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Efficacy of side lying traction versus supine lying traction in treatment of lumbar disc herniation: A randomized controlled trial

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***Abstract*---** Objective: To investigate the effect of side lying lumbar traction and Supine lumbar traction in treatment of Lumbar disc herniation (LDH). Design: Two Experimental design Pretest – Posttest control group. Subjects: Forty-seven patients of LDH with unilateral sciatica randomly assigned into side lying traction group, supine lying traction group, and control group. Intervention: control group received conventional physical therapy (hot pack- lumbar strengthening exercise and stretching exercise). Side lying group received side lying traction beside conventional physical therapy and supine lying traction group received supine lying traction beside conventional physical therapy. The treatment was 3 sessions per week for 12 weeks. Outcome measurement: The patients were evaluated by Visual Analogue Scale (VAS) for (back – leg) pain, Oswestry Disability Index (ODI), H reflex Latency, L4/L5, L5/S1 herniated disc index. The evaluation was before and after intervention. Results: There was statistically significant difference for side lying traction in VAS (back-

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leg), ODI score and L5/S1 disc index after 12 weeks of treatment ($p > 0.05$). There was statistically significant difference for both traction groups in L4/L5 disc index. There wasn't statistically significant among three groups in H reflex latency. Conclusion: Side lying traction was more effective in reducing pain (back – leg), ODI score and L5/S1 disc index than other groups. Adding side lying and supine lying traction to conventional physical therapy were more effective in reducing low back pain, sciatica, improving functional activities and regression of herniated disc size.

***Keywords*---**lumbar disc herniation, sciatica, side lying lumbar traction, supine lumbar traction

Introduction

Lumbar disc herniation (LDH) is a localized displacement of intervertebral disc material beyond the physiological margins of the intervertebral disc space that can result in low back pain with or without radicular pain [1]. Disc herniation occurs mainly between the fourth and fifth decades of life, although it has been described in all age groups [2]. The most common site of LDH is at L4–L5 or L5–S1 (95%) [3]. LDH usually occurs in patients with preexisting degenerative alterations of the intervertebral disc (IVD, (The degeneration of the IVD is a common process of aging and is usually asymptomatic. However, structural damage to the IVD due to flexion/extension, lateral bending, and axial loading may lead to the annular fissuring and fragmentation of nuclear tissue, which can result in altered biomechanical properties of the IVD with the loss of its structural integrity [4].

The origin of sciatic pain is probably multifactorial, involving mechanical stimulation of the nerve ends of the external portion of the fibrous ring, direct compression of the nerve roots (with or without ischemia) and a series of inflammatory phenomena induced by the extruded nucleus [4,5]. Most of LDH patients obtain satisfactory pain relief by conservative treatment including pharmacological agents and physical therapy. However, the conservative treatment usually effective, it may take weeks. Conservative treatment often is in the form of oral analgesics, traction, and spinal stabilization exercise [4]. Current evidence still recommends physical therapy as first line of LDH treatment [6].

Lumbar traction is a commonly used method to treat patients with LBP with or without sciatica. In the UK 41% and in the US 77% of outpatient rehabilitation providers respectively using lumbar traction [7,8]. Lumbar traction increasing the negative pressure inside the disc for the relief of lumbosacral nerve root compression pathologies and disc herniation [9]. In research by Chung et al a decrease in the volume of protruded disc has been observed by applying lumbar traction [10]. The traction force which required for separation intervertebral joints was also investigated clinically by various studies. Kumari et al. and Farajpour demonstrated that 40 – 50% of body weight was sufficient for lumbar ligament stretching and widening intervertebral foramen [9,11].

Although there are literature supports the positive mechanical effect of traction on LDH which decreasing pain and improving function [12-14]. The evidence didn't support the lumbar traction as an effective treatment for LDH and LBP [15, 16]. Inability of supporting traction benefits may due to Lack of methodological design of previous research, have made the literature regarding lumbar traction still under debate [17-19]. The contradiction in the literature makes necessary for further researching about the efficacy of the traction [20]. The study used alternative position for lumbar traction from side lying because Side lying manual lumbar traction was effective in reducing pain and improve the patient disability [21,22].

Side lying position on the contralateral side of pain has various advantages. It is unloading position for lumbar vertebrae by widening the unilateral intervertebral foramen, which releases the disc pressure from the nerve root , Gapping the zygapophyseal joint which Stimulate joint mechanoreceptors reducing pain via a gating mechanism in the spinal cord, decreasing intra discal pressure, increase its height and hydration [23- 28]. The clinical effect of the lumbar traction was widening disc spaces and the intervertebral foramen the separation can reach to 3mm in the whole lumbar region [29-30]. The study was conducted to investigate the efficacy of side lying lumbar traction and supine lying traction as a part of physical therapy program in treatment of LDH.

Material and Methods

Two experimental pretest posttest control group study was conducted in the physical therapy department, health insurance organization, Tanta city, Egypt. The study was conducted during the period from June 2020 to April 2021. Eighty-six patients were assessed for eligibility. Fifty-four patients underwent randomization for three groups. As seen in the flow diagram (Figure 1), 18 patients were allocated to each group. All of them completed the pretreatment evaluation, and 47 of them completed the study. The study approved by the research ethical committee of faculty of Physical Therapy, Cairo University with identification number (P.T.REC/012/002220). The study registered and accepted in PACTR with identification number (PACTR 201909903222498).

A pilot study consisted of 10 patients was conducted before the study. The pilot study was conducted for detection any hazards or technical problems during application of side lying traction. The pilot study was done also for demonstration the clinical efficacy of side lying traction in treatment of LDH with unilateral sciatica. The patients received side lying mechanical lumbar traction beside conventional physical therapy. The treatment was 3 sessions per week for 12 weeks. The results of pilot study were positive and there was statistically significant improvement in all outcome measures before and after treatment. The patients completed this study their age ranged from 30 to 50 years old from both genders. The patients were referred by orthopedist or neurologist as LDH with unilateral Sciatica. The patients had lumbar MRI revealed L4/L5, L5/S1 disc herniation. The patients were in chronic stage more than three months from starting the symptoms with Oswestery index disability score (ODI) 20-60%.

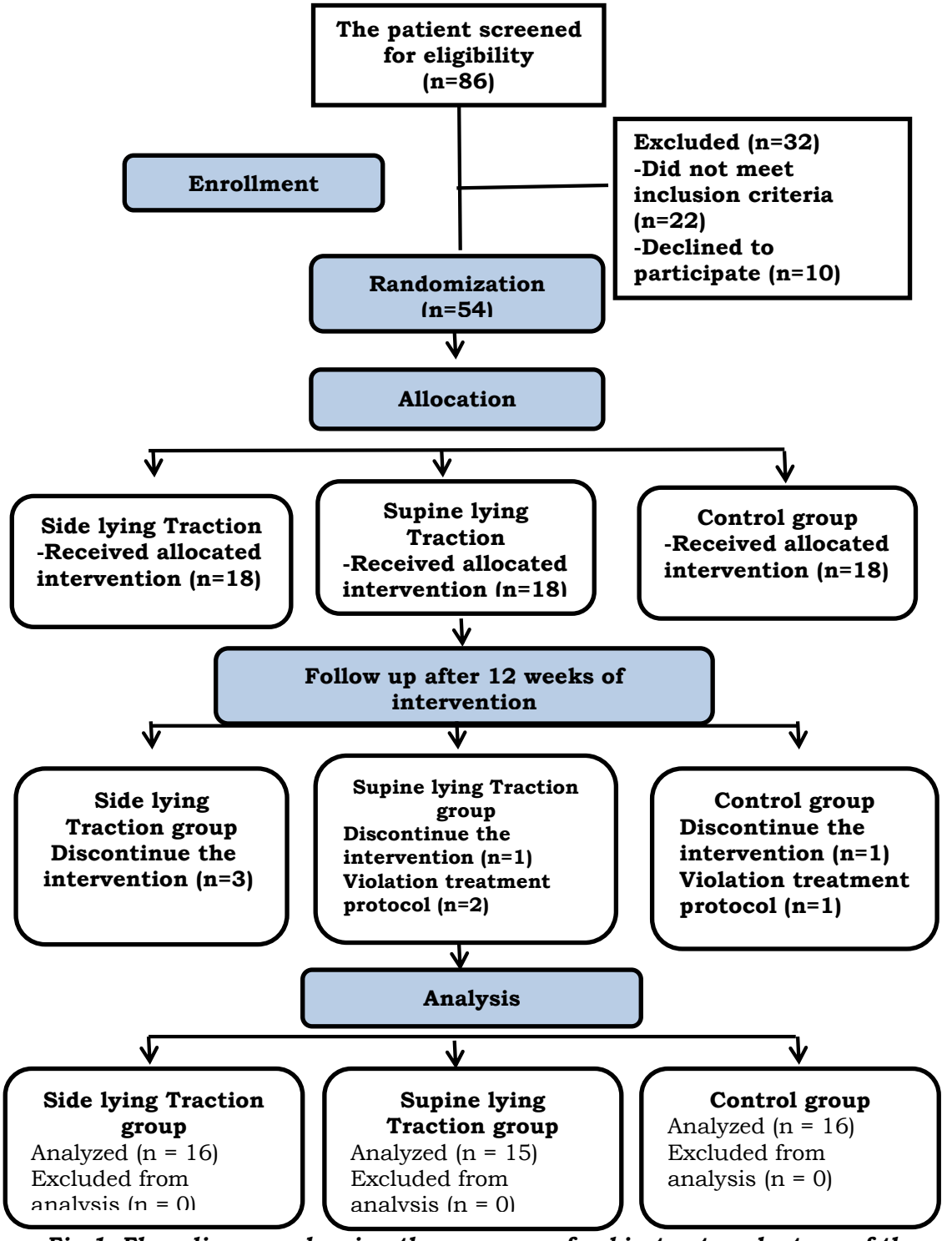

Fig 1. Flow diagram showing the progress of subjects at each stage of the clinical trial

Exclusion Criteria included LDH without sciatica, Lumbar Spondylisthesis, Lumbar instability, Osteoporosis, Previous lumbar surgery, - Scoliotic deformity or any deformity of lower extremity that may interfere with global alignment, Malignancy, Peripheral neuropathy, Rheumatoid arthritis, Pregnancy, Inability to tolerate Supine or side lying position. The three groups were included side lying traction group which the patients received side lying mechanical lumbar traction beside conventional physical. The patient rested side lying on the contralateral side from sciatica then flexed both hips to 80° with pillow between the knees. The hips angle was measured by electro goniometer before and during traction for assurance that the determined angle was maintained. The traction was for 20 minutes with intermittent mode (hold 60 sec – relax 20 sec). The force was from 40 – 50% of patient's weight.

The supine traction group received supine lying mechanical lumbar traction with conventional physical therapy. The patient rested in supine lying and his legs rested on adjustable stool. The stool was adjusted to produce hip flexion 80°. The hips angle was measured by electro goniometer before and during traction for assurance that the determined angle was maintained. The traction parameters were the same in side lying group. The control group the patients received the conventional physical therap. Conventional physical therapy was in form of William's exercises, extension strengthening lumbar exercises and hot pack for 15 minutes. William's exercises included single knee to chest, double knees to chest and pelvic tilt exercises. Extensions strengthening lumbar exercises were bridging exercises, prone trunk extension, and prone leg lift. The type of hot pack was electrical with thermostat which was set on 45°C. The treatment was 3 session per week for 12 weeks.

The outcome measures of the study were included Visual analogue scale (VAS) for back, VAS for leg, Oswestry Disability Index, H reflex latency, L4/L5 herniated disc index, and L5/S1herniated disc index. Disk herniation index measurement was done on the axial slices: The disk and intervertebral foramen were measured at intercept of the axial direction. The distance of the herniated disk was recorded as the maximum anteroposterior disk protrusion (AB), and that of the vertebral foramen was recorded as the maximum anteroposterior canal length (EF). The width of the herniated material was measured by drawing a line at the mid-level of the maximum anteroposterior disk length (CD). The width of the spinal canal was calculated at the same level (GH) as shown in figure 2. The formula used for calculating the disk herniation index was ([AB ×CD]/[EF ×GH])×1,000.The evaluation was before and after treatment. VAS back, VAS leg, ODI was done by the main researcher. The H reflex was done by physiatrist was blinded about the type of treatment. The herniated index was measured by radiologist who also was blinded about the type of treatment.

Data analysis

Data was analyzed using SPSS program version 24with Alpha level set at 0.05. Descriptive statistics about demographic data and the results were conducted using mean, standard deviation. Normality test was conducted to ensure homogeneity of demographic data and pre-assessment values for the patients among groups. One way ANOVA conducted between three groups for demographic

data and clinical baseline characteristics. Mixed design MANOVA was conducted to show difference between groups for VAS for back and leg, ODI score, H reflex latency and herniated disc index. When MANOVA is statistically significant, follow up with univariate ANOVAs for every outcome with Bonferroni correction to protect against type I error.

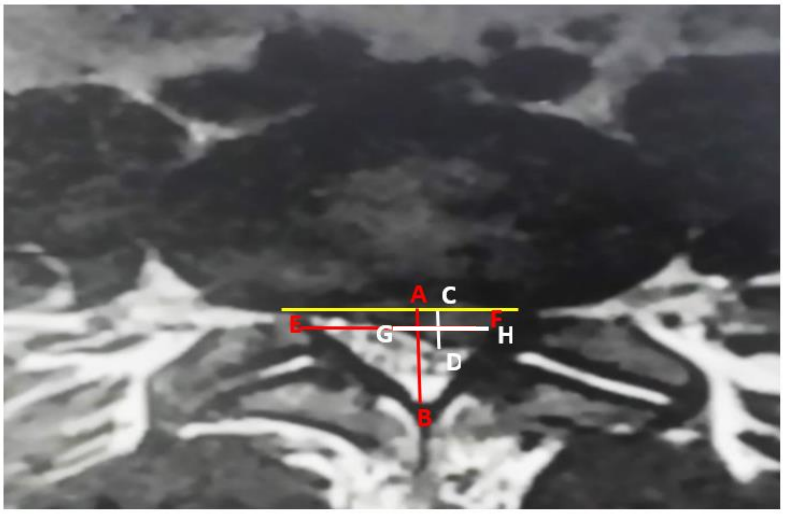

Fig 2. The herniated disc index measured in MRI of present study pretreatment

Results

Table 1 represents the demographic data for the three groups. There wasn't statistically significant between three groups, Table 2 represents the patients baseline clinical characteristics. The results showed that there wasn't statistically significant between groups. Mixed design multivariate analysis was conducted to assess the difference between participants in the three groups in the amount of change in their scores on VAS for back, VAS for leg, ODI, H reflex latency, MRI index L4/L5 and MRI index L5/S1. Significant multivariate effects were found for the main effects of group, Wilks A=0.51, F (12, 78) = 2.59, P = 0.004, $\eta 2$ = 0.29, significant for time, Wilks A=0.019, F (6, 39) =328.06, P < 0.0001, $\eta 2$ = 0.98 and for group and time interaction, Wilks A=0.15, F (12, 78) =9.91, P < 0.0001, $\eta 2$ = 0.63.

Table 3 represents post treatment values. In table 3 results of Univariate analysis demonstrated that there was statistical significant for side lying traction group in VAS of back, F (2,44) = 16.02, p< 0.001, $\eta 2$ = 0.42, VAS of leg F (2,44) = 15.91, p< 0.001, $\eta 2$ = 0.42, ODI F (2,44) = 17.73, p< 0.001, $\eta 2$=0.44, and L5/S1 MRI index variable F(2,44) = 16.33, p< 0.001, $\eta 2$ = 0.42 as shown in figure 3. However, there were nonsignificant statistical changes for H reflex latency F(2,44) = 0.23, p = 0.78, $\eta 2$ = 0.01. There was statistically significant for both traction groups in L4/L5 MRI index F (2,44) = 15.95, p p< 0.001, $\eta 2$ = 0.42 but there wasn't statistical significance between both groups.

Table 1
Comparison between three groups in the demographic data

	Side lying traction (n=16)	Supine lying traction (n=15)	Control (n=16)	f	p
Age	39.81 ±5.38	40.33 ±5.7	41.31 ±4.67	0.33	0.72
Weight (Kg)	84.75 ±11.01	79.12 ±11.9	81.94 ±6.65	1.2	0.3
Height (cm)	171.63 ±9.01	168.87 ±8.83	170.38 ±8.21	0.39	0.67
BMI (Kg/m^2)	28.8 ±1.93	27.63 ±1.92	28.22 ±2.19	1.28	0.28
Symptoms duration (Months)	6.94 ±2.96	8.2 ±2.42	7.5 ±2.03	1.07	0.35
Gender				*X^2=0.78*	0.67
Male n (%)	10 (62.5%)	8 (53.3%)	11(68.8%)		
Female n (%)	6 (37.5%)	7 (46.7%)	5 (31.2%)		
Affected side				*X^2=0.42*	0.8
Right n (%)	10 (62.5%)	11 (73.3%)	11 (68.8%)		
Left n (%)	6 (37.5%)	4 (26.7%)	5 (31.2%)		

Data are mean ± SD, except gender and affected side which are count and %; P-value < 0.05 indicates statistical significance

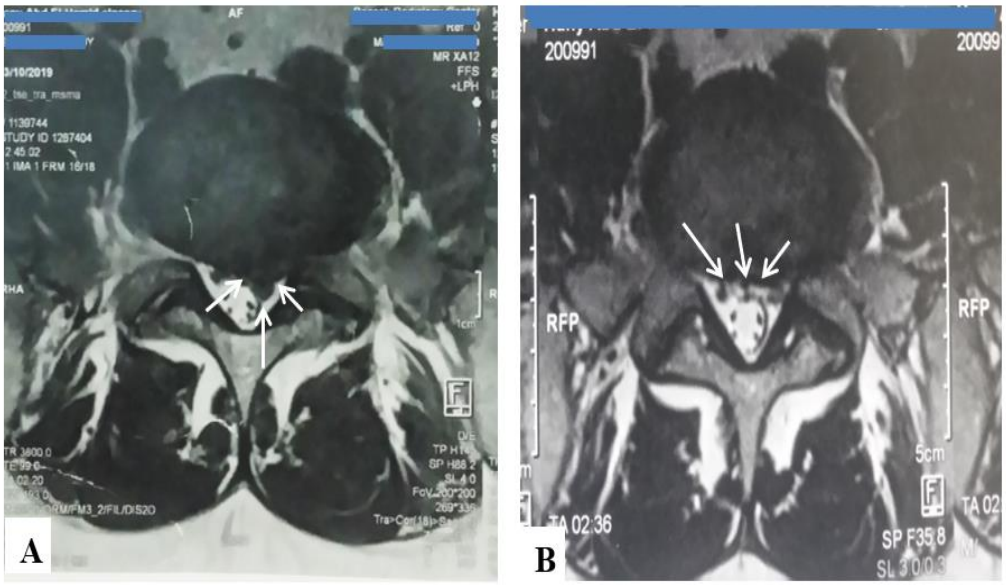

Fig 3. L5/S1 disc herniation (A) before treatment (B): regression disc herniated disc size after side lying lumbar traction.

Table 2
Baseline clinical characteristics of the patients

	Side lying traction (X±SD)	Supine lying traction (X±SD)	Control (X±SD)	f	p
VAS (back)mm	68.75±12.04	72.67±12.22	72.5 ±11.25	0.55	0.57
VAS (leg)mm	69.38±11.23	66.67±10.46	74.38±12.09	1.86	0.16
ODI	36.63±10.34	34.8±7.24	36.25±7.14	0.2	0.81
H reflex Latency (msec)	34.65±2.79	33.75±1.93	34.31±2.46	0.53	0.59
Herniated disc index L4/L5	205.41±49.03	199.46±38.76	208.4±46.85	0.15	0.85
Herniated disc index L5/S1	292.89±77.28	274.72±68.83	248.06±47.93	1.87	0.16
VAS: visual analogue scale, ODI: oswestry disability index, Data are mean ± SD, P-value < 0.05 indicates statistical significance					

Table 3
Clinical characteristics of the patients after treatment

	Side lying traction (X±SD)	Supine lying traction (X±SD)	Control (X±SD)	f	p
VAS (back)mm	25 ±11.54	38 ±13.73	49.38 ±11.23	16.02	0.0001
VAS (leg)mm	21.88 ±13.27	35.33 ±12.45	46.25 ±10.87	15.91	0.0001
ODI	13.69 ±4.17	17.4 ±3.04	20.88 ±2.84	17.73	0.0001
H reflex Latency (msec)	33.08±2.36	32.74 ±2.03	33.28 ±2.26	0.23	0.78
Herniated disc index L4/L5	123.58 ±28.19	156.42 ±37.19	197.84 ±44.56	15.95	0.0001
Herniated disc index L5/S1	147.9±47.36	195.5 ±35.08	234.33 ±44.62	16.33	0.0001
VAS: visual analogue scale, ODI: Oswestry disability index, Data are mean ± SD, P-value < 0.05 indicates statistical significance					

Discussion

The present study demonstrated that there was significant improvement in side lying lumbar traction group than other groups. The improvement was in VAS back, VAS leg, ODI score and L5/S1 herniated disc index. There was significant improvement in L4/L5 in both traction groups than control group but there wasn't statistical difference between both groups. There was improvement in H-reflex latency in the three groups but there wasn't difference between them. The present study was unique in administration of side lying position in the mechanical lumbar traction. Creighton et al used side lying manual lumbar traction. They investigated if a gentle form of manual lumbar traction could reduce painful lumbar motions associated with lumbar disc degeneration. The

researchers demonstrated that there was a statistically significant improvement for decreased pain intensity during active lumbar motion in the experimental group as compared to the sham treatment group [21].

It was noticed that the patients with unilateral sciatica feeling better with side lying on the contralateral side of sciatica. Side lying position also was used in positional distraction and in spinal manipulation in LBP patients. Rubinic et al found that side lying positioning increased spinal height [27]. Hallur et al also found that rotational side lying position increase spinal height it could be used to help maintain intervertebral disc health [31]. The present study was depended on the theory of combination between the benefits of mechanical lumbar traction, side lying position and the gravity in regression of herniated disc. Side lying position for traction has various advantages; easy applicable in different traction systems not required a special manufactured table like was used in prone lying position lumbar traction. Chest belt with Pelvis belt facilitates the delivery of mechanical traction to the lumbar segments and easily separation of affected intervertebral foramen beside zygapophyseal joints [28, 32]. Side lying position also allows delivering mechanical traction while maintaining safe body mechanics.

Holtzman et al, investigated the effects of manual spinal traction during a clinical exam on low back pain LBP symptoms. When traction was ap¬plied in side lying 78% of the patients reported immediate improvement in the symptoms and 70% of the patients reported an immediate improvement in hook-lying positioning like applied in supine traction [22]. The previous result proved the clinical effect of side lying lumbar traction in LBP. Although there is research gap up to date there wasn't studies used mechanical traction from side lying position. Supine lying position was the most popular position used in lumbar traction [29]. Tanović et al, found that supine lumbar traction was more effective than conventional physical therapy in treatment LBP associated with LDH [33] Tanabe et al proved the positive effect of supine lumbar traction alone in decreasing of Pain score and improving functional activities in chronic LBP patients [34]. Choi et al, found that both supine traction and spinal decompression were equally effective in increasing straight leg raise test range of motion and decreasing VAS and ODI scores [35] Koçak et al, also agreed with that supine traction and spinal decompression equally effective in treatment of LDH [36].

Karimi et al found that supine lumbar traction with conventional physical therapy reduced herniated disc size, pain and improves functional ability in patient with acute LBP [37]. Mohammed et al, founded that the combined effect of Maitland spinal mobilization and intermittent mechanical lumbar traction for chronic nonspecific low back pain were more effective than one of them alone [38]. Al Amer et al, investigated the effect of lumbar traction beside the conventional physical therapy comparing the conventional physical therapy alone in treatment LBP with sciatica. the lumbar traction was effective part in the treatment and improved H reflex amplitude, VAS and ODI scores comparing conventional physical therapy. It was found that the follow up for the traction group had a good prognosis [39].

Shimmel et al, stated that lumbar traction wasn't effective in treatment of LBP [15]. Thackeray et al. also concluded that there was no evidence that mechanical

lumbar traction in combination with an extension-oriented treatment was superior to extension-oriented exercises alone LBP with sciatica [16]. Gulsen et al founded that adding lumbar traction to the conventional physical therapy wasn't effective than conventional physical therapy in treatment of LDH [40]. Aynar et al, found improving in VAS, ODI score and regression in herniated disc size in traction group and conventional physical therapy group. Although the regression of disc size was higher in traction group but there wasn't statistical difference between them. [41].

Cavagnaro et al, concluded that lumbar traction produce positive results in nerve root compression symptoms but still debatable in degenerative conditions [42]. Cheng et al, also in a systematic review and a meta-analysis concluded that lumbar traction was effective in the short term for reducing LBP with LDH, but further studies are needed to determine long term effectiveness [14]. In contrary Wegner et al, in a systemic review found that traction, either alone or in combination with other treatments, has little or no impact on pain intensity, functional status, global improvement and return to work among people with LBP [43]. Alrwaily et al, in a systemic review found that there is wide variability in the type of traction, traction parameters and patient characteristics among the RCTs of lumbar traction. This variability may explain why the conclusion that lumbar traction has little no or value on clinical outcomes. Also, this variability emphasizes the need for targeted delivery methods of traction that match appropriate dosages with specific subgroups of patients with LBP [44]. Lumbar traction remains a procedure very willingly used by therapists in many countries of the world. Recent years the evidence of lumbar traction confirmed. New techniques and with newly developed traction devices can expand and increase the lumbar traction efficacy. There is need to further studies to investigate the clinical effect of side lying mechanical lumbar traction with radiological assessment in real-time for demonstration the biomechanical changes during traction.

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Conflict of interest

The authors report no conflicts of interest in this work.

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