

The Effect of Lumbar Lordosis Rehabilitation on S1 Alfa Motor Neuron Excitability in Chronic Non Specific Low Back Pain

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Abstract

Background: Chronic Mechanical Low Back Pain (CMLBP) represents a significant public health problem and an economic burden to employers. There is a gap in literature concerning the investigations on changes of the motor nerve excitability during rehabilitation of lumbar lordotic curve which represent a major barrier preventing the exploration of the most effective conservative treatment on restoring the lumbar lordosis. The Denneroll is a relatively new sagittal plane orthotic device designed to passively stretch the lordotic curve into a more lordotic position.

Aim of Study: This study designed to study the effect of lumbar Denneroll traction on motor nerve excitability on chronic low back pain patients.

Material and Methods: Thirty patients had participated in this study; they were assigned randomly into two groups (A) experimental group, and (B) control group. Group (A) consisted of 15 patients; they received combined program of Denneroll traction and conservative physical therapy treatment. Group (B) which consisted of 15 patients; they received the same conservative treatment as group (A) in form of (ultrasonic therapy, infrared and stretching exercise). Treatment was given 3 times per week, each other day, for ten consecutive weeks. Patients were evaluated pre-treatment and post-treatment for the H-reflex, H/M ratio and Absolute Rotatory Angle (ARA).

Results: Using repeated measures multivariate analysis of variance (MANOVA) test, patients showed significant improvement in the combined dependent variables in both groups but between groups difference group (A) showed a more significant improvement than group (B) in the combined dependent variables. Both of the Denneroll and traditional treatment had a significant effect on the H-reflex, H/M ratio and absolute rotatory angle indicated that there were significant effects of the tested group (the first independent variable) on the all tested dependent variables; H-reflex, H/M ratio and ARA ($F=31.357, p=0.0016$). However, there were significant effects of the measuring periods (the second independent variable) on the tested dependent variables ($F=114.404,$

$p=0.0001$). However, the interaction between the two independent variables was significant, which indicates that the effect of the tested group (first independent variable) on the dependant variables was influenced by the measuring periods (second independent variable) ($F=26.035, p=0.0001$).

Conclusion: Therefore, the combination of Denneroll with traditional physical therapy treatment program more effective than the therapeutic exercises alone in the treatment of non-specific low back pain patients.

Key Words: Non-specific low back pain – Denneroll – H-reflex – Absolute rotatory angle.

Introduction

CHRONIC Mechanical Low Back Pain (CMLBP) represents a significant public health problem and an economic burden to employers [1]. CMLBP has become one of the most common problems in industrialized societies; it can affect 80% of the people and has become the most common cause of functional limitation in individuals younger than 35 years [2,3].

Persistent back disorders seriously compromise the quality of work and life. Health care professionals are affected by several painful problems in the back during different modalities application on patients and lifting. Physical therapists are professionals who often present this type of disorder [4].

There is a gap of literature concerning the investigations on changes of the motor nerve excitability during rehabilitation of lumbar lordotic curve which represent a major barrier preventing the exploration of the most effective conservative treatment on restoring the lumbar lordosis. Only few non randomized studies were conducted [5,6], none of these studies found increases in lumbar lordosis post-treatment.

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In this regard, [7] introduced a new sagittal plane orthopedic device (Denneroll) designed to passively stretch the lumbar lordosis into a more lordotic position, its unique design allows it to create a 3-point bending extension load on the spine. The Denneroll creates a passive stretch in the direction of the normal lumbar curve which can affect the motor nerve excitability.

Accordingly, the main aim of the current study was to investigate the effect of lumbar lordosis rehabilitation on motor nerve excitability. The Electromyography (EMG) technique was used for evaluating and recording the H-reflex amplitude and HM ratio which considered a reliable assessment tool for measuring the motor nerve excitability.

Material and Methods

Thirty patients with CMLBP participated in the study, conveniently selected from the Outpatient Clinic, Faculty of Physical Therapy, Cairo University, their age ranged from 20 to 40 years with a mean age (31.9 ± 4.6) years, their mean height was (170.2 ± 6.2) cm, and their mean weight was (76.8 ± 7.4) Kg. between March 2017 and April 2018.

The patients were assigned into two groups of equal numbers. Experimental group consisted of 15 patients and control group consisted of 15 patients. The patients would be eligible to participate in the study under the following specific criteria:

Inclusive criteria:

- 1- Patients suffered from low back pain for a period over than 3 months.
- 2- Patients had ARA less than 40° .

Exclusive criteria:

- 1- Posterior osteophytes.
- 2- Previous surgery.
- 3- Spinal deformity.
- 4- Lower limb difference that may affect global posture.
- 5- Spinal canal stenosis.
- 6- Patients suffering from radicular pain.

II- Material and methods:

A- Evaluation instrumentations:

1- *Main X-ray imaging:* Radiographic techniques have been applied to quantify lordosis and evaluate range of motion. X-ray techniques are considered the most accurate clinical method for measuring lordosis since it is not affected by soft

tissue variations among different subjects. Biplanar radiography has been used to quantify motion in three axes and can achieve highly precised measures of vertebral bodies in space [8].

2- *EMG device:* Tonneis Neuroscreen plus version 1.59, had four channel Electrodiagnosis system and built amplifier was used to record the H-reflex amplitude and H/M ratio. This apparatus include [9]:

- Amplifier: Four electrically isolated amplifier channels, with impedance less than 100mv and sensitivity up to 4000mv.
- Stimulating unit: To which the stimulating electrode was connected.
- Electrodes: Ground electrode, bipolar stimulating electrode with inters electrode distance of 2.5cm and two silver surface recording electrodes (one is active and the other is the reference). Before the apparatus was used, the commit company calibrated all tested parameters.

B- Treatment measurement:

1- *Denneroll traction device:* The Denneroll is a new sagittal plane orthotic device, designed to stretch passively the lordotic curve into a more lordotic position. The Denneroll is made from soft, stable polyethylene foam providing cushioning to allow maximal comfort. It can assist in relief of pain, muscle tension, and recovery from disc injury available with two Lumbar sizes adult Medium & Large [9]; large size was used in this study.

2- *Ultrasound therapy device:* (Enrafnonius-Sonoplus 590) the Sonopulse 590 is a microprocessor-controlled unit for continuous and pulsed U.S therapy. This apparatus allow: 1MHZ frequency with transducer had an effective radiating area of 5.0cm^2 . The treatment time was 15 minutes/session. Infrared is chosen as a form of heat prior to stretching, mobilization, traction, massage and exercise therapy [10].

Design of the study:

Non-equivalent control group design was used in the study. Thirty patients were assigned in two groups of equal numbers [11,12].

Experimental group: Included 15 patients received Denneroll traction in addition to traditional physical therapy in form of ultrasound therapy (U.S.T) [13], Infra Red Radiation (I.R.R) [14] and stretching exercise [15].

Control group: Included 15 patients received only traditional physical therapy in form of (U.S.T, I.R.R and stretching exercise).

For both groups, the treatment was conducted for ten weeks; three sessions per week with the total of 30 sessions [16]. The angle of lumbar lordosis was measured by using plain X-ray, the H-reflex and H/M ratio was measured also before and after treatment by EMG.

A- Evaluation procedures:

1- Measurement of absolute rotatory angle:

Standard lateral lumbar radiographs were obtained with patients in standing position with arms folded on the chest placing; the hands in the clavicular fossae, all the posterior-superior and posterior-inferior vertebral body corner on lateral lumbar radiograph were marked and; two tangents drawn at the posterior body margins of L1 and L5 were constructed. The absolute rotatory angle is formed by the intersection of the tangents at the posterior body margins of L1 and L5 [17]. X-ray was calibrated by the Faculty of Engineering, Cairo University. X-ray for measuring ARA was validated by [18] concluded that X-ray for measuring ARA is reliable.

2- *Electrophysiological measurement:* Measurement of the H-amplitude and H/M ratio was conducted in the Faculty of Physical Therapy, Cairo University. The subjects were allowed to rest for 5 minutes before the beginning of the measurement [19].

- *Position of the patient:* The patient was placed in prone lying position in quiet room on a wooden padded table to eliminate environmental variations on the EMG. The head was maintained in mid position to control the possible effects of asymmetrical tonic neck reflex.

The examined leg was placed at zero degree of extension and mid-way between abduction and adduction at the hip. The knee was flexed 20 degrees by placing a small cushion under the knee to relax the gastrocnemius muscle to reduce any depressive influence on the H-reflex and the ankle was freely positioned in planter flexion outside the plinth.

- *Skin preparation:* First step before sensor placement is skin preparation. This includes shaving any excess hair and cleaning the skin with an alcohol pad; abrasion of the skin is also a common step. The goal of all of these steps is to allow for better adhesion of the electrode and the reduction of skin electrical resistance.

- *Position of the electrodes:* The two surface electrodes were coated with a special electro conductive gel to ensure good electrical coupling. The

active recording electrodes was placed over the soleus muscle 2cm below the junction of the two heads of gastrocnemius in line with the Achilli-estendonwhile the ground electrode was placed on the skin of the lateral side of the calf muscle, equidistant between the stimulating and recording electrodes to minimize the stimulus artifact. The electrodes were fixed to the skin by adhesive plaster.

- *Recording of the H-reflex:* The H-reflex was elicited by stimulating the posterior tibial nerve at the popliteal fossa using 1.0ms (pulse duration) square applied at 0.5sec (frequency) interval and monitored on line and stored on an oscilloscope. Resolution to 10mv was used to measure the H-reflex amplitude (peak to peak). Peak to peak H-reflex amplitude and M wave amplitude (10 readings) were displayed as waveforms on the monitor panel.

- *The H/M ratio was measured for each subject according to the following sequence:* The current intensity is slowly increased until the stimulus just activates the large Ia afferent fibers without concomitant activation of the motor fibers or just threshold for only motor fibers. The stimulus should be delivered at a rate of 1 stimulus every 2-3sec to avoid suppressing the H-reflex through central mechanism. The intensity of the stimulation gradually increased to record the maximum H-reflex as well as the maximum M value. Maximum H-reflex amplitude was manifested when most Ia fibers excited with the M response.

B- Treatment procedures:

1- *Ultrasound therapy:* Each patient in the two groups received continuous U.S therapy at an intensity of 1.0W/cm², frequency 1MHZ and 100% duty cycle. It was applied on paraspinalmuscles. The coupling media were applied to the skin surface to reduce transfer losses and minimize reflection. The treatment head had been placed on the skin before output was turned on. The treatment head moved continuously over the surface while even pressure was maintained in order to iron out the irregularities in the sonic field. A stroking technique was used, where transducer head was moved slowly at the rate of approximately 25mm/s with circular and/or parallel strokes. The duration of application was five minutes per session [12]. Each patient received treatment with U.S.T three sessions per week for ten weeks.

2- Stretching exercise (Hamstring Stretch):

- *Patient position:* Supine lying with extended knees.

- *Therapist position:* Stride standing with the patient knee fully extended and supported over therapist shoulder.
- *Procedure:* Stabilize the non stretched lower limb with one hand or with belt, with knee fully extended flex hip as much as possible and hold 30sec then relax for 30sec repeated for five times [16].

3- *Denneroll traction:* The Denneroll orthotic applies a passive 3-point bending force to the lumbar spine that is most consistent with the 2-way type traction force,

- *Technique:* The patient lies flat on the back with knees and legs were bent for comfort and tolerance with thoracic support block under torso to achieve anterior thoracic translation and prevent excessive thoracic spine extension. Over consecutive days, patients should straighten their legs so that maximum stretch on the legs, hips and back muscles can occur. A natural stretch is created as the pelvis tilts forward and the patient is encouraged to relax while lying on the Denneroll. Start with a time period of 3-5min and gradually increase reaching 20min all that is required to develop a functional stretch effect. Sustained loading periods of 10-20 minutes is necessary to cause visco-elastic deformation to the resting length of the spinal muscles and ligaments [19,20]. The Denneroll was applied day after day.

Data collection:

The data concerning the ARA using plain X-ray, H-reflex and H/M ratio by EMG were collected at two instances before applying Denneroll traction and at the end of the tenth week.

Data analysis and statistical design:

The following statistical procedures were conducted as following:

- Descriptive statistics including the mean, standard deviation and percentage of difference of post-treatment data as compared to pre one.
- Inferential statistics by using paired *t*-test for the same group and unpaired *t*-test between the two groups.

Results

The main purpose of this study was to investigate the effect of lumbar lordosis rehabilitation by Denneroll on motor nerve excitability. Statistical analysis was conducted using SPSS for windows, version 23 (SPSS, Inc., Chicago, IL). The current test involved two independent variables. The first

one was the (tested group); between subject factor which had two levels (group A received combined program of Denneroll traction and traditional physical therapy treatment, group B received only the same traditional treatment as group (A) in form of U.S therapy, I.R.R and stretching exercise). The second one was the (measuring periods); within subject factor which had two levels (pretreatment, post-treatment). In addition, this test involved three tested dependent variables (H-reflex, H/M ratio and ARA).

Prior to final analysis, data were screened for normality assumption, homogeneity of variance, and presence of extreme scores. This exploration was done as a pre-requisite for parametric calculations of the analysis of difference. Preliminary assumption checking revealed that data was normally distributed for hip H-reflex, H/M ratio and ARA, as assessed by Shapiro-Wilk test ($p>0.05$); there were no univariate or multivariate outliers, as assessed by boxplot and Mahalanobis distance ($p>0.05$), respectively; there were linear relationships, as assessed by scatterplot; no multicollinearity. There was homogeneity of variances ($p>0.05$) and covariances ($p>0.05$), as assessed by Levene's test of homogeneity of variances and Box's M test, respectively. Accordingly, 2 X 2 mixed design MANOVA was used to compare the H-reflex, H/M ratio and ARA at different measuring periods at both groups. The alpha level was set at 0.05.

General characteristics:

The current study was conducted on 30 participants. They were assigned into two equal groups. Group (A) consisted of 15 participants with mean age value of 34.53 ± 4.95 years. Group (B) consisted of 15 participants (Table 1).

Table (1): General characteristics of participants in both groups (A and B).

Items	Group A Mean \pm SD	Group B Mean \pm SD	Comparison		S
			t-value	p-value	
Age (years)	34.53 \pm 4.95	32.73 \pm 4.68	1.023	0.315	NS
Height (cm)	170.43 \pm 35.81	171.54 \pm 35.67	1.011	0.765	NS
Weight (kg)	67.54 \pm 15.87	69.47 \pm 16.82	1.23	0.654	NS
BMI (kg/m ²)	23.43 \pm 5.89	24.12 \pm 4.91	1.34	0.515	NS

SD : Standard Deviation. S : Significance.
p : Probability. NS : Non-Significant.

• 2 X 2 mixed design MANOVA (overall effect):

Statistical analysis using 2 X 2 mixed design MANOVA indicated that there were significant effects of the tested group (the first independent variable) on the all tested dependent variables; H-

reflex, H/M ratio and ARA ($F=31.357, p=0.0016^*$). However, there were significant effects of the measuring periods (the second independent variable) on the tested dependent variables ($F=114.404, p=0.0001^*$). However, the interaction between the two independent variables was significant, which indicates that the effect of the tested group (first independent variable) on the dependent variables was influenced by the measuring periods (second independent variable) ($F=26.035, p=0.0001^*$) (Table 2).

Table (2): The 2 X 2 mixed design Multivariate Analysis of Variance (MANOVA) for all dependent variables at different measuring periods between both groups.

Source of variation	F-value	p-value
Groups	31.357	0.0001*
Measuring periods	114.404	0.0001*
Interaction	26.035	0.0001*

*: Significant at alpha level <0.05.

• Multiple pairwise comparison tests:

1- H-reflex:

A- Within groups: As presented in (Table 3), within group's comparison the mean \pm SD values of H-reflex in the "pre" and "post" tests were 2.4 ± 1.02 and 0.93 ± 0.44 respectively in the group (A). Multiple pairwise comparison tests (post hoc tests) revealed that there was significant reduction of H-reflex at post-treatment in compare to pre-treatment ($p=0.0001^*$). While, the mean \pm SD values of H-reflex in the "pre" and "post" tests were 1.92 ± 1.08 and 1.25 ± 0.79 respectively the group (B). Multiple pairwise comparison tests (post hoc tests) revealed that there was significant reduction of H-reflex at post-treatment in compare to pre-treatment ($p=0.001^*$).

Table (3): Mean \pm SD and p-values of H-reflex pre and post-test at both groups.

H-reflex	Pre test Mean \pm SD	Post test Mean \pm SD	MD	% of change	p-value
Group A	2.4 ± 1.02	0.93 ± 0.44	1.47	61.25%	0.0001*
Group B	1.92 ± 1.08	1.25 ± 0.79	0.67	34.89%	0.001*
MD	0.48	-0.32			
p-value	0.231	0.198			

* : Significant level is set at alpha level <0.05.
 SD : Standard Deviation.
 MD : Mean Difference.
 p-value : Probability value.

2- Between groups: Considering the effect of the tested group (first independent variable) on H-reflex, multiple pairwise comparison tests (post hoc tests) revealed that the mean values of the "pre" test between both groups showed no significant differences with ($p=0.231$). As well as, mul-

multiple pairwise comparison tests (post hoc tests) revealed that there was no significant difference of the mean values of the "post" test between both groups with ($p=0.198$).

2- H/M ratio:

1- Within groups: As presented in (Table 4), within group's comparison the mean \pm SD values of H/M ratio in the "pre" and "post" tests were 1.15 ± 0.9 and 0.75 ± 0.6 respectively in the group (A). Multiple pairwise comparison tests (post hoc tests) revealed that there was significant reduction of H/M ratio at post-treatment in compare to pre-treatment ($p=0.0001^*$). While, the mean \pm SD values of H/M ratio in the "pre" and "post" tests were 0.62 ± 0.32 and 0.38 ± 0.2 respectively the group (B). Multiple pairwise comparison tests (post hoc tests) revealed that there was significant reduction of H/M ratio at post-treatment in compare to pre-treatment ($p=0.002^*$).

2- Between groups: Considering the effect of the tested group (first independent variable) on H/M ratio, multiple pairwise comparison tests (post hoc tests) revealed that the mean values of the "pre" test between both groups showed no significant differences with ($p=0.059$). As well as, multiple pairwise comparison tests (post hoc tests) revealed that there was significant difference of the mean values of the "post" test between both groups with ($p=0.04^*$) and this significant reduction in favor to group B than group A.

Table (4): Mean \pm SD and p-values of H/M ratio pre and post-test at both groups.

H/M ratio	Pre test Mean \pm SD	Post test Mean \pm SD	MD	% of change	p-value
Group A	1.15 ± 0.9	0.75 ± 0.6	0.4	34.78%	0.0001*
Group B	0.62 ± 0.32	0.38 ± 0.2	0.24	38.7%	0.002*
MD	0.53	0.37			
p-value	0.059	0.04*			

* : Significant level is set at alpha level <0.05.
 SD : Standard Deviation.
 MD : Mean Difference.
 p-value : Probability value.

3- Absolute Rotator Angle (ARA):

1- Within groups: As presented in (Table 5) within group's comparison the mean \pm SD values of ARA in the "pre" and "post" tests were 36.07 ± 2.09 and 41.64 ± 3 respectively in the group (A). Multiple pairwise comparison tests (post hoc tests) revealed that there was significant increase of ARA at post-treatment in compare to pre-treatment (p -value=0.0001 *). While, the mean \pm SD values of ARA in the "pre" and "post" tests were 36.33 ± 1.71 and 57.8 ± 5.38 respectively the group (B). Multiple pairwise comparison tests (post hoc tests) revealed

that there was significant increase of ARA at post-treatment in compare to pre-treatment ($p=0.0001$ *).

2- *Between groups*: Considering the effect of the tested group (first independent variable) on ARA, multiple pairwise comparison tests (post hoc tests) revealed that the mean values of the "pre" test between both groups showed no significant differences with ($p=0.715$). As well as, multiple pairwise comparison tests (post hoc tests) revealed that there was significant difference of the mean values of the "post" test between both groups with ($p=0.0001$ *) and this significant increase in favor to group B than group A.

Table (5): Mean \pm SD and p -values of ARA pre and post-test at both groups.

ARA	Pre test Mean \pm SD	Post test Mean \pm SD	MD	% of change	p - value
Group A	36.07 \pm 2.09	41.64 \pm 3	-5.57	15.44%	0.0001 *
Group B	36.33 \pm 1.71	57.8 \pm 5.38	-21.47	59.09%	0.0001 *
MD	-0.26	-16.16			
p -value	0.715	0.0001 *			

* : Significant level is set at alpha level <0.05 .

SD : Standard Deviation.

MD : Mean Difference.

p -value : Probability value.

Discussion

Abnormal posture or any deviation from normal spinal alignment causes increased stress on the spinal cord [20]. The stresses and strains in the neural elements and vascular supply are directly related to the function of the sensory, motor, and autonomic nervous systems. Prolonged loading of the neural tissue may lead to a wide variety of degenerative disorders or symptoms [21].

The Denneroll is a spinal remodeling device used to help restore proper sagittal plane spinal curvature and correct other conditions. The Denneroll products are patent pending designs which are specific to each region of the spine (cervical, thoracic and lumbar), with precisely engineered contours, carefully tested firmness and flexibility, to enhance treatment. Lumbar spine was assigned to the patient in this study [22].

This study demonstrates that the group receiving lumbar Denneroll extension traction in addition to U.S therapy, I.R.R and stretching exercises showed more improvement than the control group in clinical, mechanical and neurophysiological parameters based on H-reflex, H/M ratio and ARA measurements. Furthermore these results provide objective evidence that ARA dysfunction in terms of lumbar curve malalignment, and not just pathoanatomy, influences outcome measures [23].

The improvement in lumbar lordosis recorded by the study group is similar to that reported in a case study that showed the effectiveness of extension traction on restoring lumbar sagittal spinal configuration [24]. Another study by [25] concluded that lumbar extension traction with stretching exercises and infrared radiation was superior to stretching exercises and infrared radiation alone for improving the sagittal lumbar curve, pain, and intervertebral movement in CMLBP.

Stretching of the viscous and plastic elements of the longitudinal ligament and intervertebral disc may be the possible explanation for restoring the normal lumbar lordosis. Overall, our results are conceptually in agreement with other studies that have identified the strong association between sagittal alignment and back pain [26].

In contrast, these findings contradicted those of many authors who investigated the relationship between lumbar lordosis and pain and reported no significant correlation between them [16]. The reasons for these differences may be related both to the initial selection of patients with relatively small numbers, and to the fact that all of these studies were correlational studies and not true experimental studies; that is, they look for a degree of association between variables without the ability to ascribe cause and effect [27].

With regard to the outcomes, the improvement of measured parameters and lumbar mobility compared with the control group are in agreement with those of Miyakoshi et al., who reported that lumbar lordosis restoration was an important factor in improving spinal function. In contrast, the systematic review of [28].

This contradiction may be attributed to different reasons: First, the low methodological quality of included studies. The systematic review of Christensen and Hartvigsen included all types of sagittal plane curvature measurement methods. We found that several studies were using a flexicurve (flexible ruler) to measure lumbar lordosis via sagittal skin contour. Interestingly, flexicurve measurement of lumbar lordosis is not externally valid and not useful for making legitimate decisions regarding the state of lumbar lordosis [28].

The second issue relates to the vague inclusion and exclusion criteria for patient selection. Another outcome assessment that has been investigated in the present study was restoring curve of lumbar vertebrae. Our findings that "lumbar extension traction had a significant and stable effect on intervertebral movements for the most levels com-

pared with the control group” are in agreement with those of [29], who reported that ‘proper mechanical alignment is essential for joint function’.

These findings are aligned with those of [30], who indicated that spinal posture is one of the most common factors affecting the coupled movements of spinal vertebrae [31]. This concept was further supported by Keorochana et al., who stated that ‘sagittal alignment, disc degeneration, and segmental mobility likely have a reciprocal influence on one another’ [32].

The majority of included studies employed traction on patients that suffered nerve root compression symptoms (radiculopathy, sciatica, discogenic pain). In their randomized clinical trial, aims to investigate the effects of lumbar extension traction in patients with unilateral lumbosacral radiculopathy due to L5-S1 disc herniation. All patients had also hypolordotic lumbar spine ARA ($<39^\circ$). The control group received hot packs and interferential therapy, whereas the traction group received lumbar extension traction in addition to hot packs and interferential therapy. They concluded that traction group had better effects than the control one with regard to pain, disability, H-reflex parameters and segmental intervertebral movements [25].

Neurophysiologically, the significant and persistence changes in H-reflex parameters (decrease in H-reflex latency and increase in H-reflex amplitude) in the traction group compared with the control group could indicate that a normal lumbar lordotic curve is essential for normal neural function. Restoring the normal mechanics for the nervous system and decreasing the abnormal stresses and strains on neural elements are the likely explanation for significant improvement in H-reflex parameters. This concept showed how loss of the lumbar curve alters the mechanical properties of the spinal cord and nerve root that may change the firing patterns of involved neurons [33].

The unique contribution of our study is that it evaluated the independent effects of structural rehabilitation in the form of lumbar lordosis correction on ARA and neurophysiological findings, which to our knowledge have not been previously reported. In conclusion, the findings of the current study might serve to reinforce the importance of using structural rehabilitation in the form of restoring the normal lumbar lordotic curvature in management of low back pain patients. Interestingly, restoring the normal curve introduces yet another treatment option to a list that already includes physical agent modalities and manual therapies

such as massage and myofascial stretch. Its unique appeal lies in its long lasting effect. These observed effects should be of value to clinicians and health professionals involved in the treatment of spinal disorders [18].

Certain limitations of the present study are worthy of mention. The primary limitation was the kinematic analysis nature of the spine. Furthermore, due to the type of intervention, it was not possible to blind the physiotherapist who provided the interventions. With regard to the initial selection of the patients, they probably represented a convenient sample rather than a random sample of the whole population.

The control group did not receive the same form of time-consuming treatment. Since this trial was conducted in a clinical setting with the majority of participants referred by medical practitioners for physiotherapy treatment, it was not possible to incorporate a control group that did not receive physiotherapy intervention. The patients were selected according to absolute rotatory angle only, ignoring the role of relative rotatory angle between adjacent vertebrae. This may be the main cause for the inconsistency of results for certain levels. No attempt was made to control for medications taken by participants, which included opioid and non-opioid analgesics and non-steroidal anti-inflammatory drugs.

However, medication use was similar at baseline and no significant difference was found between the groups for number of participants who were managing their pain with medication immediately after the 10-week intervention. Future randomized trials should be conducted on a randomly selected sample using non-invasive methods such as a motion analysis system. Traction mechanism to relieve pain seems to separate the vertebrae, remove pressure or contact forces from injured tissue, increase peripheral circulation by a massage effect, and reduce muscle spasm [17].

The aim of the current study is to discuss and analyze the latest result regarding lumbar traction by Denneroll in order to clarify some aspects of this specific and useful physical therapy toll. This study had several strengths, including that it was analysed using the intention-to-treat principle and that participants were assigned randomly to experimental and control groups. Also, interventions were provided by the same experienced physiotherapist. In addition, participants in both intervention groups received the same number of interventions.

Clinical messages:

Lumbar Denneroll extension traction is beneficial in restoring lumbar lordosis. Restoring of lumbar lordosis seems to be effective in patients who have low back pain, with respect to pain, mechanical, clinical and functional status outcomes.

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تأثير إعادة تأهيل التحذب القطني على استثارة الخلايا العصبية الحركية ألفا بالفقرة العجزية الأولى في آلام أسفل الظهر المزمنة الغير المحددة

الخلفية: تمثل آلام أسفل الظهر المزمنة مشكلة صحية عامة وخاصة الموظفين. هناك فجوة في الأدبيات المتعلقة بالإستقصاءات حول التغيرات في استثارة العصب الحركي أثناء إعادة تأهيل المنحنى القطني والتي تمثل حاجزاً رئيسياً يمنع إستكشاف العلاج المحافظ الأكثر فعالية على إستعادة القعس القطني. دينرول هو جهاز تقويم سهمي مستوى جديد نسبياً مصمم لتمديد المنحنى القهري بشكل سلبي إلى وضع أكثر قوة.

الهدف من الرسالة: صممت هذه الدراسة لدراسة تأثير جر دينرول القطني على استثارة العصب الحركي على مرضى آلام أسفل الظهر المزمنة.

المادة والطرق: شارك ثلاثون مريضاً في هذه الدراسة. تم تعيينهم بشكل عشوائي إلى مجموعتين (أ) مجموعة تجريبية، و (ب) مجموعة تحكم. تتألف المجموعة (أ) من ١٥ مريضاً، تلقوا برنامجاً مشتركاً لجر دينرول والعلاج الطبيعي المحافظ. المجموعة (ب) التي تتكون من ١٥ مريضاً، تلقوا نفس العلاج المحافظ مثل المجموعة (أ) في شكل (العلاج بالموجات فوق الصوتية، الأشعة تحت الحمراء وتمارين التمدد). تم إعطاء العلاج ٣ مرات في الأسبوع، كل يوم، لمدة عشر أسابيع متتالية. تم تقييم المرضى قبل المعالجة والمعالجة اللاحقة لنسبة الإنعكاس H ونسبة H/M وزاوية الدوران المطلقة.

النتائج: بإستخدام مقاييس متكررة تحليل متعدد المتغيرات لإختبار التباين (MANOVA)، أظهر المرضى تحسناً كبيراً في المتغيرات التابعة المجموعة في كلا المجموعتين ولكن بين مجموعة فرق المجموعة (أ) أظهر تحسناً أكثر أهمية من المجموعة (ب) في المتغيرات التابعة المجموعة. كان لكل من دينرول والمعالجة التقليدية تأثير كبير على إنعكاس H، ونسبة H/M وزاوية التدوير المطلقة تشير إلى وجود تأثيرات كبيرة للمجموعة المختبرة (المتغير المستقل الأول) على جميع المتغيرات التابعة المختبرة، إنعكاس H ونسبة H/M. ومع ذلك، كانت هناك تأثيرات كبيرة لفترات القياس (المتغير المستقل الثاني) على المتغيرات التابعة. ومع ذلك، كان التفاعل بين المتغيرين المستقلين كبيراً، مما يشير إلى أن تأثير المجموعة المختبرة (المتغير المستقل الأول) على المتغيرات التابعة قد تأثر بفترات القياس (المتغير المستقل الثاني).

الإستنتاج: لذلك، فإن الجمع بين دينرول وبرنامج العلاج الطبيعي التقليدي أكثر فعالية من التمارين العلاجية وحدها في علاج مرضى آلام أسفل الظهر غير المحددة.