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Journal of Musculoskeletal Surgery and Research

Original Article

Comparative effects of shockwave therapy and Maitland lumbar mobilization on pain, disability, and range of motion in patients with mechanical low back pain: A pilot study

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Received: 31 January 2024
Accepted: 23 March 2024
Epub ahead of print: 24 April 2024
Published: 30 April 2024

DOI
10.25259/JMSR_42_2024

Quick Response Code:

ABSTRACT

Objectives: Low back pain (LBP) has been considered a neuromusculoskeletal issue that affects a wide variety of populations around the globe at some stage in their life. This paper aimed to see the comparative effects of shockwave therapy and Maitland lumbar mobilizations on pain severity, disability, and range of motion (ROM) values in subjects with mechanical LBP.

Methods: A randomized clinical trial was carried out involving 26 subjects divided into two groups using a random number generator table. After baseline therapy (lumbar stretches and core strengthening exercises), shockwave therapy was administered to Group A (2000 shocks/session, pressure of 2 bars, frequency 10 Hz), while Group B received Maitland lumbar mobilizations (starting from Grade 1, with 3–4 sets of oscillations with 40 counts/set, two sets of oscillation to one level below and above the affected vertebras). Both therapeutic interventions were administered for 30 days, twice a week (total of eight sessions) for individual groups.

Results: Numeric pain rating scale, Oswestry LBP disability index, lumbar flexion, and extension ROM pre- and post-treatment values showed significant differences with $P < 0.05$. A greater difference in mean values was observed in group B receiving Maitland mobilization as compared to group A receiving shockwave therapy. Between-group analysis showed a statistically significant difference in both groups with $P < 0.005$.

Conclusion: Both groups showed significant effects in reducing pain levels, functional disability scores, and improving flexion and extension ROM values. However, participants receiving Maitland mobilization showed more significant improvement in all variables than shockwave therapy.

Keywords: Low Back pain, Lumbar mobilizations, Maitland mobilizations, Range of motion, Shockwave therapy

INTRODUCTION

In the current era, pain in the lower back region has become a fundamental health issue. It influences daily working routines and leads to medical consultations. Mechanical low back pain (LBP) is more common in 1/4th of the younger- and middle-aged populations.[1] Literature

How to cite this article: Ejaz R, Rafique S, Hamid K, Raza Q, Haider S. Comparative effects of shockwave therapy and Maitland lumbar mobilization on pain, disability, and range of motion in patients with mechanical low back pain: A pilot study. J Musculoskelet Surg Res. 2024;8:153-9. doi: 10.25259/JMSR_42_2024

suggests that people with complaints of LBP have decreased spinal mobility, mainly spinal extension.[2]

The LBP may be categorized into specific and mechanical/non-specific pain. Intervertebral disc pain, pain due to an unknown cause, any lump, sepsis, fracture, and osteoporotic pain may be some of the reasons that are the specific causes of the pain in the lumbar region, while the pain that is mostly described by the patients and is more general is non-specific low back pain (NSLBP) or mechanical LBP.[3] The most common areas of the spine that are affected by LBP involve the lumbosacral, thoracolumbar, and lumbar areas.[4]

The incidence of mechanical LBP relative to specific pain in the lower back region is almost 9:1 in the adult population.[5] On the global level, the incidence of pain in the lower back usually lies within the range of 30–80% in the community and progresses with aging progress.[6] The LBP is influenced by several elements. Changes in the body mass index (BMI), inappropriate body movements, age, and sex are some of the elements that cause individuals to suffer from LBP.[7]

Pain in the lower back region can be managed in a variety of ways such as surgery, pharmacological treatment, steroid injection, psychological management, and most commonly, rehabilitation involving physical therapy.[8] Therapeutic electrical appliances such as laser therapy, ultrasonic, shortwave diathermy, soft-tissue techniques, traction, hot pack, and management through manual techniques are some of the approaches that are used for managing pain in the lower back in the domain of physical therapy.[9]

At present, a new technique, extracorporeal shockwave therapy (ESWT), has also been introduced lately in the management of LBP.[10] For musculoskeletal (MSK) pathologies such as tennis elbow, frozen shoulder, and plantar fasciitis, ESWT is considered an effective approach to managing such conditions. Basically, shockwaves have been categorized into two major kinds, that is, one focused ESWT (fESWT) and the other radial ESWT (rESWT). Both these waves are used for treatment purposes but are differentiated based on mode and the distribution range of acoustic energy, rays form, and physical features.[11]

The production of fESWT is done using the following methods: Electromagnetic, electrohydraulic or piezoelectric phenomenon. The energy these waves produce grows very quickly (in <10 ns) and achieves its climax of 10–100 MPa. Contrary to this, the beam that rESWT produces is scattered in form, done by the pneumatic phenomenon, and is generated slowly along with elevation in pressure till 5 µs, achieving the range of 0.1–1.0 MPa (up to 3 cm of transmission capacity). The fESWT and rESWT can also be differentiated based on the length and structure of the applier's heads.[12]

Another general method that is usually used by rehabilitation specialists in the management of different MSK pathologies (like LBP) is manual treatment (hands-on procedures).[13] Mobilizing the vertebral column and manual exercises to improve mobility ranges help significantly enhance the spinal column's mobility.[14]

Manual therapy mobilization methods described by Maitland consist of passive and accessory oscillatory movements on the spine vertebral joints to produce an analgesic effect and improve joint stiffness caused by the mechanical type of LBP. The basic criteria for applying Maitland mobilizations on the lumbar spine are parallel to the plane of joints of the vertebral column.[15] Maitland's concept of mobilization has been considered the most effective one in managing subjects suffering from NSLBP, as this technique works by exciting the mechanical receptors of the joints.[16]

This study aimed to compare the mechanical effects of shockwave therapy and Maitland lumbar mobilization in reducing pain and disability and improving range of motion (ROM) in treating patients with mechanical LBP. The study's main aim was to find evidence supporting the effectiveness of Maitland mobilization and ESWT for LBP and to achieve the most beneficial approach that could minimize patient pain and reduce disability while improving ROM. Unlike previous studies, this study provides a direct comparison between two distinct, evidence-based interventions over a consistent timeframe and dosage, highlighting the differential impacts and potential clinical significance of each method in managing mechanical LBP.

MATERIALS AND METHODS

Study design

It was a single-blinded randomized clinical trial (RCT) using a random number generator table. It was conducted at the outpatient department of "Riphah International University, Lahore Campus." The study was completed in ten months. Written informed consent was taken from all patients, who participated in the study by signing the consent form. This completed study was reported in accordance with the requirements of the Consolidated Standards of Reporting Trials statement.

Participants

Data was collected from 26 LBP patients using a convenient sampling technique. The inclusion criteria of the study were patients of both sexes between the ages of 20 and 50 years, having continuous LBP despite >90 days of pharmacological therapy within the past year, who reported to the OPD of physiotherapy and got a referral from the orthopedic department, with the previous week's mean score of numeric pain rating scale (NPRS) ≥6.0 and ≤9.0 and diagnosed with mechanical LBP for a duration of more than three months.

The patients who were excluded were those who had any prior thoracolumbar surgical intervention at T9 or lower vertebral levels, anesthetic block of medial branch or introduction of epidural steroids in the management of LBP in the past 30 days, BMI levels >35, patients with certain conditions like spondylosis, disc prolapse, and spondylolisthesis at the lumbar spine, any tumor of spine or inflammatory disorder such as rheumatism and acute LBP. Finally, 24 out of 30 participants were evaluated for NPRS, Oswestry LBP disability index (ODI), and bubble inclinometer readings. Four subjects were excluded for not meeting the inclusion criteria (their level of pain on NPRS was <5), and two were dropped out in the follow-up sessions (one from each group) [Figure 1].

Sample size

The sample size of this study was calculated using Epitool on the basis of ROM, which was found to be 26 by adding an attrition rate of 10. So, 13 participants were included in each group.

Blinding and randomization

This study was single-blinded and RCT. After taking the baseline measurements, subjects were divided randomly into two groups using a random table number generator. Group A was administered ESWT, while Group B was given Maitland lumbar mobilization treatment. The researchers who recruited and evaluated the individuals were unaware of the use of a computer-generated list of random numbers. The allocation was concealed from the result assessors and data analyzers.

Interventions

After enrollment according to inclusion and exclusion criteria, consent was obtained from the subjects by signing the consent forms. Participants were randomly divided into two groups using a random number generator table, that is, Group A and Group B.

Group A (shockwave therapy treatment)

Subjects in Group A received traditional physiotherapy maneuvers, which involved lumbar stretching exercises (including bridges, knee to chest, press-up back extensions, and bird dogs) and exercises for the strengthening of core muscles (partial crunches, pelvic tilts, wall sits, hip stretches) for 10 min. After the general therapeutic approach, these participants were administered ESWT (two times a week for 30 days). Then, the affected area was exposed and cleaned with alcohol, and an appropriate quantity of gel was applied to the region to be treated, and the machine was adjusted at (2000 shocks in each session, eight sessions over four weeks, with an energy flux density of 0.18 mJ/mm^2, 2 bars of pressure, frequency of 10 hertz), by the application of 20 mm D-Actor head.[17]

Group B (Maitland lumbar mobilizations)

Subjects in Group B also received the traditional physiotherapy maneuvers that involved lumbar stretching

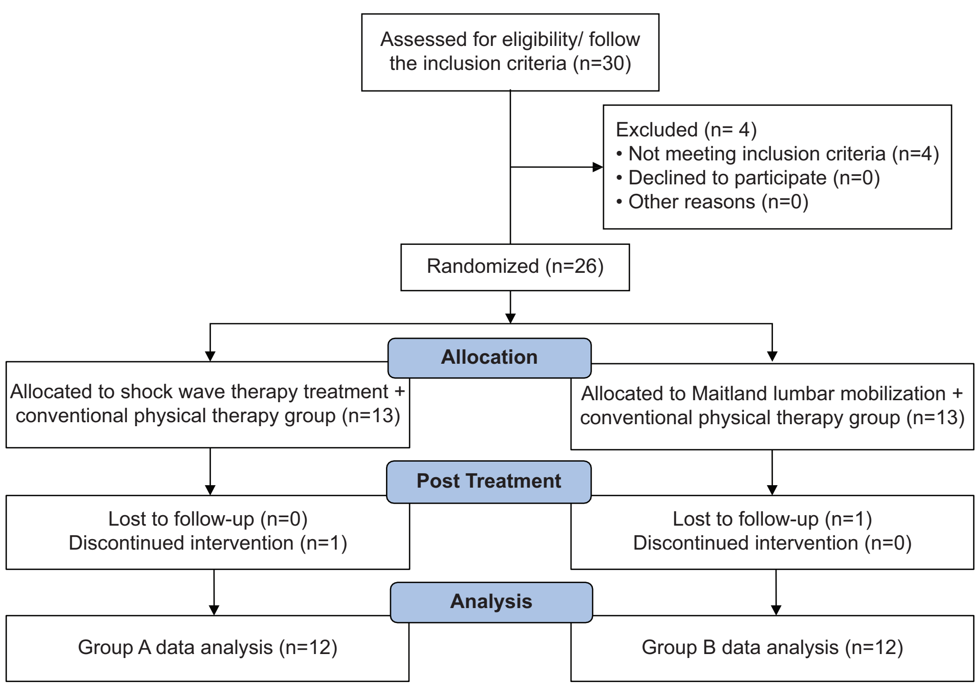

Figure 1: Consolidated standards of reporting trials diagram.

exercises (bridges, knee to chest, press-up back extensions, and bird dogs) and exercises for the strengthening of the core muscles (partial crunches, pelvic tilts, wall sits, and hip stretches) for 10 min. After the general therapeutic approach, Group B was administered with Maitland's lumbar (PA-glide) mobilizations, which were initiated from Grade 1, with 3–4 sets of oscillations with 40 counts/set. Two oscillation sets had been given to one level below and above the involved vertebral levels. This complete approach was administered for 10 min, two times a week for four weeks. This complete mobilization therapy was administered two times a week for 10 min.[18]

Outcome measurements and data analysis

The total intervention protocol for both treatment approaches was given for four weeks. Measurements for pain intensity, disability, and ROM were taken using NPRS, ODI, and bubble inclinometer, respectively, before and at the end of the treatment session. Outcomes were measured after four weeks. Data was analyzed using the Statistical Package for the Social Sciences version 25 (IBM Corp., Armonk, NY, USA). The normality of the data was checked by the normality test, that is, the Shapiro-Wilk test, and then parametric tests were applied accordingly.

RESULTS

Out of 24 participants recruited in the study, 11 (45.83%) were male and 13 (54.17%) were female. The sociodemographic variables involving the participants' age, height, weight, and BMI are summarized in Table 1.

The within-group analysis of pre- and post-intervention values of NPRS, ODI, and bubble inclinometer readings was done using a paired sample *t*-test. Analysis showed that a statistically significant difference was observed in outcome measurements of both groups with $P < 0.05$, with more significant improvements in the Maitland mobilization group (Group B) than the ESWT group (Group A) [Table 2].

The intergroup statistics of pre- and post-intervention values of NPRS, ODI, and bubble inclinometer readings were compared using an independent t-test. Analysis revealed that there was a statistically significant difference in both groups with $P < 0.05$, with more significant improvements in the Maitland mobilization group (Group B) than the ESWT group (Group A) [Table 3].

The mean values of NPRS, ODI, lumbar flexion, and extension after four weeks of treatment are shown in Figure 2. There was a statistically significant difference in both groups, with more significant improvements in the Maitland mobilization group (Group B) than the ESWT group (Group A).

DISCUSSION

The present study concluded that ESWT significantly relieved patients' pain with mechanical LBP ($P < 0.05$). The results supported the previous study by Kong *et al.* in 2020, which concluded that ESWT significantly reduces pain and enhances quality of life (QoL) in patients with chronic LBP. The pain levels decreased significantly in the treatment group

Table 1: Demographic statistics.

	Group A (Shockwave Therapy)	Group B (Maitland Lumbar Mobilization)
Age in years	35.41±8.37	34.58±7.21
Height in cm	166.6±6.37	165.72±8.70
Weight in kg	35.41±8.37	73.58±13.04
BMI	166.61±6.37	26.67±3.53
Number of participants	12	12

BMI: Body mass index

Table 2: Within-group comparison of the numeric pain rating scale.

Study group	Paired difference		
	Mean±Standard deviation	Mean difference	*P*-value
ESWT			
NPRS-Pre	7.50±1.08	4.75±1.05	0.000
NPRS-Post	2.75±0.75		
ODI-Pre	52.66±5.80	17.667±3.17	0.000
ODI-Post	35.00±6.52		
Lumbar flexion ROM-Pre	40.50±2.84	1.50±1.67	0.010
Lumbar flexion ROM-Post	42.00±2.33		
Lumbar extension ROM-pre	7.58±1.16	0.667±0.88	0.025
Lumbar extension ROM-Post	8.25±0.96		
Maitland mobilization			
NPRS-Pre	7.16±0.93	5.167±0.577	0.000
NPRS-Post	2.00±0.60		
ODI-Pre	51.00±6.57	28.166±3.35	0.000
ODI-Post	22.83±4.62		
Lumbar flexion ROM-Pre	40.91±2.90	8.08±1.37	0.000
Lumbar flexion ROM-Post	49.00±3.27		
Lumbar extension ROM-PRE	7.41±0.99	4.000±1.04	0.000
Lumbar extension ROM-Post	11.41±0.79		

ROM: Range of motion, NPRS: Numeric pain rating scale, ODI: Oswestry disability index, ESWT: Extracorporeal shockwave therapy

Table 3: Across-group comparison of NPRS, ODI, and bubble inclinometer readings in the intervention groups.

Variable	Group A (ESWT) Mean±Standard Deviation	Group B (Maitland Mobilization) Mean±Standard Deviation	Mean difference	*P*-value (2-tailed)
NPRS-Pre	7.50±1.08	7.16±0.93	0.333	0.430
NPRS-Post	2.75±0.75	2.00±0.60	0.750	0.013
ODI-Pre	52.667±5.80	51.00±6.57	1.667	0.517
ODI-Post	35.00±6.52	22.83±4.62	12.166	<0.05
Lumbar flexion-Pre	40.50±2.84	40.916±2.90	-0.416	0.726
Lumbar flexion-Post	42.00±2.33	49.00±3.27	-7.000	<0.05
Lumbar extension-Pre	7.58±1.16	7.41±0.99	-0.1667	0.710
Lumbar extension-Post	8.25±0.96	11.41±0.79	-3.167	<0.05

NPRS: Numeric pain rating scale, ODI: Oswestry disability index, ESWT: Extracorporeal shockwave therapy

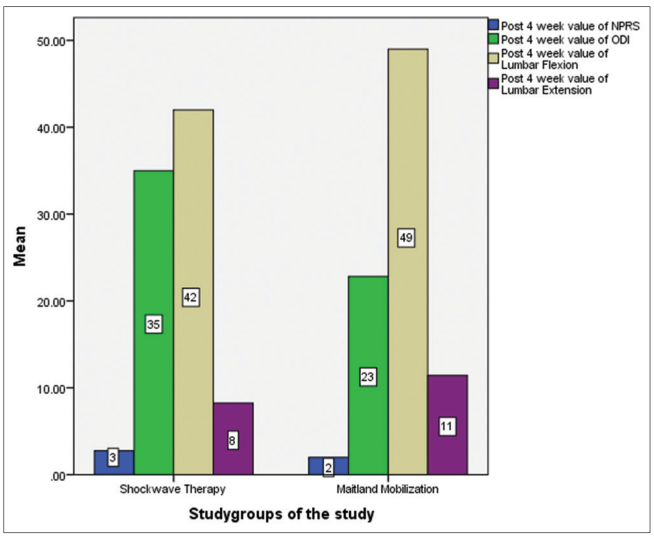

Figure 2: Across-group comparison of NPRS, ODI, and bubble inclinometer readings in the intervention groups. NPRS: Numeric pain rating scale, ODI: Oswestry disability index.

as compared to the control group (94.0% vs. 64.0%, P<0.05). In addition to this, QoL scores had also been found to be enhanced in the intervention group ($P < 0.05$) in comparison with the control group.[19]

The earlier study by Walewicz *et al*. in 2019 found that the use of rESWT showed a significant reduction in pain levels as well as improvements in functional status in patients suffering from chronic LBP.[10] Results were more evident in the control group than the treatment group, but for the short term. However, with the longer follow-up periods, the intervention group showed greater significant results ($P > 0.05$ after 30 days and 90 days post-treatment; $P < 0.0001$). Functional disability scores were more evident in the treatment group, specifically with the follow-up sessions ($P < 0.03$ after 30 days and $P < 0.004$ 90 days post-treatment).[10] This study highly supported the present study with $P < 0.05$ that showed a significant reduction in pain levels and enhancement of disability scores along with improved lumbar flexion ROM values when treated with the ESWT in patients with mechanical LBP.

The present study, with $P < 0.05$, is in contrast with the previous study conducted by Lange *et al.*[20] in 2021, who concluded that the application of rESWT had limited effects in reducing pain severity, improving functional competence, and enhancing QoL in patients suffering from acute LBP. Initially, the scores of the visual analog scale had reduced in the treatment group by 60.7% ($P < 0.001$) than in the sham group at 86.4% ($P < 0.001$), but pain reduction was less significant in the treatment group when the follow-up was done for four weeks, and so on, up to 12 weeks. The EuroQoL five dimensions scores also summarized lower outcomes for the treatment group than the control group ($P < 0.014$) when eight weeks of follow-up was done. Moreover, rESWT in combination with the traditional physical therapy approach, effects were not significant for the severity of pain, physical competence, and QoL in LBP patients.[20]

The recent study concluded that the patients with mechanical LBP showed a significant reduction in the pain severity levels as well as marked improvements in functional disability scores and lumbar flexion and extension ROM values when treated with Maitland's lumbar mobilization ($P < 0.05$) in contrast with the previous study conducted by Ali *et al.* in 2019, in which two mobilization techniques were used (Mulligan and Maitland mobilizations) who found that pain, lumbar flexion and extension ROM, and functional disability scores were not significantly improved in any of these groups in patients of LBP.[15]

A study conducted by Manzoor *et al.* in 2019 showed that Mulligan mobilization was proven to be the efficacious choice of treatment compared with Maitland mobilization in managing pain and improving the functional capability of patients suffering from NSLBP. Results of between-group comparisons of NPRS and ODI declared that the effects of Mulligan Snags were more obvious ($P < 0.05$) as compared to Maitland mobilizations.[21] In the present study, when Maitland mobilization was compared with an electrotherapeutic modality, it was found to be more effective than shockwave therapy in subjects with mechanical LBP.

Limitations of study

Only one clinical setting was used. It was a short study, so long-term effects could not be observed after three or six months. In this study, only flexion and extension ROM of the lumbar spine were observed; side bending and rotation were not observed.

CONCLUSION

This study concluded that both groups showed significant effects in reducing pain levels and functional disability scores, as well as improving flexion and extension ROM values in subjects with mechanical LBP. Maitland mobilization treatment was more effective than shockwave therapy in subjects with mechanical LBP.

Recommendations

Both techniques should be compared with another exercise therapy to further investigate the best possible treatment for subjects with LBP due to mechanical causes. Future studies should measure ROM for side bending and rotation of the lumbar spine. Future research should be conducted by taking samples from different populations.

ACKNOWLEDGMENT

We would like to acknowledge all participants, who voluntarily participated in the research and special thanks to the research supervisor for proper guidance and assistance in the research process.

AUTHORS' CONTRIBUTIONS

RE contributed to study conception and design and data acquisition. SR contributed to the conception and design. KH contributed to data analysis and interpretation. QR contributed to manuscript drafting, and SH contributed to critical analysis and proof reading of the manuscript.. All authors have critically reviewed and approved the final draft and are responsible for the manuscript's content and similarity index.

ETHICAL APPROVAL

The study was approved by "Riphah International University, Lahore Campus" Research and Ethics Committee (ref no: REC/RCR & AHS/22/0127) on March 04, 2022. This RCT was registered in the UK clinical trial registry platform clinicaltrials.gov (IRCT#NCT05404997).

DECLARATION OF PATIENT CONSENT

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY FOR MANUSCRIPT PREPARATION

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

CONFLICTS OF INTEREST

There are no conflicting relationships or activities.

FINANCIAL SUPPORT AND SPONSORSHIP

This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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