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LUMBAR LORDOSIS AND SACRAL SLOPE ANGLE MEASUREMENTS ACCORDING TO ADULT AGE GROUPS: A MORPHOMETRIC STUDY

ERIŞKIN YAŞ GRUPLARINA GÖRE LOMBER LORDOZ VE SAKRAL SLOP AÇILARININ ÖLÇÜMÜ: MORFOMETRIK ÇALIŞMA

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SUMMARY:

Purpose: The aim of the study is to evaluate lumbar lordosis (LL) and sacral slope (SS) angle values according to healthy adult age groups, gender and correlations with each other.

Materials-Methods: We inspected 132 patients' datas retrospectively from the patient files. The patients were divided into 3 age groups as 18-40, 41-60 and 61-80. Patients who had been imaged with lumbar vertebral multi-sliced computed tomography were included.

Results: Forty-six participants (34.8 %) were between 18-40 years, 46 cases (34.8 %) between 41-60 years, and 40 cases (30.3 %) between 61-80 years. There was no significant difference between the age groups regarding gender. The comparisons revealed that both LL, and SS values were significantly higher in 61-80 years ($p<0.001$ for both). According to the analyses, age ($p<0.001$), LL ($p<0.001$), and SS ($p<0.001$) values were significantly higher in females when compared to males. LL and SS values showed statistically significant and strong positive correlation with each other.

Conclusion: LL and SS values showed statistically significant and strong positive correlation with each other through all age groups additionally significantly higher in 61-80 years.

Key Words: Lumbar lordosis, sacral slope, morphometric angles of lumbosacral region

Level of evidence: Retrospective clinical study, Level III

ÖZET:

Amaç: Bu çalışmanın amacı sağlıklı erişkin yaş gruplarına ve cinsiyete göre lomber lordoz (LL) ve sakral slop (SS) açılarını ve birbirleri ile olan ilişkiyi incelemektir.

Materyal-Metod: Retrospektif olarak 132 hasta dosyası incelendi. Hastalar yaş gruplarına göre 3 gruba 18-40, 41-60 ve 61-80 olarak ayrıldı. İnce kesit lomber vertebral bilgisayarlı tomografi çekilen hastalar çalışmaya alındı.

Sonuçlar: 46 hasta (% 34.8) 18-40 yaş arasında, 46 hasta (% 34.8) 41-60 yaş arasında ave 40 hasta (30.3%) 61-80 yaş arasında idi. Cinsiyetler arası yaş farkı istatistiksel olarak anlamlı değildi. Karşılaştırma sonucunda LL ve SS değerleri anlamlı olarak 61-80 yaş aralığında yüksek olarak bulundu ($p<0.001$). Analizlere göre yaş($p<0.001$), LL ($p<0.001$) ve SS ($p<0.001$) değerleri kadınlarda erkeklere göre daha büyük olarak bulundu. LL ve SS değerleri birbirleri ile doğru orantıda hareket ettikleri anlaşıldı.

Çıkarım: LL ve SS değerleri tüm yaş gruplarında birbirleri ile anlamlı ve güçlü pozitif birliktelik göstermekte ve 61-80 yaş grubunda anlamlı olarak daha yüksek değerlere çıkmaktadır.

Anahtar Kelimeler: Lomber lordoz, sakral slop, lumbosakral bölgenin morfometrik açıları

Kanıt Düzeyi: Retrospektif klinik çalışma, Düzey III

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INTRODUCTION:

The sagittal balance of the spine is determined by the pelvic shape which is set by the pelvic incidence (PI)[8]. The PI was initially described by Duval-Beaupère et al[4]. PI is defined as the angle between the perpendicular to the upper sacral end plate at its midpoint and the line connecting this point to the femoral head axis.

Sacral slope (SS) is defined as the angle between the horizontal and the upper sacral endplate[15]. The pelvic tilt (PT) is defined by the angle between the vertical and the line through the midpoint of the sacral plate to the femoral head axis [11]. PI is strongly correlated with the SS and PT, and represents the algebraic sum of the SS and the PT (PI=SS+PT). Lumbar lordosis (LL) is defined as the angle between the upper L1 endplate and the upper sacral endplate[11].

The aim of our study is try to investigate the correlations between LL and SS according to gender and different age groups of healthy adults.

MATERIALS AND METHOD:

We inspected 132 patients' datas retrospectively from the patient files. The patients were divided into 3 age groups as 18-40, 41-60 and 61-80. Patients who had been imaged with lumbar vertebral multi-sliced computed tomography(CT) were included. The exclusion criteria were having degenerative spinal disease, fractures, spondylolisthesis and pathological images on CT. LL and SS angles were measured with Osirix® software(Figure1,2). LL was defined as the angle between the upper endplates of L1 and S1. SS corresponds to the angle between the upper sacral endplate and the horizontal plane. All measurement values included for statistical analyse.

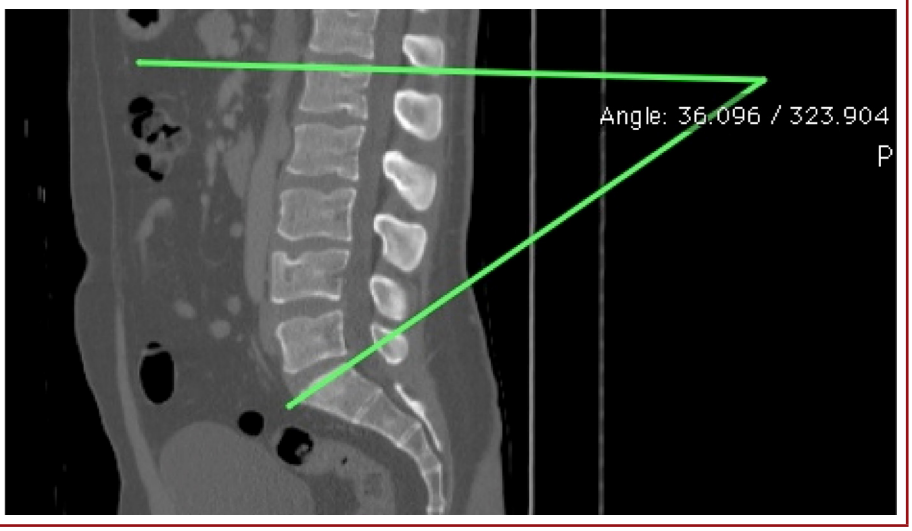

Figure-1. Lumbar lordosis angle measurement with Osirix®

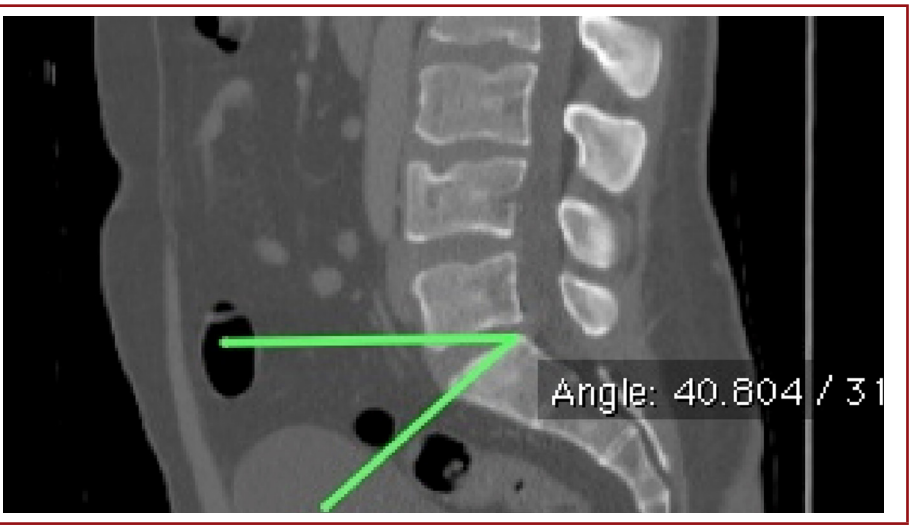

Figure-2. Sacral slope angle measurement with Osirix®

Statistical Analysis:

Descriptive data of VAS scores were presented as mean, standard deviation, minimum and maximum. The categorical variable, gender, was presented as frequency and percent. The comparisons between independent two groups were conducted by Mann-Whitney U test. Comparison of distribution of sexes among age groups was conducted by Chi-square test. Spearman non-parametric correlation analysis was performed to evaluate the correlations between lumbar lordosis and sacral slope values. SPSS software version 21 (IBM Inc., USA) was used for the statistical analyses. Statistical significance level was considered as 0.05 in the analyses of this study.

RESULTS:

Fifty-five participants were female (41.7%), and 77 were male (58.3%). Mean age of the females and males were 50.82 ± 15.40 years and 46.73 ± 18.18 years, respectively (p=0.154, Mann-Whitney U test). Forty-six participants (34.8 %) were between 18-40 years, 46 cases (34.8%) between 41-60 years, and 40 cases (30.3%) between 61-80 years. The distribution of the sexes according to age groups is presented in Table-1. There was no significant difference between the age groups regarding gender (p=0.147, Chi-square test).

Table-2 shows the LL and SS according to age groups. The comparisons revealed that both LL, and SS values were significantly higher in 61-80 years (p<0.001 for both).

The comparisons of age, LL and SS values between males and females are presented in Table 3. According to the analyses, age (p<0.001), LL (p<0.001), and SS (p<0.001) values were significantly higher in females when compared to males.

LL and SS values showed statistically significant and strong positive correlation with each other (r=0.909, p<0.001, Spearman correlation analysis). The correlations were consistent through all age groups (18-40: r=0.906, p<0.001; 41-60: r=0.922, p<0.001; 61-80: r=0.861, p<0.001).

Table 1. Distribution of gender in age groups

	18-40		41-60		61-80		p
	n	%	n	%	n	%	
Female	14	30,40%	21	45,70%	20	50,00%	0.147
Male	32	69,60%	25	54,30%	20	50,00%	

Table 2. Lumbar Lordosis and Sacral Slope according to age groups

	18-40				41-60				61-80				p
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	
LL	44,54	11,16	18,1	64,2	47	10,32	24,5	64,2	59,79	10,52	42,1	77,1	<0.001
SS	37,23	8,78	16	52,4	38,49	7,32	23,1	51,2	45,05	5,92	34	56,6	<0.001

Table 3. Age, Lumbar Lordosis and Sacral Slope according to gender

	Female				Male				p
	Mean	SD	Min	Max	Mean	SD	Min	Max	
Age	50,82	15,4	18	74	46,73	18,18	18	80	<0.001
LL	52,33	12,05	18,1	65,3	48,36	12,56	26,5	77,1	<0.001
SS	40,62	8,35	16	52,4	39,62	8,05	20,1	56,6	<0.001

DISCUSSION:

The analysis of sagittal balance seems to be important in the management of lumbar degenerative pathologies. Clinical importance of LL and SS is being recognized increasingly. Lumbar lordosis is formed by the wedging of the lumbar vertebral bodies and intervertebral discs[15]. Abnormal lordotic alignment may lead pathologic changes in the spine from load bearing and accelerate degeneration of the functional motion units[7].Overall, the degree of lumbar lordosis decreases with advanced age[14]. LL and SS value range means in asymptomatic adults is 43-61 and 36-42 degrees[11].

Spinopelvic parameters have been studied extensively in the literature. The relationship SS and LL in healthy patients has been documented[8,9,12,13]. Roussouly et al. reported the standard sagittal parameters in a normal population[12]. The average value for LL was 61.4 with a range from 41.2 to 81.9. The sacral slope averaged 39.9 (SD 8.2 , range 21.2–65.9). The correlation between SS and LL with a Pearson's r of 0.86 indicates that the total amount of lordosis is determined by the relationship of the superior endplate of S1 with the horizontal axis[2,12].

Oh et al. reported the spinopelvic parameters of Korean normal population as followings, the PI was 49°; the SS was 38°; the PT was 11°, the LL was 48° [10]. Legaye et al. and Vaz et al. have demonstrated a correlation between PI and LL in the general population; a low PI is usually associated with a low lumbar lordosis, whereas a high PI is usually associated with a high lumbar lordosis[8,13]. Also, the correlation between LL and SS has been reported in normal populations; LL increases linearly with SS.

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].

All measurements were performed in supine position. Although both groups had identical positions during imaging and some former studies had demonstrated that sagittal alignment measured in supine position is reliable for investigational analyses[1,2,5,6].

The comparisons revealed that age, LL and SS angle values were significantly higher in females when compared to males. LL and SS values showed statistically significant and strong positive correlation with each other through all age groups additionally significantly higher in 61-80 years.

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