Effect of Three Dimensional Mechanical Traction on Functional Outcomes in Patients with Discogenic Sciatica

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Abstract

Background: Sciatica is a common form of neuropathic pain affecting 5% of people. It is not a disease, but a group of symptoms caused by pressure on the spinal nerves. A goniometer is a device used in physical therapy to measure joint range of motion (ROM). The Numerical Rating Scale (NRS) is a simple, easily understood pain intensity measure. The Oswestry Disability Index (ODI) is a self-reported outcome measure for low back pain. Mechanical traction is a treatment method for spinal pain syndromes, although scientific evidence is contradictory.

Aim of Study: To examine the effect of specific three-dimensional traction on functional outcomes in patients with discogenic sciatica.

Material and Methods: Thirty patients diagnosed as discogenic sciatica were recruited and assigned randomly to two groups of equal size: The study group (A) and the control group (B). The study group (A) received three-dimensional lumbar mechanical traction, while the control group (B) received non-specific lumbar traction. Both groups received traction for 15 minutes at the session. The treatment lasted for four consecutive weeks, three times per week. All patients assessed by NRS, ODI and measuring hip flexion ROM by goniometer.

Results: Within groups comparisons, there was a statistically significant reduction in Numerical Rating Scale (NRS), Oswestry Disability Index (ODI) and increase inhip flexion ROM when comparing pre- and post-treatment conditions (*p*=0.001). Comparison between groups post treatment revealed non significant difference in ODI, NRS and hip flexion ROM between study and control groups (*p*>0.05).

Conclusion: There was no significant difference between effect of three dimensional lumbar mechanical traction and traditional nonspecific mechanical traction on functional outcomes in patients with discogenic sciatica and both methods were effective.

Key Words: 3D Lumbar traction – Discogenic sciatica – Lumbar traction – Straight leg raising.

Introduction

SCIATICA is the most common form of neuropathic pain, affecting at least 5% of people at some stage in their lives. It is not a disease, despite the fact that medical professionals have thought of it as such for decades [1]. Sciatica is a group of symptoms caused by pressure on the spinal nerves that form the sciatic nerve at the L4, L5, or S1 levels It can happen unexpectedly after straining or raising something heavy or it can happen gradually without any obvious cause [2].

Numerical Rating Scale (NRS) is typically consists of a series of numbers with verbal anchors representing the entire possible range of pain intensity. The NRS can be administered verbally or in a written format, is simple and easily understood, and is easily administered and scored it is most commonly 0 to 10, with 0 being "no pain" and 10 being "the worst pain imaginable" [3].

A goniometer is a device used in physical therapy to measure a joint's range of motion (ROM). There are two "arms" -one that is stationary and one that is movable- that are hinged together. Each is positioned at specific points on the body with the center of the goniometer aligned at the joint of interest. Hash marks on the hinge allow the therapist to precisely measure ROM in degrees [4].

Oswestry Disability Index (ODI) (Arabic version) is Self-reported outcome measure that widely

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used and recommended for low back pain. The ODI indicates the extent to which a person's functional level is restricted due to LBP [5].

Mechanical traction is one such method with a long history of use in the treatment of spinal pain syndromes [6]. Intervention of patient specific three-dimensional lumbar traction significantly decreased the pain and improved the functional disability in patients with LIVDP [7].

At three dimensional mechanical traction patient position adjusted at three dimensions as flexion, side bending and rotation with applying mechanical traction.

Material and Methods

Study design:
Randomized Control Trial was carried-out to examine the effect of specific three-dimensional traction on functional outcomes in patients with discogenic sciatica. During period from May 2022 to November 2023, The whole procedure was well explained for subjects that participated in the study, and they signed an institutionally approved informed consent that was accepted by the Ethical Committee of the Faculty of Physical Therapy, Cairo University (No: P.T.REC /012/004744).

Sample size calculation:
Sample size calculation was performed using G*POWER statistical software (version 3.1.9.2; Franz Faul, Universitat Kiel, Germany); and revealed that the required sample size for this study was 15 subjects in each group. Calculation is made with $\alpha=0.05$, power=80% and effect size=1.1.

Subjects:
Thirty subject from both sexes participated in this study recruited from out clinics of faculty of physical therapy and Kasr Al-Ainy Hospital of Cairo University. Their ages ranged from 30 to 50 years old.

Participants:
Thirty subject from both sexes participated in this study. They were divided to two equal groups, medically diagnosed with unilateral discogenic sciatica with episode of sciatic pain occurring at last week prior to assessment. The study group (A): Fifteen patients were treated by three-dimensional lumbar mechanical traction for 15 minutes, Control group (B): Fifteen patients were treated by non-specific lumbar traction for 15 minutes.

Inclusion criteria were: Age: 30-50 of both sexes, Unilateral discogenic Sciatica with episode of pain one week ago before assessment, Patient can walk without assistance even in presence of pain.

Exclusion criteria were: Neoplastic lesions of the spine, Implants in the lumbar spine, Spondylolisthesis (all grades), Patient with psychiatric disorders, Senile patient above 60 years old, Inability to walk unaided in presence of pain.

Procedures:

Assessment procedure:
Numerical Rating Scale (NRS) The numerical scale is a scale from 0 to 10, with 0 equaling no pain and 10 equaling the worst possible pain," the patient was asked to rate his level of pain [3].

Oswestry Disability Index (ODI) (Arabic version) is a disease-specific self-administered questionnaire that quantifies the effects of LBP on daily activities. It has the following 10 dimensions: Pain intensity, personal care, lifting, walking, sitting, standing, sleeping, sex life (if applicable), social life, and travelling.

Each dimension has six levels with a score of 0 allocated to the least disabled level and a score of 5 allocated to the most disabled level. The subscales together add up to a total maximum score of 50. The score is then doubled and interpreted as a percentage of the patient-perceived disability, that is, the higher the score, the greater the disability. Oswestry Disability Index is a recommended and widely used outcome measure for LBP because it is able to detect changes in disability over time [6].

After that, the total scores are divided by 50 to get a percentage score: 0%–20% represents minimal disability, 21%–40% moderate disability, 41%–60% severe disability, 61%–80% crippling back pain, and 81%–100% bedridden or exaggerated symptoms [5].

A goniometer is a device used in physical therapy to measure a joint's range of motion (ROM). There are two "arms" one that is stationary and one that is movable that are hinged together. Each is positioned at specific points on the body with the center of the goniometer aligned at the joint of interest. Hash marks on the hinge allow the therapist to precisely measure ROM in degrees [4].

Treatment procedure:
Patient laid on the traction table and two Velcro belts strapped around him/ her - one around the lower ribcage and one just above the pelvis. Once he / she was comfortable, the traction machine was started and it works by gently pulling down the belt attached above the pelvis, while the belt below the ribcage is maintaining his/her body up the bed.

Patients received intermittent traction started gradually until the loading force was 50% of

body weight and unloading force was 25% of body weight. The pulling time was 30 seconds per cycle and the resting time was 30 seconds with total duration of 15 minutes.

Three dimensional mechanical traction Patients laid on traction table at side laying position with the affected side above, lateral bending achieved by pillow below the patient and rotation of trunk toward the ceil with chest facing up and affected leg flexed 90 degrees at hip and rested on the traction table, lower most leg was extended then will receive mechanical traction for 15 minutes.

Non-specific lumbar traction Patients laid on traction table at supine position with hip and knee at 90 degrees flexion, legs rested on padded stool, then receive mechanical lumbar traction for 15 minutes.

Statistical analysis:

Unpaired *t*-test was conducted for comparison of subject characteristics between groups. Chi squared test was conducted for comparison of sex distribution between groups. Normal distribution of data was checked using the Shapiro-Wilk test. Levene's test for homogeneity of variances was conducted to test the homogeneity between groups. Unpaired *t*-test was conducted to compare the mean values of ODI, NRS and hip flexion ROM between groups. Paired *t*-test was conducted for comparison between pre and post treatment in each group. The level of significance for all statistical tests was set at *p*<0.05. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 25 for windows (IBM SPSS, Chicago, IL, USA).

Results

Subject characteristics:

Table (1) showed the subject characteristics of study and control groups. There was no significant difference between groups in age, weight, height, BMI and sex distribution (*p*>0.05).

Table (1): Subject characteristics.

| | Study group | Control group | MD | *t*-value | *p*-value | Sig. |
	Mean ± SD	Mean ± SD				
Age (years)	39.13±7.52	38.87±8.09	0.26	0.09	0.93	NS
Weight (kg)	76.53±9.13	77.40±9.42	–0.87	–0.25	0.80	NS
Height (cm)	167.20±10.87	165.53±9.01	1.67	0.45	0.65	NS
BMI (kg/m^2)	27.48±3.79	28.28±3.16	–0.8	–0.63	0.54	NS
Sex, N (%):						
Females	9 (60%)	10 (67%)		(χ2 = 0.14)	0.71	NS
Males	6 (40%)	5 (34%)				

SD: Standard deviation.

MD: Mean difference.

χ2, Chi squared value *p*-value, level of significance.

Effect of treatment on ODI, NRS and hip flexion ROM:

- *Within group comparison:*

There was a significant decrease in ODI and NRS and a significant increase in hip flexion ROM post treatment compared with that pretreatment in study and control groups (*p*>0.001). The percent of change in ODI, NRS and hip flexion ROM in study group was 55.74, 55.31 and 61.15% respective- ly, and that of control group was 48.07, 47.08 and 48.16% respectively. (Table 2).

- *Between groups comparison:*

There was no significant difference between groups pre-treatment (*p*>0.05). Comparison between groups post treatment revealed nonsignificant difference in ODI, NRS and hip flexion ROM between study and control groups (*p*>0.05). (Table 2).

Table (2): Mean ODI, NRS and hip flexion ROM pre and post treatment of study and control groups.

	Pre treatment	Post treatment	MD	% of change	t-value	p-value	Sig.
	Mean ± SD	Mean ± SD					
ODI:	52.87±12.39	23.40±8.63	29.47	55.74	9.67	0.001	S
Study group	51.47±11.01	26.73±10.37	24.74	48.07	6.42	0.001	S
Control group	1.4	−3.33					
MD	0.33	−0.96					
t-value	p=0.74	p=0.34					
NRS:	6.87±1.46	3.07±1.16	3.8	55.31	8.66	0.001	S
Study group	6.67±1.29	3.53±0.92	3.14	47.08	10.22	0.001	S
Control group	0.2	−0.46					
MD	0.39	−1.22					
t-value	p=0.69	p=0.23					
Hip flexion ROM (degrees):							
Study group	52.33±12.08	84.33±13.35	−32	61.15	−14.04	0.001	S
Control group	54.67±12.74	81±12.28	−26.33	48.16	−7.59	0.001	S
MD	−2.34	3.33					
t-value	−0.51	0.71					
	p=0.61	p=0.48					

SD: Standard deviation. MD: Mean difference. *p*-value: Probability value.

Discussion

This study indicated that there was no significant difference between 3D traction and traditional nonspecific traction in patients with discogenic sciatica and both methods are effective on ODI, NRS and hip flexion ROM with significant decrease in ODI and NRS, as well as an increase in hip flexion ROM, after therapy compared to pre-treatment.

For patients with lumbar intervertebral disc prolapse, This study agrees with Asiri et al., concluded that twelve sessions of patient-specific three-dimensional lumbar traction led to improvements in functional impairment and pain reduction [7] and with Naguib et al., who commented that It was observed that patients with unilateral sciatica felt better when they were lying on their non-affected side. and they founded that The VAS back, VAS leg, ODI score, and L5/S1 herniated disc index all showed improvement. Both traction groups (side lying group and supine lying group) showed a statistically significant improvement in L4/L5. However, there was no difference between the groups [8].

Also this study agrees with Vanti et al., conclouded that According to available data, adding supine mechanical traction to physical therapy treatment can be beneficial in the short term for reducing pain and disability in individuals with lumbar radiculopathy [9]. And Vanti et al., founded that Five of the sixteen papers that satisfied the requirements for qualitative analysis's inclusion were pooled. At short-term follow-up, meta-analyses of data from five trials on low back pain with lumbar radiculopathy revealed no discernible difference between various traction techniques [10].

This study disagree with Borman et al., who compared between two groups as Physical therapy was administered to each patient, whether or not traction was used. And founded that the mean pain intensity for both groups significantly decreased right after therapy, with no significant variations between the groups [11].

Conclusion: There was no significant difference between effect of three dimensional lumbar mechanical traction and traditional nonspecific mechanical traction on functional outcomes in patients with discogenic sciatica and both methods were effective.

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تأثير الشد الميكانيكى ثلاثى الأبعاد على الناتج الوظيفى فى مرضى آلام عرق النسا الغضروفى

نظـرة عامـة: عرق النسا هـو شـكل شـائع مـن آلام الأعصـاب التـى تؤثر على ٥٪ مـن النـاس. وهـو مجموعـة مـن الأعراض الناتجـة عن الضغـط على الأعصـاب الشـوكية.

مقياس الزوايا: هو جهاز يستخدم فى العلاج الطبيعى لقياس نطاق حركة المفاصل (ROM).

مقياس تقييم الألـم العـددى (NRS): هـو مقيـاس بسـيط وسـهل الفهـم لشـدة الألـم. مؤشـر الإعاقـة أوسويسـترى (ODI): هـو مقيـاس نتائـج تم الإبـلاغ عنـه ذاتيًـا لآلام أسـفل الظهـر. الجر الميكانيكى هـو وسـيلة عـلاج لمتلازمـات آلام العمـود الفقـرى، على الرغـم مـن أن الأدلـة العلميـة متناقضـة.

الهـدف مـن الدراسـة: دراسـة تأثيـر الشـد ثلاثـى الأبعـاد على النتائـج الوظيفيـة لـدى المرضـى الذيـن يعانـون مـن عرق النسـا قرصـى المنشأ.

المـواد والطـرق: تم مشـاركة ثلاثـين مريضـاً تم تشـخيص إصابتهـم بعـرق النسـا غضروفـى المنشـأ وتم توزيعهـم عشـوائياً على مجموعتـين متسـاويتين فـي الحجـم: مجموعـة الدراسـة (أ) والمجموعـة الضابطـة (ب). تلقـت مجموعـة الدراسـة (أ) جـرًا ميكانيكيًـا قطنيًـا ثلاثـى الأبعـاد، بينمـا تلقـت المجموعـة الضابطـة (ب) جـرًا قطنيًـا غيـر محـدد. تلقـت كلتـا المجموعتـين قـوة شـد لمدة ١٥ دقيقـة فـى الجلسـة. واسـتمر العـلاج لمدة أربعـة أسـابيع متتاليـة، ثـلاث مـرات فـى الأسـبوع. تم تقييـم جميـع المرضـى بواسـطة مقيـاس تقييـم الألـم العـددى ومؤشـر الإعاقـة أوسويسـترى وقيـاس انثنـاء الـورك بواسـطة مقيـاس الزوايـا.