Does Cervical Radiculopathy Affect Lumbar Lordosis and Lateral Pelvic Tilt?

Ahmed S. Ali, Ph.D[1], Asmaa F. Gabre, M.Sc[1] , Hoda M. Zakria, Ph.D[1], Magdy K. Ahmed, MD[2], Noura A. Elkafrawy, Ph.D[1]

Abstract

Background: There are several causes of nerve root dysfunction, but cervical radiculopathy (CR) is a prevalent neurological condition. The impact of cervical radiculopathy on lumbar lordosis as well as pelvic tilt has received less attention. The purpose of this study was to examine the impact of cervical radiculopathy on lumbopelvic alignment in patients having cervical radiculopathy. **Methods:** A cross-sectional observational study was conducted on 100 participants of both sexes, aged from 30-50 years old. they were randomized into two groups of equal number: Group (A): the "control" (fifty normal matched participants) The study Group (Group B) (fifty patients having cervical radiculopathy). Raster-Stereography (Formetric 2) was utilized to assess the impact of cervical radiculopathy on lumber lordosis and lateral pelvic tilt. **Results:** findings of the current study revealed that lumbar lordosis and lateral pelvic tilt increased in patients with cervical radiculopathy (p<0.001 **Conclusion:**). Cervical radiculopathy has a major impact on lumbopelvic alignment, which should be considered when treating patients having cervical radiculopathy.

Key Words: Lumbar lordosis, Pelvic tilt, Cervical radiculopathy, Raster-Stereography.

DOI Number: 10.14704/nq.2020.18.9.NQ20226 **NeuroQuantology 2020; 18(9): 140-145**

***Corresponding author:** Ahmed S. Ali **E-mail:** dr.shawky_2011@cu.edu.eg

Affiliations:

1. Physical Therapy department for Neurology, Faculty of Physical Therapy, Cairo University, Egypt.
2. Department of Neurosurgery, Faculty of Medicine, Cairo University, Egypt.

Relevant conflicts of interest/financial disclosures:
The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received: 15/07/2020 **Accepted:** 05/09/2020

Introduction:

Cervical radiculopathy (CR) is a prevalent neurological condition caused by nerve root compression. Mechanical compression is typically the reason, and inflammatory cytokines are secreted from the injured intervertebral disc, causing symptoms [1]. The most common causes of cervical radiculopathy are cervical disc herniation followed by cervical spondylosis [2]. The clinical picture of cervical radiculopathy includes radicular pain, paresthesia in the dermatomal distribution, and motor system manifestations such as muscle weakness in the myotomal distribution of the compressed nerve roots.

Radiculopathy symptoms are typically unilateral. Bilateral symptoms are more common with cervical spondylosis; these symptoms can interfere with activities of daily living [3]. The incidence of cervical radiculopathy is unknown, however in the US military, the annual incidence of 0.83 cases for every 1000 people has been reported [2]. The reported male-to-female incidence varies from 1:1 to 1.4:1. The peak incidence of CR is in the fourth and fifth decades [4].

There are various significant correlations among spinal segment curvatures; for example, lumbar lordosis corresponds with thoracic kyphosis and also thoracic kyphosis corresponds with cervical lordosis [5]. The Spinopelvic orientation in the sagittal plane reflects a chain connecting the head to the pelvis, with every anatomic segment being strongly related to the adjacent segment.

For the cervical spine to perform its primary function of supporting the weight of the head and enabling horizontal gazing, the head must be tilted backward by around 44 degrees. This reduces the workload on the neck muscles while keeping the spine in its natural sagittal position. Disorders of the cervical region such as cervical radiculopathy will affect the neck tilting angle and may affect the lumbar lordosis and encourage a compensatory mechanism leading to greater energy expenditure, excessive muscular forces, fatigue, as well as pain [6].

As the prevalence of cervical radiculopathy and its complications is dramatically increasing, there is a great need for a comprehensive and early assessment of its effect on lumbar lordosis.

Aim of the study: The purpose of the study was to evaluate the impact of cervical radiculopathy on lumbar lordosis and lateral pelvic tilt in patients with cervical radiculopathy.

Materials and Methods

Participants

The present study was carried out during the period from July 2019 to February 2020 in the Formetric laboratory, Faculty of Physical therapy, Cairo University, Egypt. One hundred individuals of both sexes were recruited for the study, fifty patients were recruited from the Out-patients' clinic, Faculty of Physical Therapy, Cairo University, and fifty normal matched subjects (student volunteers) from the Faculty of Physical therapy, Cairo University also were recruited. This study was approved by the Ethical Committee of the Faculty of Physical Therapy, Cairo University (NO: **P.T.REC/012/002388**).

The participants were divided into two identical groups: ***Group (A):*** The control group (fifty normal matched subjects), ***Group (B):*** The study group (fifty patients with cervical radiculopathy). All individuals signed an informed consent form before their participation in the study to ensure complete satisfaction

Study design: Cross-sectional observational design was used.

Inclusion criteria: Subjects aged from 30-50 years, both sexes, Body mass index (18-25) kg/m^2, patients with unilateral, discogenic, lower cervical radiculopathy with lateral disc protrusion(C3-C7) were recruited. The duration of the cervical radiculopathy was six months at least.

Exclusion criteria: Subjects were excluded if they had upper cervical radiculopathy (C1-C3), cervical myelopathy, BMI >25 kg/m^2, pregnancy, osteoporosis, neurological deficit or any disease of the pelvis and leg length discrepancy.

Instrument

Raster-Stereography (Formetric 2) was utilized to evaluate the impact of cervical radiculopathy on lumbar lordosis as well as lateral pelvic tilt. It is a reliable way to examine spinal defects in three dimensions and restore normal spine anatomy without the use of ionizing radiation. Three-dimensional surface analysis is made possible due to its foundation in photogrammetric concepts.

Spinal deformity diagnosis can benefit greatly from the repeatability of measurements made possible by 3D body surface reconstruction and analysis systems. This helps to reduce the impact of physician variability and allows for an objective evaluation. Formetric II Raster-Stereography is valid and reliable method for measuring and analyzing spinal curvatures, because it has an extreme accuracy with an error margin of 0.1mm, can reliably recognize the necessary topographical points for the evaluation as well as calculation of the spinal curves, and measures all current curvatures without invasive manual intervention [7]. Similar to previous surface topography devices, this one beam light in parallel stripes across the patient's back while they stand.

The automatic reconstruction of the sagittal back shape relies on the automatic identification of anatomical landmarks (vertebra prominent or even the iliac spine in the pelvic area). It provides a collection of parameters describing the profile of the back [8].

Procedures

Demographic data for each subject were recruited from all participants involved in this study including name, age, sex, height, and BMI. Careful history taking and observation of the patients to exclude any spine pathology that may affect the results was conducted and an assessment of the leg length discrepancy is conducted for each subject.

The subjects stood with an appropriate upright posture at a distance of (2 meters) facing the 3D scanning system (photo camera). The subject's back surface (containing half of the buttocks) was totally bare. It was essential to the study that the participant's upper gluteal cleft be visible, therefore the researcher made sure the patient's clothing was low appropriately. Adhesive paper drapes were given to the female participants to wear to cover their breasts. Hair clips were given to normal-matched patients with long hair, and also the investigator ensured the hair was clipped out of the way and away from the subjects' necks.

We took off any jewelry (necklaces, watches, etc.) that could have been seen in the shot. When setting up the shot, the subject's height was taken into account to ensure that the green crosshairs were centered underneath the subject's shoulder blades and the spine was in the center of the frame. The lights in the examination room were dimmed just enough for the raster lines to be clearly visible on the patient's back. The lights were turned on after the detective pressed the "project stripes" button.

When the exposure control was initiated, the Formetric II system assessed the back surface shape in a sophisticated, anatomic method using anatomic landmarks, as well as the projector bulb automatically turned on under program control. After capturing the subject's motion for 5 seconds, the lights switched off automatically, and the participant was given two minutes of resting while the Formetric program analyzed the information. These procedures were carried out a total of 3 times on each patient. The Formetric system records various measurements with every trial, and we averaged all these parameters across all trials. Additionally, the mean values for all 3 trials were determined for each parameter.

Data analysis and statistical design

SPSS Package, version 25 for Windows was used to perform the statistical analyses (SPSS, Inc., Chicago, IL, USA). These statistical operations were carried out: descriptive Statistical data for describing the population, containing (age, weight, height, as well as BMI). Mean values for age, weight, height, as well as body mass index were compared using an independent t-test between the two groups. A one-way multivariate analysis of variance (MANOVA) was utilized to evaluate the impact of cervical radiculopathy on lateral pelvic tilt as well as lordotic angle for both groups. Significant level: considered at ($P \leq 0.05$) [9].

Results

Subject's general characteristics for both groups expressed by mean and standard deviation are extensively expressed in (**Table 1**). These include age, weight, height, as well as BMI. There was no statistically substantial difference ($p > 0.05$) in the mean values of age, weight, height, as well as BMI when the two groups were compared.

Table 1. Descriptive statistics and t- test for the mean values of age, weight, height, and BMI for the study and =control groups.

	Study group	Control group	MD	t-value	p-value
	$\bar{X} \pm$ SD	$\bar{X} \pm$ SD			
Age (years)	32.4 ± 6.2	30.96 ± 3.92	1.44	1.38	0.16
Weight (kg)	68.64 ± 6.77	67.34 ± 3.37	1.3	1.21	0.22
Height (cm)	168.7 ± 4.83	167.6 ± 3.67	1.1	1.28	0.2
BMI (kg/m²)	24.11 ± 1.63	23.95 ± 0.31	0.16	0.66	0.5

x̄: Mean; SD: Standard deviation; **MD:** Mean difference; **t-value:** Unpaired t test; **p-value**: Probability value

Table 2 shows the gender distribution of both study groups; there was no statistically substantial difference in the distribution of males and females between the two groups (p = 0.41). Multivariate Analysis of Variance (MANOVA) was utilized to evaluate the impact of cervical radiculopathy on the lordotic angle and lateral pelvic tilt. There was a significant impact of cervical radiculopathy on the lordotic angle and lateral pelvic tilt.

Table 2. The frequency distribution and chi squared test for comparison of sex distribution between study and control groups.

	Study group	Control group	χ^2	p-value
Females	29 (58%)	33 (66%)	0.67	0.41
Males	21 (42%)	17 (34%)		

X²: chi-squared test; **P-value:** probability value

The mean ± SD of the lordotic angle of the study group was 43 ± 5.68 degrees and that of the control group was 38.74 ± 5.04 degrees. The mean difference among both groups was 4.26 degrees. There was a substantial increase in the lordotic angle of the study group in comparison with that of the control group (p = 0.0001). The mean ± SD of the lateral pelvic tilt of the study group was 4.7 ± 0.83 mm and that of the control group was 3.58 ± 0.49 mm. The mean difference among both groups was 1.12 mm. There was a substantial increase in the lateral pelvic tilt of the study group in comparison with that of the control group (p = 0.0001). (**Table 3, Figure 1,2**).

Table 3. Comparison of the mean values of lordotic angle and pelvic tilt between the study and control groups.

	Study group	Control group	MD	F- value	p-value
	$\bar{x}$ ± SD	$\bar{x}$ ± SD			
Lordotic angle (degrees)	43 ± 5.68	38.74 ± 5.04	4.26	14.98	0.0001
Pelvic tilt (mm)	4.7 ± 0.83	3.58 ± 0.49	1.12	65.83	0.0001

x̄: Mean; SD: Standard deviation; **MD:** Mean difference; **t-value:** Unpaired t test; **p-value:** Probability value; **F-value:** Value on the F distribution

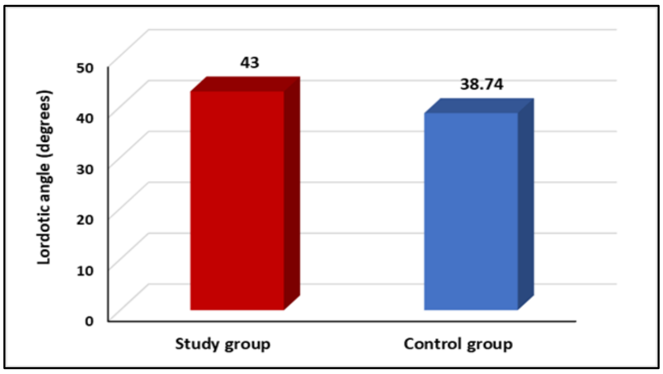

Figure (1). Mean values of lordotic angle for both study and control groups.

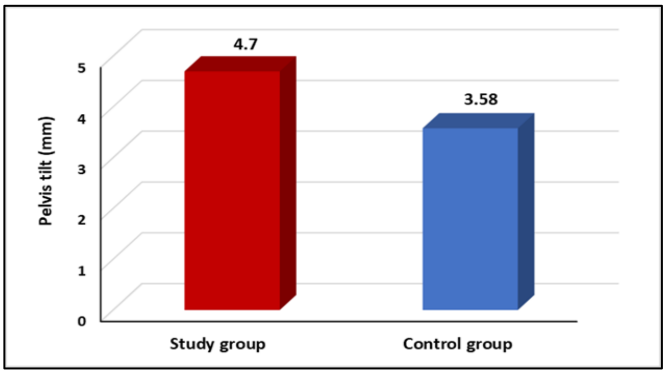

Figure (2). Mean values of the lateral pelvic tilt for both study and control groups.

143

Discussion:

This study was carried out to evaluate the impact of cervical radiculopathy on spinopelvic alignment regarding the lordotic angle and lateral pelvic tilt. Regarding the impacts of cervical radiculopathy on lumbar lordosis, there was a substantial difference between both groups. The lumbar lordosis increased in people with cervical radiculopathy, this is in accordance with **Barrey *et al.*** [10] who indicated that the forward head is compensated by lumbar hyperlordosis to maintain spinopelvic alignment.

The increase in lumbar lordosis can be accredited to the anatomical and fascial continuity among the cervical and lumbar spine, this is in accordance with **Yucesoy, (2010)** [11] who reported that the problem of the fascia can impact a range of motion along its peripheral pathway preventing any muscle from acting alone. This result is also in accordance with **Simons, (2004)** [12] who reported that muscle alternations anywhere usually affect more than one joint these alterations are important to maintain balance. This chain reaction can begin anywhere, whether close or at a distance so, the problem at the cervical spine can affect the lumbar spine.

The findings of the current study came to an agreement with **Murphy *et al.* (2000)** [13], who reported that cervical distortion may result in lumbar distortion due to the effect of tonic neck reflexes (TNR) in which rotation or lateral flexion of head to one side resulting in increase in extensor tone of trunk and extremities on the side to which the head is rotated and increase of flexor tone on the opposite side of the body.

Cervical distortion stimulates tonic neck reflexes in two ways. The first route is through the muscle spindles, which send afferents to the vestibular nucleus, the pontine as well as medullary reticular formation. The second way is by propriospinal neurons receiving signals from upper cervical afferents. These two factors modify lumbar muscle tone by sending both excitatory and inhibitory signals to alpha and gamma motor neurons in the trunk and extremities where side flexion to the same side in unilateral radiculopathy increases the tone of lumbar extensors so that, may affect the lumbar lordosis [13].

Regarding the impact of cervical radiculopathy on lateral pelvic tilt, the result was significant, the cervical radiculopathy was associated with increased values of lateral pelvic tilt more than the normal values in the same direction, this means that left radiculopathy was associated with a higher iliac crest on the left side and vice versa. This is in accordance with **Ahn, (2004)** [14]**, Page *et al.* (2011)** [15], **Hyun & Kang, (2013)** [16], **Scheer *et al.* (2013)** [17] who found that the pelvis would adjust to accommodate a primary cervical deformity. As a result of the fascia's impact on the connectivity of the body's many parts, this is the case. The tissue on the lateral line connects the agonist muscles of neck side flexion (scalenei) as well as pelvis side tilting angle (quadratus lumborum). The scalenus acts in a pattern similar to that of the QL, flexing the neck laterally, and the QL acts as a lateral flexor of the trunk. The scalenus does its pulling on the other end of the rib cage from where the QL is pulling. As a result, there is a strong functional connection between the two muscles. When the scalenus muscle spasms, it pulls the rib cage, which can have an effect on the QL [15]. This can cause the pelvis to tilt to the side that also has cervical radiculopathy.

Similarly, this agrees with **Chaitow, (2010)** [18]. Who first noted that the middle of the axial skeleton (where the spine meets the pelvis) is the navel in a mirror image? Pairs are formed by the coccyx and atlas, the axis as well as sacrum, the lumbar and cervical regions, and so on. Pairs of muscles include the scalenes and quadratus lumborum, there is a co-contraction or reciprocal inhibition pattern if the paired agents are agonists and antagonists. Accordingly, a lateral pelvic tilt on the same side can occur if the quadratus lumborum shortens reflexively as a result of short scalenes. These results indicate that cervical radiculopathy affects the spinopelvic alignment.

The strength of this study may be due to its focus on investigating the relationship between cervical pathology and lumbo-pelvic alignment. This might optimize the management of patients with cervical radiculopathy, preventing poor consequences on spinopelvic alignment.

Limitations of this study, small sample size can't be generalized to all patients with cervical radiculopathy, also cognitive status and cooperation of the participants may affect the findings of the study and individual differences between patients may affect the assessment outcome.

Finally, according to the results of the current study, spinopelvic alignment has been affected in patients having cervical radiculopathy and this should be taken into account during the treatment of those patients.

Conclusion

cervical radiculopathy has a major impact on lumbar lordosis in addition to lateral pelvic tilt. Lumbar lordosis, as well as lateral pelvic tilt, have both been found to be raised in patients having cervical radiculopathy, and this should be taken into account during the rehabilitation of patients having cervical radiculopathy.

Conflict of Interest:

The authors declare that they have no competing interest.

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