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ORIGINAL RESEARCH ARTICLE

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Comparative effects of patient-specific 3-dimensional and 2-dimensional lumbar traction on pain and functional disability in patients with lumbar radiculopathy

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Abstract

Background Low back pain (LBP) resides as a most common type of symptom pointing towards lumber radiculopathy. It is defined as burning sharp leg pain that originates from the back and goes all the way down your legs and extends into the toes and foot. Lumbosacral radiculopathy is caused by pathology of the intervertebral disk or associated structures. Different dimensional traction has been used to treat lumbar radiculopathy. This study aimed to compare the effects of 3-dimensional and 2-dimensional lumbar traction on pain and functional disability in patients with lumbar radiculopathy. The randomized clinical trial study of 4 weeks was carried out at the Lifeline Health Care Imaging and Pain Center and the Hamza Hospital Lahore. Twenty-six subjects were included in the clinical trial and divided into two groups after randomization. Group A received three-dimensional lumbar traction with traction force 50% of total body weight on Spine MT 3D traction machine, and group B received two-dimensional lumbar traction with traction force 50% of total body weight. Pre- and post-values of NPRS and ODI were noted.

Results Parametric tests were used during statistical analysis because data was normally distributed. NPRS pre- and posttreatment values showed significant results with p-value < 0.05. ODI pre- and post-values were also obvious with p-value < 0.05. Independent sample T-test was used to assess across the group comparison, suggesting that both groups showed significant improvements of NPRS and ODI post-treatment with p-value (< 0.001).

Conclusion The study concluded that 3D traction significantly reduced pain levels and improved functional impairment more effectively than 2D traction in patients with lumbar radiculopathy.

Trial registration Trial was registered with ClinicalTrials.gov: NCT05356689.

Keywords Lumbar radiculopathy, Lumbar traction, Low back pain, Mechanical traction

Introduction

A syndrome originating from irritation, inflammation, impingement, or compression of a spinal nerve root is referred as radiculopathy, primarily because of a disc herniation [1]. Radiculopathy is a electric, burning, or sharp back and leg pain that originates from the back and goes all the way down your legs and extends into the toes and foot [2]. One of the most typical radiculopathies is lumbar radiculopathy. It affects both men and women equally and is thought to impact 3 to 5% of the population [3]. Low back pain (LBP) resides as a most common type of symptom pointing towards lumber radiculopathy [4]. Prolapsed intervertebral discs (PIVD) at the lumbar spine are one of the many causes of LBP with lumbar

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radiculopathy. It is defined as PIVD when the disc lumps or herniates anterolaterally, posteriorly, or anteriorly. It is common for discs to prolapse posteriorly or posterolaterally, and this can cause nerve roots to be compressed within the spinal canal. It has been estimated that about 10% of LBP episodes are related to nerve root involvement [5].

Lumbar radiculopathy can be caused by a variety of conditions, including infections, inflammations, and neoplasms. Radiculopathy of the L5 is most commonly caused by herniated intervertebral disks. Anterolateral leg drop and foot dorsum sensory symptoms are the relevant clinical features [6]. Along with ankle dorsiflexion weakness, L5 radiculopathy usually results in weakness of the toes, foot eversion, inversion, and hip abduction. An intervertebral disk herniation can also result in S1 radiculopathy, resulting in weakness of hip extension, knee flexion, and foot plantar flexion. It is possible to demonstrate subtle weakness of foot plantar flexion by asking patients to stand on their toes or walk on their toes [7].

L4/5 is most frequently affected by LIVDP, followed by lumbar L5 and S1 level. Middle-aged women are most prone to experience it. Studies have shown that spinal decompression therapy reduces pain and improves functional outcomes [8]. The chronic low back pain population's activities and mobility are strongly correlated. Using patient-specific three-dimensional lumbar tractions, this study is the first of its kind. In association with the conventional method of traction, there are many specific patients' options for spine manual therapy, including inclination at sacral level, leg rest position, a 3-dimensional pressure adjustment decompression, lateral bending at lumber, and adjustments in rotation. With these sidewise adjustments and effected level, PS3DLT reduced pain and improved functional disability in patients with lumbar intervertebral disc prolapse. There is still controversy surrounding the effectiveness of lumbar traction for LIVDP, but it remains the most commonly used therapeutic modality in physical therapy clinical practice [9].

There are nonsurgical and surgical treatments available for disc prolapse, but nonsurgical treatment is generally recommended at the beginning of the treatment process. Among the main components of nonsurgical management for such patients is physical therapy [10]. In addition to spinal manipulation, mobilization exercises, mechanical traction, strengthening exercises, and other electrotherapeutic modalities, physical therapy is used in the treatment of PIVD [11].

Considering manual therapy most commonly, Cyriax techniques are used, which focus on mobilizing and manipulating the spine in a generalized manner. In McKenzie's technique, the spine is gradually and gradedly extended from a flexed position, and it is believed that the disc regression is a natural consequence of this. Unlike Maitland's strategy, Maitland's tactic is more localized and concentrates on a segment-by-segment basis. For mobilization of the segments by its four grades, posteroanterior (PA) glides are applied. As a general rule, Brian Mulligan's techniques emphasize on NAGS and SNAGS by utilizing that concave-convex rule [12]. These manual techniques are complicated and difficult to conduct from patients' perspective, whereas traction is one of the ancient methods used since Hippocrates, spinal traction has been used to address pain complaints on a continuous, erratic, manual, mechanical, and sustained basis. As well as positions in lying (supine and prone), it is capable of functioning in a variety of positions and can be used according to the patient ease [13].

Spinal traction has been used to alleviate pain on a continuous, erratic, manual, mechanical, and sustained basis. In addition to supine and prone lying positions, it can be used in a variety of positions. As described by Cyriax, traction is beneficial in the lumbar region as it includes the maximization of available space in-between vertebras, and it stretches the posterior longitudinal ligament so that a force is generated to pull the disc in the original center position as it was before herniation. Through traction in the lumbar region, several impacts are created that disrupt the expansion of foraminal space and facet joints [14].

Furthermore, there are different types of traction, i.e., two dimensional and three dimensional. Traction in two dimensions provides traction to the entire spine. Moreover, three-dimensional traction provides traction at a specific angle at a specific vertebra. An important element of three-dimensional traction is setting a target angle for the lesion site, unilaterally adjusting the direction of the herniated material, and rotating the material [9]. Clinically, it is determined when and how to administer this procedure. It is found that this treatment reduces LBP (low back pain) and improves LBP-related physical functions in patients with lumbar herniated discs [15].

The use of lumbar traction, which can be provided by a variety of methods (e.g., gravity, mechanical, motorized), is commonly prescribed for a variety of lumbar conditions. Although the mechanisms of lumbar traction are yet unknown, it has been suggested that it splits vertebral bodies and reduces nerve root compression by enlarging the intervertebral foramen and thereby reducing the compressive forces on the disks. By generating tension on spinal ligaments, the herniated disks return to their original positions, and more space is available for the nerves and discs to function properly. The clinical effects of lumbar traction for subjects experiencing lower back pain related to intervertebral herniation of disc remain unclear despite its common use in clinical practice [16].

This research is specifically focused on comparing the effectiveness of 3-dimensional and 2-dimensional lumbar traction on pain and functional disability in patients with lumbar radiculopathy. Using the outcomes provided by this research, physical therapists able to design and select the most appropriate treatment lumbosacral radiculopathy Traction is the most common treatment for lumber radiculopathy. However, the effectiveness of traction is still up for debate, and the available treatments are still murky. So, this research is aimed to determine the optimal treatment so that it may serve as a basis for effective treatment protocol in lumber radiculopathy.

Material and methods

Study aim

This study aimed to compare the effects of 3-dimensional and 2-dimensional lumbar traction on pain and functional disability in patients with lumbar radiculopathy.

Study design

The trial is randomized clinical trial, which is registered with ClinicalTrials.gov: NCT05356689 after the institutional approval of the study from the research ethical committee. The study was conducted at the Hamza Hospital on Shama Road in Lahore and the Lifeline Health Care Imaging and Pain Center in Lahore.

Participant's selection

The approach of consecutive sampling was used to identify potential participants. The study comprised patients with age range of 30 to 65 years old. Participants assessed by treatment-based classification system for low back pain which shows participants with either one or both legs affected by persistent radiating pain (sign of nerve root compression) with positive SLR test and peripheralization with extension and crossed straight leg raise [17] were included. Patients who have experienced low back pain for 30 days in the previous 6 months were having intervertebral disc prolapse diagnosed by an orthopedic surgeon based on optimal imaging technique MRI (magnetic imaging technique). Also have minimum score of 25 on the low back pain index. Patients excluded from the study had a history of autoimmune diseases, organic referred pain, back surgery, neurodegenerative diseases, inflammatory joint disease, and participants with histories of arthritis. Participants were taking medications on a regular basis or have taken spinal manipulative therapy. Once the selection criteria indicated above were met by the assessor, the clinical physiotherapist considered they obtained the potential participants for this study and written informed consent to be part in this study. Thirty participants were assessed using selection criteria out of which 28 participants met the inclusion criteria.

Sample size calculation

The sample size was calculated by an online EPITOOL sample size calculator. The sample size of 26 participants was obtained by using value of numeric pain rating scale (NPRS) [18], confidence level 95%, power 0.8, mean of group 1 3.99, variance of group 1 1.78, mean of second group 5.52, and variance of second group 1.86. That was further divided into two group, 13 in each group.

Randomization and allocation

Twenty-eight patients who satisfied the eligibility requirements were enlisted using a convenience sampling approach, and they were divided into two groups using a straightforward randomization process using sealed, opaque envelopes labelled with the numbers 0 for group A and 1 for group B. Each participant was asked to pick a card from the box, which contained 28 cards. Two participants refused to participate in the study. Twenty-six cards were drawn randomly and divided into to sets, 13 were allocated to group A, and 13 were allocated group B randomly. It was single-blind research in which the assessor was unaware of the treatment group.

Data collection

The initial exam was done on first day which include a complete history and physical exam, including manual muscle testing, sensory testing, deep tendon reflexes, and Lasegue's sign. The magnetic resonance imaging (MRI) was assessed to identify the level of lumbar disc herniation. Pre-treatment readings were taken from the numeric pain rating scale and Oswestry Disability Index by the assessor. One physiotherapist worked as assessor used his good expertise for evaluating outcome measure. Assessor was kept blind about the treatment groups. Three sessions per week for 2 weeks of treatment were given by the other clinical therapist. Posttreatment readings were taken at the end of the 4 weeks by the same assessor. Additionally, no adverse events have been observed during and after treatment.

Interventions

Baseline treatment given to both groups include a 10-min 1-MHz continuous ultrasound on the paravertebral muscles and 20 min of Hot Pack and TENS at 60–100 Hz and 60 pulse duration, intensity based on patient comfort.

Group A received 3-dimensional lumbar traction with the amount of traction as per the patient weight and height 50% of the body weight (as shown in Fig. 1). Each session comprised of 30 min, and every participant received three sessions per week and total 12 sessions.

Pelvic tilting was done on the spinal MT traction table in increments of 0 to 25°. According to the patient's

Fig. 1 Three-dimensional traction

weight and height, the machine's traction setting was changed to 50% of body weight. By shifting two halves of the bed apart, the split bed directly tractioned the spine. The body parts are firmly fastened to the bed with safe straps. Right or left side lumbar lateral bending from 0° to 15°can be done. On thoracic rotation, the left/right rotation stop decompression ranged from 0 to 5.5°, and at the pelvis level, it ranged from 0 to 9.5° [9].

Group B got two-dimensional lumbar traction on TRU-TRAC TT-928 machine with intermittent 30-s hold, 10-s rest at a rate equal to 50% of the patient's body weight and height in supine position, and 90° knee flexion and hip flexion with supported legs (as shown in Fig. 2). Every participant received three sessions a week for a total of 12 sessions, each lasting 30 min [19].

Outcome measure tool

Numerical pain rating scale (NPRS)

This scale was used to determine the patient's pain threshold. This scale has a 0 to 10 range. The pain scale goes from zero (no pain) to ten (highest agony). High test–retest reliability has been demonstrated using NPRS ($r = 0.96$ and 0.95, respectively) [20].

Oswestry Disability Index (ODI)

Researchers and disability evaluators employed the Oswestry Handicap Index, also known as the Oswestry Low Back Pain Disability Questionnaire, as a very crucial instrument to assess a patient's functional disability over the long term. The evaluation is regarded as the "gold standard" for measuring low back functional result. The

Fig. 2 Two-dimensional traction

final score/index is on a scale of 0 to 100. Scores range from 0 to 20 for mild impairment, 21 to 60 for severe disability, 61 to 80 for crippled, and 81 to 100 for bed bound [21].

Data analysis

The data is analyzed by SPSS version 25. The descriptive statistics were used to evaluate the demographics of the participants. To test the normality, Shapiro-Wilk test was used. The test showed a significance level of more than 0.05, so the data was normal, and parametric analysis tests were used. To find differences between pre- and posttreatment values of pain and disability within the same group, paired t-test was used. An independent sample t-test was used to find differences between the groups analyzed. Mean differences were considered at a 5% probability level (p-value 0.05) and 95% confidence interval.

Results

Total 24 participants out of 26 subjects were eligible for the statistical analysis of this study who participated on the basis of inclusion and exclusion criteria. Two were lost to follow-up and did not complete the intervention protocols due to loss of interest in the study after pain recovery. All these subjects were randomly allocated into two groups, i.e., (group A: 3-dimensional lumbar traction) and (group B: 2-dimensional lumbar traction) as shown in the CONSORT diagram (Fig. 3). The sociodemographic data of participants was represented in Table 1. In 3-D lumbar traction group, there were 12 participants, with 1 shopkeeper (8.3%), 2 businesspersons (16.7%), 5 housewives (41.7%), 1 sports person (8.3%),

Table 1 Comparison of sociodemographic variables of groups

Group	*N*	Mean ± standard deviation
3-D lumbar traction		
Age in years	12	48.50 ± 5.48
Height in cm	12	166.61 ± 6.37
Weight in kg	12	75.00 ± 11.87
BMI	12	26.67 ± 4.20
2-D lumbar traction		
Age in years	12	50.58 ± 4.58
Height in cm	12	165.72 ± 8.70
Weight in kg	12	73.58 ± 13.04
BMI	12	26.67 ± 3.53

3-D Three dimensional, *2-D* Two dimensional, *BMI* Body mass index

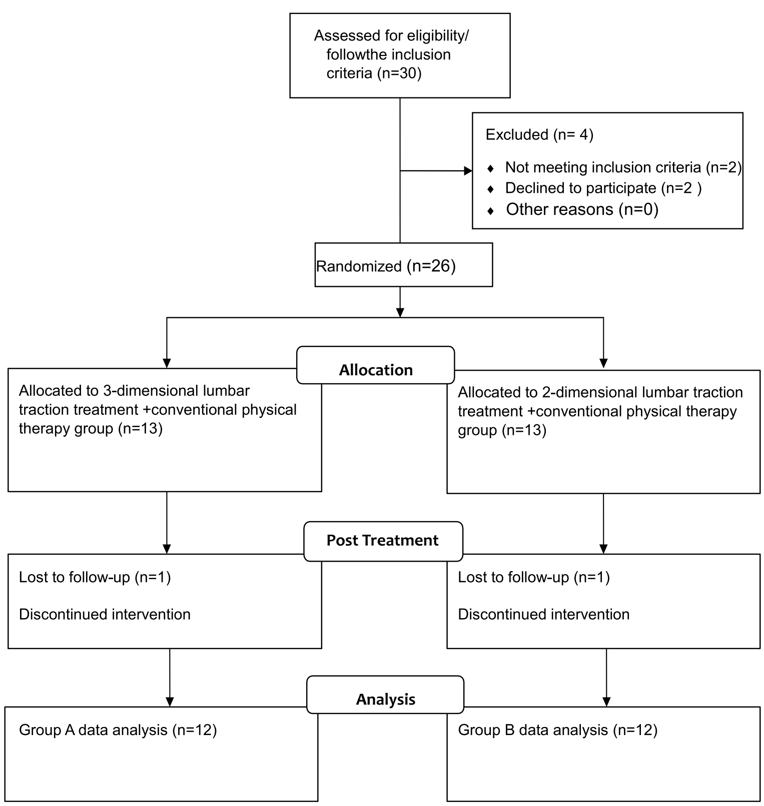

Fig. 3 Consort flow diagram

and 3 IT workers (25%), while in 2-D lumbar traction group also there were 12 participants with 1 shopkeeper (8.3%), 3 businesspersons (25%), 6 housewives (50%), and 2 sports persons (16.7%). In 3-D lumbar traction group, there were 12 participants, with 2 lower-class (16.7%), 7 middle-class (58.3%), and 3 upper-class (25%) members, while in group B there were 12 participants with 4 lower-class (33.33%), 6 middle-class (50%), and 2 upper-class (16.7%) members. In 3-D lumbar traction group, there were 12 participants; among them, there were 7 males (58.33%) and 5 females (41.67%), while in 2-D lumbar traction group that also contained 12 participants, there were 6 males (50%) and 6 females (50%).

Paired *T*-test was used to compare the values of NPRS score within each treatment group declared statistically significant difference in two groups (p-value < 0.05) with greater difference seen in 3-D lumbar traction group as shown in Table 2. Similarly, paired *T*-test was used to compare the values of ODI score within each treatment group declared statistically significant difference in two groups (p-value < 0.05) with greater difference seen in 3-D lumbar traction group in Table 3. The comparison between pre-treatment and posttreatment value of NPRS between two groups was done by using independent *T*-test. Analysis showed that there was statistically significant difference between two groups with p-value < 0.05. The comparison between pre-treatment and posttreatment value of ODI between two groups was done by using independent *T*-test. Analysis showed that there was statistically significant difference between two groups with p-value < 0.05 as shown in Table 4.

Discussion

The current study showed the comparative effects of patient-specific 3-dimensional and 2-dimensional lumbar traction on pain and functional disability in patients with lumbar radiculopathy. The results of the current study were corroborated (p-value < 0.05) by a prior study by F. Asiri et al. from 2020, which found that three-dimensional lumbar traction significantly improved functional impairment among participants with lumbar radiculopathy and had a positive impact on NPRS score. The NPRS score and Oswestry Disability Index showed a substantial shift in mean values from before to post treatments

Table 2 Within-group comparison of numeric pain rating scale (NPRS)

Study group	Paired difference				
	Mean ± standard deviation	Mean difference	95% confidence interval of the difference		*p*-value
			Lower	Upper	
3-D lumbar traction					
NPRS (pre-treatment)	7.58 ± 0.79	5.667 ± 0.88	5.10270	6.23064	< 0.05
NPRS (post-treatment)	1.91 ± 0.51				
2-D lumbar traction					
NPRS (pre-treatment)	7.33 ± 0.88	4.166 ± 0.83	3.63623	4.69710	< 0.05
NPRS (post-treatment)	3.16 ± 0.71				

3-D Three dimensional, *2-D* Two dimensional, *NPRS* Numeric pain rating scale

Table 3 Within-group comparison of Oswestry Disability Index

Study Group	Paired difference				
	Mean ± standard deviation	Mean difference	95% confidence interval of the difference		*p*-value
			Lower	Upper	
3-D lumbar traction					
ODI (pre-treatment)	52.66 ± 5.80	28.58 ± 3.96	26.06421	31.10245	< 0.05
ODI (post-treatment)	24.08 ± 6.33				
2-D lumbar traction					
ODI (pre-treatment)	49.83 ± 8.02	14.83 ± 9.66	8.69209	20.97458	< 0.05
ODI (post-treatment)	35.00 ± 10.44				

3-D Three dimensional, *2-D* Two dimensional, *ODI* Oswestry Disability Index

Table 4 Across group comparison of numeric pain rating scale (NPRS) and Oswestry Disability Index (ODI)

Intervention values	Group A (3-D lumbar traction) Mean ± standard deviation	Group B (2-D lumbar traction) Mean ± standard deviation	Mean difference	95% confidence interval of the difference		*p*-value (2-tailed)
				Lower	Upper	
NPRS (pre-treatment)	7.58 ± 0.79	7.33 ± 0.88	0.25	−0.46257	0.96257	0.475
NPRS (post-treatment)	1.91 ± 0.51	3.16 ± 0.71	−1.25	−1.77884	−0.72116	0.000
ODI (pre-treatment)	52.667 ± 5.80	49.833 ± 8.02	2.833	−3.09417	8.76084	0.332
ODI (post-treatment)	24.08 ± 6.33	35.00 ± 10.44	−10.91	−18.22871	−3.60463	0.005

3-D Three dimensional, *2-D* Two dimensional, *NPRS* Numeric pain rating scale, *ODI* Oswestry Disability Index

(p 0.001). Functional impairment decreased from 53.5 to 31.3%, and the level of discomfort was decreased from 8.5 to 3.2 [9].

Previously, different mechanisms have been suggested to understand the effects of traction like elongation of soft tissues around the facet joints, reduction of muscle spasm by improvement of blood circulation, relaxation of longitudinal ligaments correction of displaced intervertebral discs and facet joints, separation of facet joints, expansion of intervertebral foramina, reduction of intervertebral discs pressure, and disc protrusions which directly or indirectly help to reduce the radicular symptoms of lumbar pain [22].

In a comprehensive evaluation of research on the benefits of lumbar traction in lumbar radiculopathy conducted in 2019, Yu-Hsuan Cheng et al. discovered that in the short term, lumbar traction considerably increased pain relief and functional gains. After 7 papers containing 403 individuals were excluded based on the title, abstract, and full-text review, they were included for quantitative analysis. With standard mean differences of 0.44 (95% confidence interval (CI): 0.11–0.77) and 0.42 (95% *CI*: 0.08–0.76), respectively, between the traction group and the control group, individuals in the traction group had substantially larger improvements in pain and function in the short term. This study provided strong evidence that traction treatment significantly reduced pain levels and improved functional impairment in the current study, which also had a p-value of 0.05 [23].

The present study's p-value contrasts with a prior study by Sadiye Murat et al. from 2018 that examined the effects of two different traction loads on individuals with subacute lumber disc hernias' physical and clinical state. All patients' treatment outcomes were assessed using the visual analogue scale, Oswestry Low Back Pain Disability Index, and Roland-Morris Disability Questionnaire before and after treatment, as well as before and 40 days after treatment, where statistically significant differences were discovered. Both groups showed gains on outcome evaluation measures ($p > 0.05$). According to these findings, physical therapy techniques and exercise other than lumber traction can help lumber hernia sufferers improve within 2 to 6 weeks, regardless of the type of treatment used. This investigation revealed that the lumbar traction had a limited impact. In three-dimensional lumbar traction, a recent study revealed a significant difference in NPRS and functional impairment [24].

In the current study, participants with lumbar back pain who underwent three-dimensional traction showed a notable decrease in pain intensity and a significant decrease in functional disability when compared to the control group. The NPRS and functional disability scores' p-values were both less than 0.05, indicating that this traction strategy is statistically significant in reducing the patient's pain and disability values. These findings were in line with those of a prior study by Zahra Masood et al., which found that lumbar traction decreased functional impairment and reduced pain in discogenic low back pain. Fifteen (or 50%) of the 30 patients were split between the two groups. The average age was 30 5.5 years, with 18 (60%) females and 12 (40%) men present. Additionally, 18 (or 60%) of the individuals had high body mass indices. Both groups' pain levels significantly decreased (p 0.05) [25].

In a study conducted by Hideki Tanabe in November 2021, immediate effects of mechanical lumbar traction were checked in patients with chronic low back pain. The purpose of this multicenter RCT was to prove efficacy and safety of traction by using equipment capable of precise traction force control. In this study, 98 patients from 28 clinics were randomly assigned to either intermittent traction with vibration group A or intermittent traction only group B. All patients were followed up for 2 weeks. The outcome measures were disability level, pain, and quality of life. These were measured repeatedly by using JLEQ (Japan Low Back Pain Evaluation Questionnaire). Statistical analysis was performed using linear-mixed model. Comparing to pre-traction data, both traction modes had significant improvement. However, JLEQ scores overtime showed significant improvement in the group having treatment in which vibration was added. Mean difference was − 1.75 (p = 0.001). However, neither difference between the Two sequences (p = 0.884) nor carry over effect (p = 0.527) has been observed. The results indicated that lumbar traction was able to improve pain and functional status of patients with chronic low back pain [26].

In order to examine the effects of the newly developed lumbar lordotic curve-controlled traction (L-LCCT) and traditional traction (TT) on functional changes in patients and morphological changes in the vertebral disc, Chang-Hyung Lee and his coworkers undertook a double-blind randomised control research in 2019. A total of 40 patients were enrolled and split into two groups after having magnetic resonance imaging reveal they had lumbar intervertebral disc disease at the L4/5 or L5/S1 level (L-LCCT or TT). The visual analogue scale, the Oswestry Disability Index, the Roland-Morris Disability Questionnaire, and morphological alterations (in the lumbar central canal area) before and after traction treatment were used to measure the patients' overall changes in health status. Both groups' pain assessments considerably dropped after traction (p 0.05). However, only the L-LCCT group saw a substantial improvement in functional scores and morphological alterations following therapy (p 0.05). This investigation came to the conclusion that regulated lumbar lordotic curve traction produced better results [27].

This study has some limitations as an expensive treatment; therefore, most of the patients could not afford this treatment. Moreover, most of the patients have phobia of this treatment. The age range and weight range are too vast which decreases specificity. Lastly, follow-ups lasting more than 8 or 12 weeks were not taken into account. Therefore, longer-lasting benefits of any therapy strategy were not discovered. To further examine the best potential treatment for patients with lumbar radiculopathy, it is strongly advised to enhance the sample size and compare both procedures with another exercise therapy. In this study, only the NPRS and ODI scales were measured in this study; however, future research should additionally take into account the lumbar motions of flexion, extension, and side bending. Furthermore, long-term studies are advised so that the results of the relevant investigation may be tracked throughout time. It is also further recommended to limit the age gap according to the pathological changes to be more specific. Lastly, it is also advised to study effect of traction in different treatment positions.

Conclusion

The study concluded that both groups significantly reduced pain levels and improved functional impairment ratings in participants with lumbar radiculopathy, however, group A who received 3-dimensional lumbar traction was shown to be more effective than group B who received 2-dimensional lumbar traction on pain and functional disability in patients with lumbar radiculopathy.

Abbreviations

LBP	Low back pain
PIVD	Prolapsed intervertebral disc
LIVDP	Lumbar intervertebral disc prolapse
2D	Two dimensional
3D	Three dimensional
RCT	Randomized clinical trial
NPRS	Numeric pain rating scale
ODI	Oswestry Disability Index
L-LCCT	Lumbar lordotic curve-controlled traction
TT	Traditional traction

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Authors' contributions

Conceptualization, Dr. HM and NS. Investigation, Dr. HM and AW. Methodology, Dr. HM and NS. Data curation, Dr. HM and GH. Formal analysis, Dr. SR and GH. Supervision, Dr. SR. Roles/writing—original draft, Dr. HM and Dr. AW. Writing—review and editing, Dr. SR.

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Availability of data and materials

All the data and materials of this research are available for any interested researchers and journals upon request by email to the corresponding author.

Declarations

Ethics approval and consent to participate

The study was approved by Research and Ethics Committee of Riphah International University under reference no. of REC/RCR&AHS/22/0126. All participants signed a written informed consent before starting the study.

Consent for publication

The authors of this research consent that is research has not been sent for any journal for publication and it is not considered for publication for any other journals.

Competing interests

The authors declare that they have no competing interests.

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