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MEASUREMENT OF SPINAL CURVATURE ANGLES ON ADULTS

ERİŞKİNLERDE SPİNAL KURVATUR AÇILARININ ÖLÇÜMÜ

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SUMMARY:

Objective: The aim of the study is to inspect the angles of cervical lordosis (CL), thoracal (TK) and lumbar lordosis (LL) in adults to collect data of the normal mean values for developing spinal deformity patient population.

Materials and Method: We inspected 135 thin-layered reconstructive computed tomography(CT) scans of whole spine that obtained in adult patients who were admitted to our hospital for emergency treatment retrospectively.

Results: 135 patients (60 females, 44.4%, and 75 males, 55.6%) were included in the study. Accordingly, mean age was 50.8±18.1 years, angles of CL was 28.5±6.4, TK 39.7±7.4 and LL was 31.7±6.2 degrees. When the measurements were compared between females and males, it was found that only LL was significantly different between genders (35.0±6.2 in females, and 29.1±5.0 in males, p=0.032), and females had greater values. Age (p=0.420), CL (p=0.083), and TK (p=0.903) were similar between females and males.

Conclusions: This work provided a useful tool for analyzing and understanding sagittal imbalance in patients with spinal disease or deformity and also a means of calculating corrections to be made with treatment, established from the linear regression equations which were elaborated by reconstructive computed tomography.

Key Words: Cervical lordosis, Thoracal kyphosis, Lumbar lordosis, Spinal curvature

Level of Evidence: Morphometric radiologic analysis, Level III

ÖZET:

Amaç: Çalışmanın amacı spinal deformite gelişebilecek hastalar için normal ortalama servikal lordoz (CL), torakal kifoz (TK) ve lomber lordoz (LL) açılarının verilerini toplamaktır.

Materyal ve Metod: Acil servise başvuran ve spinal patolojisi olmayan 135 hastanın ince-kesit bilgisayarlı tomografi görüntüleri retrospektif olarak incelendi.

Sonuçlar: Çalışmaya 135 hasta (60 kadın, % 44.4, and 75 erkek, % 55.6) dahil edildi. Ortalama yaş 50.8 ± 18.1, ortalama kurvatur değerleri CL 28.5 ± 6.4, TK 39.7 ± 7.4 ve LL 31.7 ± 6.2 derece olarak ölçüldü. Ölçümler cinsiyetler arasında karşılaştırıldığında, sadece LL anlamlı olarak gözlendi (kadınlarda 35.0 ± 6.2, ve erkeklerde 29.1 ± 5.0, p=0.032), kadınlarda daha yüksek bulundu. Yaş (p=0.420), CL (p=0.083) ve TK (p=0.903) cinsiyetler arasında benzer bulundu.

Çıkarım: Bu çalışma sagital dengeyi anlamada ve spinal hastalık ve deformitelerde ölçümlerin rekonstrüktif bilgisayarlı tomografi kullanarak daha rahat anlaşılmasına yardımcı olacağı düşünülerek yapılmıştır.

Anahtar kelimeler: Servikal lordoz, Torakal kifoz, Lomber lordoz, Spinal kurvatur

Kanıt Düzeyi: Morfometrik radyolojik analiz, Level III

INTRODUCTION:

Many literature reports suggested that up to 60% of elderly people demonstrated evidence of spinal deformity[11]. Main issues in treatment of patients with adult spinal deformity are disability and pain.

Landmarks on radiographies driving disability in patients with spinal deformity were pointed as sagittal vertical axis (SVA), regional Cobb angles, cervical lordosis (CL), thoracic kyphosis (TK), lumbar lordosis (LL), pelvic tilt, sacral slope (SS), and pelvic incidence (PI) were generalized to assess patient outcomes[6]. The C7 plumb line usage and its relationship with the posterior aspect of the S1 superior endplate is a standardized assessment of global spinal balance; however, this omits the head position and craniocervical alignment[8]. True global sagittal balance should consider the head position in relation to the whole spine and pelvis[9].

Sagittal balance of the spine is a fundamental element necessary for understanding spinal disease and instituting proper treatment. The aim of study was to establish the physiological values of spinal curvature parameters of sagital balance of the spine.

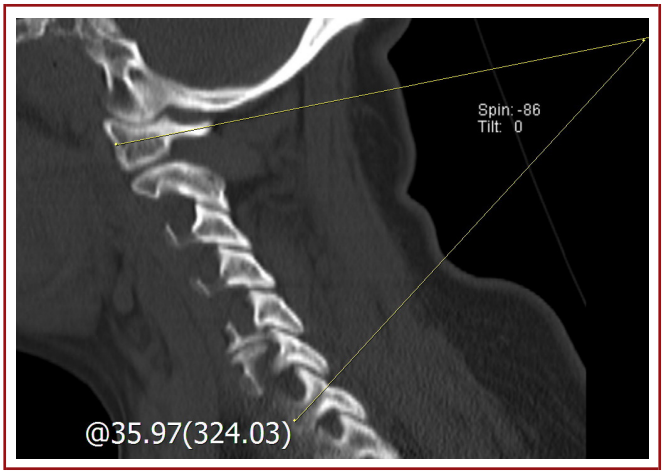
METHODS:

We inspected 135 thin-layered reconstructive computed tomography (CT) scans of whole spine that obtained in adult patients who were admitted to our hospital for emergency treatment retrospectively. Inclusion criterias for patients in the study are, patients had to be older than 17 years and have undergone a complete 3D-CT scan of the spine and had no pathological spinal trauma or disease. Patients were excluded if their radiological examinations were not sufficient for the proposed measurements or if they were known to have pathological conditions of the spine.

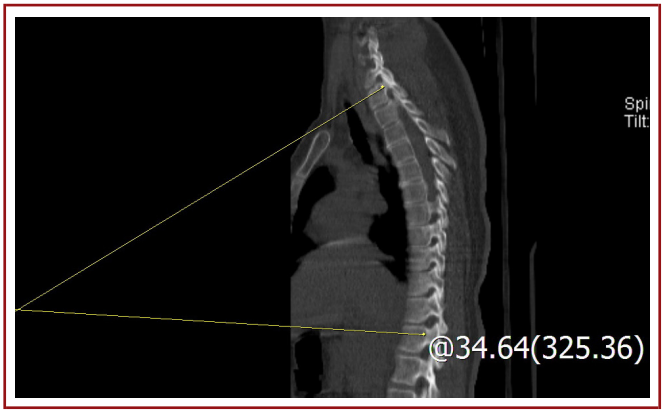
Measurements were made at cervical level from the midline of vertebra bodies C1-C7, Thoracic T1-T12and lumbar level L1-L5 with sagittal reconstructive 3D-CT. (Figure-1,2,3)

STATISTICAL ANALYSES:

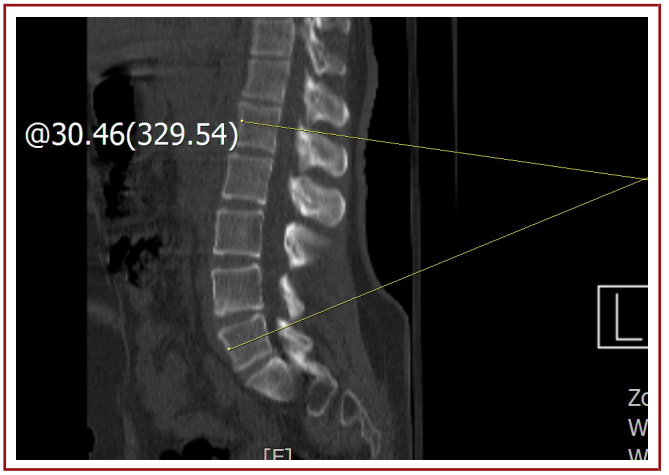
Descriptive data were presented as frequencies and percent for categorical variables, and as mean and standard deviation for numerical variables. Independent group comparisons between both genders were performed with Mann-Whitney U test. P values lower than 0.05 (Type I error level of 5%) was considered as statistically significant result. All analyses were performed by using IBM SPSS Statistics for Windows, Version 21.0 (Armonk, NY: IBM Corp.).



Şekil-1. Radiologic measurement of servical region



Şekil-2. Radiologic measurement of throcic region



Şekil-3. Radiologic measurement of throcic region

RESULTS:

135 patients (60 females, 44.4%, and 75 males, 55.6%) were included in the study. General characteristics of patients were presented in Table-1. Accordingly, mean age was 50.8±18.1 years, angles of CL was 28.5±6.4, TK 39.7±7.4 and LL was 31.7±6.2 degrees.

Table-1. General characteristics of patients and curvature angles

	n	%
Gender		
Female	12	44.4
Male	15	55.6
	Mean	**SD**
Age	50.8	18.1
Cervical Lordosis	28.5	6.4
Thoracic Kyphosis	39.7	7.4
Lumbar Lordosis	31.7	6.2

When the measurements were compared between females and males, it was found that only LL was significantly different between genders (35.0±6.2 in females, and 29.1±5.0 in males, p=0.032), and females had greater values. Age (p=0.420), CL (p=0.083), and TK (p=0.903) were similar between females and males. Comparisons between genders are presented in Table-2.

DISCUSSION:

The study of sagittal spinal alignment refers to the assessment of various local, regional, and/or global parameters of the spine. Global spinal balance refers to the overall alignment of the spine that generally using center of C7 vertebral body as a reference point with respect to another reference point on the sacrum or pelvis[7].

Assessment of global spinal balance provides information on existing relationships between parameters describing the sacropelvis, lumbar spine, thoracic spine, and cervical spine[1]. Clinically, global spinal balance is an important aspect of the evaluation of patients with spinal pathology and of surgical planning, to minimize complications such as adjacent segment disease, sagittal imbalance, pseudarthrosis, and progressive deformity[3,10].

Clinical importance of sagittal balance is important in the management of spinal degenerative pathologies[2]. Abnormal spinal sagittal alignment can cause persistent low back pain (LBP) and the association of acute LBP with hyperlordosis and the relationship of chronic LBP with hypolordosis have been demonstrated also[5].

Guigui et al reported from 250 patients, they have measured maximal lumbar lordosis 61 +/- 12.7 degrees, maximal thoracic kyphosis 41.4 +/- 9.2 degrees from plain radiographs[4].

Yukawa et al reported sagittal alignment and range of motion of the cervical spine in 1230 asymptomatic volunteer[s12]. They revealed that cervical lordosis in the neutral position increased with age, particularly in the sixth decade and to a greater degree in females[12]. Yoshida et al inspected TK increased with age more in females; therefore, females developed greater compensatory lordosis of the cervical spine with age[11].

In our study mean age was 50.8±18.1 years, angles of CL was 28.5±6.4, TK 39.7±7.4 and LL was 31.7±6.2 degrees. The similar age rated studies in the literature all support each other but all these studies are limited by the heterogeneity of the cohorts, radiographic protocols, positioning and measurement techniques.

This work provided a useful tool for analyzing and understanding sagittal imbalance in patients with spinal disease or deformity and also a means of calculating corrections to be made with treatment, established from the linear regression equations which were elaborated by reconstructive computed tomography.

Table-2. Comparisons of measurements between genders

	Female		Male		p
	Mean	**SD**	**Mean**	**SD**	
Age	54.3	19.9	48.0	16.6	0.420
Cervical Lordosis	30.4	4.7	27.1	7.4	0.083
Thoracic Kyphosis	39.9	7.4	39.5	7.7	0.903
Lumbar Lordosis	35.0	6.2	29.1	5.0	0.032

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