctuating levels of lessening low-back-pain. However, post-treatment phase for the treatment group was complete, the self-reported low-back-pain scores were another time collected from both of the groups and a 2 group by 2 low-back-pain outcome that were positive or non-positive. McNemar's chi-squared test was conducted. The treatment group had expressively reduce self-reported low back pain scores after treatment period in comparison to control subjects. When matched to a control group, early results advocate that KKT might be an effective way of dealing with low back pain and contributes to the improve range of motion ROM and a trend of decreasing total dose in analgesic medication. Though, the alternative but already existing overall activity and work-activity assessment methods did not adequately notice variations in this measurement (G. Desmoulin et al., 2012).

Besides that in our study, ODI parameter was also recorded on three occasions, baseline assessment from both groups was recorded before therapy began. Second assessment was recorded on 4th week of therapy and 3rd assessment was recorded on 12th week of therapy. The analysis showed significant association with p value less than 0.001. Both therapies showed significant reduction in disability scores but KKT showed more profound reduction in disability compared to LLLT group. Baseline ODI score for KKT group was 25.8 ± 2.7 and after continuing therapy for 12 weeks, the disability score reduced to 14.9 ± 0.88. The Khan Kinetic therapy (KKT) approach seeks to address the bio-mechanical aspect of low back pain while providing orthopedic vertebral therapy using focused vibro-percussion wave action. Patients with a restricted range of motion, hemodynamic issues, neurological issues, positive variations in pain, movement control, spasticity, specifically weariness and anxiety in individuals with spinal cord or brain injuries, and patients with these conditions have all been shown to benefit from vibration treatment. In KKT, low-frequency quantum acoustic waves are presented within the audible range and are guided to the spine through a vibro-percussive wave. The vibro-percussive waves of low-frequency provide vibrations that leads to gentle reverberations of the backbones, and slight stretching that is repetitive and initiation of the soft tissues attached at multiple levels of spine (Abu Omar, Al Baradie, Al Dera, Vannabouathong, & Bartel, 2022).

CONCLUSION

The analysis concluded that there was main association with p value fewer than 0.001 for both groups getting KKT and LLLT, but KKT group presented with more marked enhancement in flexion and extension ROM, lumbar spine disability and pain severity was also expressively reduced in KKT. Laser therapy also improved lumbar spine flexion and extension and there was lessening in pain severity and lumbar spine disability but compared to KKT, laser therapy produced fewer effects.

This study lacked randomization, in future studies double blinding must be done and researchers should also check long term effects of KKT and laser therapy to check if the effects are reversible or not.

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