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MEASUREMENT OF CERVICAL LORDOSIS WITH DIFFERENT METHODS

SERVİKAL LORDOZUN FARKLI METODLAR İLE ÖLÇÜMÜ

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SUMMARY

Aim: The purpose of this study is therefore to compare Cobb angles, Jackson stress lines and Harrison tangents methods to measure the cervical lordosis angle using lateral cervical X-ray graphics and collect nominative values.

Materials-Method: We evaluated 76 patients' lateral cervical X-ray graphics between the ages of 18 to 60 years retrospectively. Exclusion criteria was any pathology that seen on graphics. Cervical X-ray graphics were taken as standing lateral neutral positioned. Cervical lordosis measured with Cobb, Jackson and Harrison techniques on pacs system.

Results: 47 patients (61.8 %) were female, and 29 patients (38.2 %) were males. Mean age was 43.83 ± 15.9 years. We found mean values of $C_{0-2,}$ C_{2-7}, Jackson stress lines and Harrison tangents as 30,72° ± 7,76°, 18,37° ± 9,44°, 18,92° ± 10,98° and 22,91° ± 8,96°. Cobb C0-C2 (p=0.307), Jackson (p=0.106), and Harrison (p=0.688) measurements were similar between males and females. But Cobb C_{2-7} was significantly different between genders (p=0.017), and males had significantly higher Cobb C_{2-7} values. The comparisons of methods revealed that Cobb C_{0-2} had highest values, and Cobb C_{2-7} and Jackson was lower than Harrison (Cobb C_{0-2}>Harrison>Cobb C_{2-7}~Jackson) (p<0.001).

Conclusion: Harrison tangent technique is difficult to measure but we thought its results are better to show the best values because tangents also could measure the internal curve. All these techniques must be understood well with the biomechanics features so that surgeons could choose which technique would be better to use for the management of deformities.

Key Words: Cervical lordosis, Cobb angles, Jackson stress lines, Harrison tangents

Level of Evidence: Retrospective clinical study, Level III.

ÖZET

Amaç: Çalışmamızın amacı Cobb açıları, Jackson stres çizgileri ve Harrison tanjant metotlarının direkt yan servikal grafide servikal lordoz ölçümlerinin karşılaştırılması ve normal değerlerin elde toplanmasıdır.

Materyal-Metot: Çalışmada 60-18 yaş arası yan servikal grafileri çekilmiş 76 hasta retrospektif olarak değerlendirildi. Grafilerde herhangi bir patolojiye rastlanan hastalar çalışma dışında bırakıldı. Servikal grafiler ayakta, yan ve nötr pozisyonda çekildi. Cobb, Jackson ve Harrison metotları uygulanarak servikal lordoz açıları pacs sisteminden ölçüldü.

Sonuçlar: Hastaların 47' si kadın (%61.8), ve 29' u erkek (38.2%) idi. Ortalama yaş 43.83±15.9 olarak bulundu. $C_{0-2,}$ C_{2-7}, Jackson stres çizgileri ve Harrison tanjant ölçümleri ortalama değerleri 30,72°±7,76°, 18,37°±9,44°, 18,92°±10,98° ve 22,91°±8,96° olarak hesaplandı. Cobb C0-C2 (p=0.307), Jackson (p=0.106) ve Harrison (p=0.688) ölçümlerinde kadın ve erkekler arasında anlamlı fark bulunamadı. Fakat Cobb C_{2-7} değeri kadın ve erkekler arasında (p=0.017) anlamlı bulundu ve erkeklerde daha yüksek idi. Değerler karşılaştırıldığında en yüksek Cobb C_{0-2} bulundu(Cobb C_{0-2}>Harrison>Cobb C_{2-7}~Jackson) (p<0.001).

Sonuç: Harrison tekniği güç olmasına karşın daha doğru sonuçlar vermektedir. Servikal sagital parametrelerin bilinmesi cerraha cerrahı tedavi için önemli bililer vermekte olup, tüm patolojilerde ayrıntılı olarak ölçülerek göz önünde tutulmalıdır.

Anahtar Kelimeler: Servikal lordoz, Cobb açıları, Jackson stres çizgileri, Harrison tanjantları

Kanıt Düzeyi: Retrospektif klinik çalışma, Düzey III

INTRODUCTION

Cervical lordosis (CL) may be dependent on the anatomy of the cervico-thoracic junction (CTJ), which typically involves the C_7 and T_1 vertebrae, the C_{1-7} discs, and the associated ligaments [5,14]. CTJ is the site at which lordosis of the cervical spine changes to kyphosis in the thoracic spine [4]. This change in curvature causes a significant amount of stress at the CTJ, both in the static and dynamic states [1,16].

In asymptomatic normal volunteers approximately 75 % – 80 % percentage of cervical standing lordosis is localized to C_{1-2} and relatively little lordosis exists in the lower cervical levels [8,10].

Lippman reported the procedure of drawing perpendiculars to vertebral body endplate lines to evaluate scoliotic curves on anteroposterior radiographs in 1945, which was later popularized in 1948 by Cobb [3,15]. Cobb angles were subsequently drawn on lateral radiographs in the cervical, thoracic, and lumbar areas to evaluate the state of the sagittal spinal curves [3]. In 1957, Jackson presented her physiologic stress lines on the posterior vertebral body margins of C2 and C7 in the cervical spine [11]. In 1986, Gore et al used Jackson's stress lines at C2 and C7 to measure CL [7]. In 1986, Harrison began drawing posterior tangents on each vertebra to measure segmental angles on lateral radiographs [9].

The purpose of this study is therefore to compare these three different methods to measure the CL angle using lateral cervical X-ray graphics.

MATERIALS AND METHOD

We evaluated 76 patients' lateral cervical X-ray graphics between the ages of 18 to 60 years retrospectively. Exclusion criteria was any pathology that seen on graphics. All patients were reported as normal. Cervical X-ray graphics were taken as standing lateral neutral positioned. These graphics were searched with the radiology pacs program and CL angle measurement of these patient was evaluated with the techniques being explained below:

Cobb Angle:

Cobb angles are measured with the 4-line method includes drawing a line either parallel to the inferior endplate of C_2 to the posterior margin of the spinous process, and another line parallel to the inferior endplate of C_7. C_{0-2} angle, an angle between the McRae line and the C_2 lower end plate was measured using Cobb method Perpendicular lines are then drawn from each of the 2 lines noted above and the angle subtended between the crossing of the perpendicular lines is the cervical curvature angle **(Figure-1,2).**

Figure-1. C0-2 Cobb angle

Figure-2. C2-7 Cobb angle

Jackson Physiological Stress Lines:

The Jackson physiological stress lines method which requires drawing 2 lines, both parallel to the posterior surface of the C_7 and C_2 vertebral bodies, and measuring the angle between them **(Figure-3).**

Harrison Posterior Tangent Method:

Harrison posterior tangent method involves drawing lines parallel to the posterior surfaces of all cervical vertebral bodies from C_2 to C_7 and then summing the segmental angles for an overall cervical curvature angle **(Figure-4).**

STATISTICAL ANALYSIS:

Descriptive data were presented as mean and standard deviations for numerical variables, and frequencies and percent for categorical variables. Independent group comparisons were analyzed with Mann-Whitney U test between genders. A Type I error level of 5% was considered as statistical significance in analyses. SPSS 18 (IBM Inc., Armonk, USA) was used for the statistical assessments.

Figure-3. Jackson stress lines angle

Figure-4. Harrison tangents angles

RESULTS:

Table-1 represents the patients' demographics. Accordingly, 47 patients (61.8%) were female, and 29 patients (38.2%) were males. Mean age was 43.83±15.9 years.

The measurements according to gender were presented in **Table-2**. Accordingly, Cobb C_{0-2} (p=0.307), Jackson (p=0.106), and Harrison (p=0.688) measurements were similar between males and females. But Cobb C_{2-7} was significantly different between genders (p=0.017), and males had significantly higher Cobb C_{2-7} values.

The comparisons of methods **(Table-3)** revealed that Cobb C_{0-2} had highest values, and Cobb C_{2-7} and Jackson was lower than Harrison (Cobb C_{0-2}>Harrison>Cobb C_{2-7}~Jackson) (p<0.001).

Table-1. Patient demographics

		Count	%
GENDER	Female	47	61,8%
	Male	29	38,2%
		Mean	**SD**
AGE (year)		43,83	15,90

Table-2. Measurement comparison between genders

	Female		Male		p
	Mean	SD	Mean	SD	
COBB_C_{0-2}	31,43	7,12	29,57	8,72	0,307
COBB_C_{2-7}	16,30	9,18	21,73	9,01	0,017
JACKSON	17,43	11,02	21,33	10,66	0,106
HARRISON	22,43	9,48	23,69	8,14	0,688

Table-3. Comparison of measurement methods

	Mean	SD	p
COBB_C_{0-2}	30,72	7,76	p<0.001
COBB_C_{2-7}	18,37	9,44	
JACKSON	18,92	10,98	
HARRISON	22,91	8,96	

DISCUSSION:

The widest range of motion is on the cervical spine relative to the rest of the spine and also this region supports the mass of the head [13]. Beier et al. reported that CL is localized to C_{1-2} and the center of gravity of the head sits almost directly above the centers of the C_1 and C_2 vertebral bodies[2]. Only 6° (15 %) of lordosis occurs at the lowest 3 cervical levels (C_{4-7}). The loss of subaxial lordosis has been reported in occiput–C_2 fusions in which excessive hyperlordosis is created at occiput– C_2 [17-18].

Although a few studies have reported the normal sagittal balance of the cervical spine and physiological CL has not been clearly defined yet, Hardacker et al. reported a mean CL of 40.0°±9.7°that had a significant correlation with thoracic kyphosis [8].

Lee et al. reported that the mean values C_{0-2} angle was 22.4° ± 8.5° and C_{2-7} angle was 9.9° ± 12.5° [12]. The ratio of the C_{0-2} angle and the C_{2-7} angle was 77 % and 23 % of the total CL[12]. Also Gore et al. reported C_2-C_7 cervical lordosis angles of 16° for men and 15° for women[6].

Harrison et al. made a comparison of two techniques which were 4 line Cobb method and Harrison Tangents to measure CL [9]. They found that Cobb method at C_1–C_7 overestimated the cervical curvature (-54°) and, at C_2–C_7 it underestimated the cervical curve (-17°), whereas the posterior Harrison tangents were the slopes along the curve (-26° from C_2 to C_7) [9].

Harrison et al. also suggest this as the posterior tangent method is part of an engineering analysis and more accurately depicts cervical curvature than the Cobb method [9]. We found mean values of $C_{0-2,}$ C_{2-7}, Jackson stress lines and Harrison tangents as 30,72° ± 7,76°, 18,37° ± 9,44°, 18,92° ± 10,98° and 22,91° ± 8,96°. Our results are similar to Harrisons'.

Harrison tangent technique is difficult to measure but we thought its results are better to show the best values because tangents also could measure the internal curve. All these techniques must be understood well with the biomechanics features so that surgeons could choose which technique would be better to use for the management of deformities.

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