ISSN: 2755-0133

Journal of Medical & Clinical Nursing

SCIENTIFIC Research and Community

Review Article

Open Access

Why does Scoliosis most Often Show an Associated Loss of Cervical Lordosis? One Possible Analysis

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ABSTRACT

Introduction: Loss of cervical lordosis is a frequently detected finding in the analysis of the full-spine x-ray examination in the lateral view.

If this finding is not of particular importance from an orthopedic point of view, it is notable from a posturological one.

The aims of this work are to verify the possible correlation of some physical and patient variables with the loss of cervical lordosis and to hypothesize its possible origin.

Methods: 300 full-spine x-ray examinations were analyzed from 2013 to 2022, considering the CObb angle, the type of curve, the gender, the age and the presence/absence of loss of cervical lordosis.

The obtained data were then analyzed using a statistical method.

Results

No type of association between the variables considered and the loss of cervical lordosis was found

Conclusion: The statistical analysis carried out demonstrates how the origin of the loss of cervical lordosis in adolescent idiopathic scoliosis must necessarily be sought outside of the physical and patient variables. One possibility could be an induced neurological response that causes contraction of the paravertebral muscles of the neck, but this hypothesis still needs to be demonstrated with targeted studies.

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Received: November 07, 2023; **Accepted:** November 13, 2023; **Published:** November 17, 2023

Keywords: Scoliosis, Cervical, Loss, Posture

Introduction

Scoliosis is a multigenic, multifactorial pathology of the spine and manifests itself with a structured deformity in the three planes of the space, particularly evident in the coronal one. In this way Moe et al. defined and classified it for the first time in 1978, a definition still accepted and shared, as reported in their 2020 review [1-2].

Its diagnosis is typically clinical, with the use of the Adams test (Forward Bending Test), while the quantification, both at diagnosis and in the follow-up, takes place through the current gold standard, consisting of the full-spine X-ray examination, on the basis of which the Cobb method geometrically obtains the angle expressed in degrees, which numerically defines the curve under examination [3-7].

There are different classifications of the various types of scoliosis, depending on the parameter identified: age, location or value of the Cobb angle. An examination of the classifications is not part of the aims of this work; however, some aspects deserve a particular consideration as they are directly inherent.

First of all, it is observed that scoliosis of the cervical spine is very rare, as can be deduced from the work and confirmed, while the most widespread form is universally accepted and shared to be Adolescent Idiopatic Scoliosis (AIS), as already indicated, and taken up from which articles it can be inferred that AIS represents over 80% of cases with a presence of 1-3%. This consequently delimits the age range of potentially involved subjects, which can be estimated at approximately between 10 and 16 years [7-14].

Within this identified population, it is evident that the female gender is more interested, especially in cases of evolutionary curves, as already indicated [15-17].

This situation makes the topic particularly important and delicate precisely by virtue of the developmental age involved, linked to

the greater life expectancy.

In fact, the idea of this study was born from this consideration and from the systematic observation of multiple full-spine X-ray examinations performed over a period of 10 years, noting that in the latero-lateral view the loss of cervical lordosis is highlighted with not negligible systematicity.

If from an orthopedic point of view this finding may be of little interest for what has been described in the previous lines, from a postural point of view it assumes a very important relevance as it proves a drastic reduction in the load capacity of the spine involved.

In fact, according to Dalmas' law, the loss of one of the physiological curves of the vertebral column on the sagittal plane results in the halving of the load capacity of the column itself, as demonstrated by the following mathematical passages:

Normal Column
$R= n^2 +1 = 3^2 + 1 = 9+1=10$

Column with Loss of a Curve
$R= n^2 +1 = 2^2 + 1 = 4+1=5$
The purpose of this work is, therefore, to analyze X-eay examinations relative to full-spine to highlight any associations with the main parameters relating to the pathology. Nonetheless, the article also aims to highlight this finding as it is of particular relevance from a prevention perspective, being linked to subjects in the developmental age.

Methods
The study is retrospective and involved a period of 10 years, from 2012 January 01st to 2022 December 31th.

The Inclusion Criteria Were
- diagnosis of AIS
- radiographic examination performed in double view, anteroposterior (AP) and laterolateral (LL)
- subjects who have not undergone surgical treatment of the spine, for scoliosis or other pathology
- no known comorbidities at the diagnosis of AIS
- age ≤20yy

The Exclusion Criteria Were
- failure to meet one or more of the inclusion criteria.

The data, collected anonymously, took into consideration the Cobb angle relative to the main curve or, in the case of the major curve, the gender, the type of curve, the age, the presence/absence of the loss of cervical lordosis and Body Mass Index (BMI).

As far as the Cobb angle is concerned, since the data itself is not relevant, but rather its belonging to one of the classes indicated by the Scoliosis Research Society (SRS), the angles were aggregated for values lower than 25° (<25), for values between 25° and 45° (><) and for values above 45° (>45).

The gender was identificated with female (F), male (M) or other (O).

The types of curves considered are: the thoracic curve (T), the lumbar curve (L), the thoracolumbar curve (TL) and the presence of a thoracic curve and a lumbar curve (T+L).
The age variable was classified as <13 years, 13-14 years, 15-16 years and over or equal 17 years.
The presence of loss of cervical lordosis was indicated with "Y", while the absence of loss of cervical lordosis was indicated with "N".

With regard to the BMI, since in many cases it is not possible to exactly trace the weight and height of the subject, it has been thought to give a quantification by sets, identifying through the radiographic projections available, normal BMI (N), higher than the normal value (S) and lower than the normal value (L). For the statistical analysis, Categorical variables were compared using the chi square test or Fisher's exact test, as appropriate. Continuous variables were compared between groups using the Wilcoxon test. All P values were two-sided, and values of $P < 0.05$ were considered statistically significant. A logistic regression model was used in order to identify the association between lordosis and other variables. All statistical analysis was performed using SPSS statistic.

Results
Three hundred full-spine x-ray examination of the spine performed both in AP and LL view were analysed.

The data collected concerned a total of 207 female patients, aged included between 8 and 20 years, average 13.86 and 93 male patients, aged between 9 and 19 years, average 14.76.
All collected data are reported in Table 1.

As the table shows, no P value indicates a presence of statisticaly significant association among the considered variables and the loss of the cervical lordosis.

Table 1

Lordosis	Y/N	0	1	OR (univariable)	OR (multivariable)
Cobb	<25 [1]	11 (5.3)	198 (94.7)		
	>< [2]	3 (6.1)	46 (93.9)	0.85 (0.25-3.88, p=0.811)	0.73 (0.19-3.62, p=0.665)
	>45 [3]	2 (4.8)	40 (95.2)	1.11 (0.28-7.36, p=0.894)	0.99 (0.20-7.46, p=0.989)
Gender	M [0]	4 (4.3)	89 (95.7)	-	-
	F [1]	12 (5.8)	195 (94.2)	0.73 (0.20-2.16, p=0.595)	0.59 (0.15-1.88, p=0.400)
Curve type	T [1]	2 (4.0)	48 (96.0)	-	-
	TL [2]	7 (4.9)	136 (95.1)	0.81 (0.12-3.49, p=0.796)	0.69 (0.10-3.25, p=0.667)
	L [3]	6 (7.3)	76 (92.7)	0.53 (0.08-2.40, p=0.445)	0.37 (0.04-2.10, p=0.291)
	T+L [4]	1 (4.0)	24 (96.0)	1.00 (0.09-22.15, p=1.000)	0.90 (0.08-20.25, p=0.932)
Age	Mean (SD)	14.5 (1.9)	14.1 (2.5)	0.94 (0.76-1.15, p=0.552)	0.90 (0.72-1.12, p=0.365)

Note that BMI dors not appear in Table 1 because it has been necessary to exclude it from the considered parameters list as in practice it is too difficult to distinguish between a normal BMI and one below the threshold, by using the only siupport given from the radiological images and this make the evaluation of the parameter overall unreliable.

Discussion

The statistical analysis carried out and showed in Table 1, clearly demostrates thet no one of the considered parameters seems to have a statistically significant association with the loss of the cervical lordosis (each p>>0,05).

Moreover, the total number of cases in which we observed a cervical lordosis loss is equal to 284 and represents the 94,7% of the total cases considered, according to the finding in 1995 [18].

Some authors argue that the reason of this cervical lordosis loss must be investigatred in an adaptation to the thoracic and lumbar curves, as reported [19,20]. claim that cervical lordosis loss rises in order to compensate for a loss in thoracic kyphosis and lumbar lordosis aimed at keep sagittal vertical axis neutral and balanced [21,22].

However, no authors seam to say something about the possible fundamentals on which this is based on.

The results we obtained, although not absolutely in direct contrast with the findings of these authors, reveal an inconsistency due to what we observed in the cases we examined: loss in kyphosis or lordosis increases at Cobb angle increasing, and then the greater the angle, the greater the loss should be, instead we found a loss of cervical lordosis also in very slight scoliosis and appears the same in moderate ones.

This led us to hypothesize that the loss of cervical lordosis may be associated with a neurological response capable of producing neck muscle tension resulting in stretching of the cervical lordosis and this regardless of the value of the Cobb angle.

This hypothesis has its rational basis in the works where the authors explained and demonstrated the property and the role of fasciae [23-25].

Similar support is also provided by the work on fascial neuromodulation [26].

Bianco proposed neuromodulation method joined with Stecco Fascioal Manpulation Method although not completely agreed, suggest us to design a study to confirm or not our hypothesis: fascial or acupressure/acupuncture treatmets on patients with AIS, to see if cervical lordosis loss can be restored [27-29].

However, we still do not have scientific proof of this statement, we think that an investigation on it is mandatory in order to try to preserve health of the future generation.

Conclusion

Loss of cervical lordosis is a common finding among individuals with AIS. Its origin is not clear, but the young age of the subjects involved and the potential harmfulness of the find on their life expectancy leads us to promote studies that confirm its origin and can provide possible tools to contrast the phenomenon.

Acknowledgment

We feel to thanks never enough Fabrizio Trucchi MD for his great contribution in built this article as well as his friendship.

Declarations

Conflicts of Interest

The Authors declare that they have no conflicts of interest.

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