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EVALUATION OF SPINOPELVIC PARAMETERS IN ASYMPTOMATIC INDIAN POPULATION

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ABSTRACT: BACKGROUND: The study aims at evaluation of spinopelvic parameters in an Indian population in a sample composed of asymptomatic individuals. **METHODS**: 84 healthy adult individuals were evaluated. The exclusion criteria included spinal deformity, spine degenerative or infective condition and improper radiograph study. In each radiograph the sagittal balance and spinopelvic parameters were evaluated, including vertical sagittal axis, sacral slope, pelvic tilt and pelvic incidence. **RESULTS**: Data obtained in this study were in accordance to International literatures. No significant variation between genders was obtained for various parameters. The mean values of Pelvic Incidence, Sacral Slope and Pelvic Tilt in healthy Indian Population is 49.4°±7.6°, 37.4°±6.6° and 13.9°±5.8° respectively. **CONCLUSION**: There were no differences in any radiographic parameter between males and females in the present study. Further, the values obtained are comparable with the values presented as normal in the literature. The Indian and European populations shows significance in pelvic incidence and sacral slope which were higher in European populations and Indian and Korean population showed significant difference in pelvic tilt which was lower in Korean population.
KEYWORDS: Pelvis, Lordosis, Spinopelvic Parameters, Pelvic Tilt, Sacral Slope, Pelvic Incidence.

INTRODUCTION: The vertebral spine has a key role in the support and locomotion of the body and hence an understanding of the elements that compose it is essential for learning about its role in body balance and alignment.[1,2,3,4] With the introduction of the concepts of Pelvic Incidence(PI), Pelvic Tilt(PT), and Sacral Slope(SS), the role of the pelvis has been widely recognized in the evaluation of spinal balance and alignment.[5,6,7]

Deformities of the sagittal plane can cause anterior inclination of the trunk, affecting sagittal balance. The main causes of loss of sagittal balance included degenerative diseases, inadequate fixation of the lumbar spine, post-traumatic deformity, and ankylosing spondylitis.[8] To analyze and interpret the degree of deformity in the sagittal balance, the normal parameters for the population must be studied. Spinopelvic Parameters have been studied, compared and documented amongst different populations.[8,9,10] However, a similar study has not yet been conducted for the Indian population.

The objective of this study is to observe the parameters of sagittal and spinopelvic balance in a sample of the Indian population consisting of volunteer asymptomatic individuals, in order to establish the relationship between these parameters, age, and sex and to compare the results with those of other studies that cover other population groups.

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MATERIALS AND METHOD:

The Study Setting: This was a prospective observational study, which was carried out over a period of one month (October 16, 2014 to November 15, 2014) in the Department of Orthopaedics of New Civil Hospital, Surat, which is a tertiary health care centre, which caters to the population of Surat district.

All the patients without lower back pain and above 20 years, presenting to the hospital during October 16, 2014 to November 15, 2014, and willing to participate were enrolled for the study.

Before their enrolment, all the participants were explained about the nature and the purpose of the study. Consent was obtained from all the subjects.

The Study Subjects: A total of 84 subjects who fulfilled the below mentioned criteria were enrolled in the study.

All the individuals who were Indian, above 20 years of age, without history of spinal pain or disease and those willing to give informed consent were included in the study. The presence of spinal disease that includes deformity, degenerative changes or infections of spine along within adequate imaging, which would prevent proper analysis of the parameters in the study, was excluded.

The demographic profile, complete histories, information on the vitals and relevant systemic examinations of all the subjects who were fitting in the inclusion criteria were recorded in a proforma and were subjected for relevant radiological examinations.

Technique of Radiological Examinations: Only one professional, conducted the required Radiological Examination, using the same technique. The radiographs were obtained with the subjects in standing position with the knees extended and the hands on the supraclavicular fossae. Long cassettes (91cm) were used and the radiograph was centered on T12 in inspiration, with a distance of 2 meters between the film and the focus. The images were digitalized and evaluated. The sagittal and spinopelvic parameters, which were analyzed, included sacral slope (SS), pelvic tilt (PT), and pelvic incidence (PI).[11]

The pelvic incidence (PI) was defined as the angle between the perpendicular to the sacral plate and the line connecting the midpoint of the sacral plate to the bi-coxo-femoral axis. The PI is a morphological parameter, considered as a constant, independent of the spatial orientation of the pelvis. The sacral slope (SS) corresponds to the angle between the sacral plate and the horizontal plane. The SS is a positional parameter, varying according to the pelvis positioning .The pelvic tilt (PT) corresponds to the angle between the line connecting the midpoint of the sacral plate to the bi-coxo-femoral axis and the vertical plane. As said for the SS, the PT is also a positional parameter.[11]

Statistical Analysis: It was carried out by using mean, standard deviation (SD) and p value of the variables. In addition, the present study was compared with other similar studies in different population using unpaired students t test.

RESULTS: A total of 84 subjects (Male-55 and Female-29) were enrolled in the study, the analyzed spinopelvic parameters of study participants are described in [Table 1]. It also states there is no significant difference in spinopelvic parameters when comparing in different genders.

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	Total		Male		Female		Pvalue
	Average	SD	Average	SD	Average	SD	
Pelvicincidence(°)	49.04	±7.6	49.8	±6.8	47.6	±9.2	0.263
Sacralslope(°)	37.4	±6.6	37.6	±6.4	37.1	±7.2	0.755
Pelvictilt(°)	13.9	±5.8	14.3	±7.1	13.2	±6.4	0.47
Table 1:Spinopelvic Parameters in Study Subjects							

[Table 2] shows the normal values of spinopelvic parameters from the different studies.[12,13,14,15]

Parameters	Degrees
Pelvicincidence	40-65
Sacralslope	30-50
Pelvictilt	10-25
Table 2: Normal values in literature[12,13,14,15]	

DISCUSSION: [Table 3] Compares the analyzed parameters in the study with the published data from different population, which shows no statistical significance in parameters from Indian and Brazil, while Indian and European populations shows statistical significance in pelvic incidence and sacral slope which were higher in European populations. Assessing the Indian and Korean population, there was statistical significance in the values of pelvic tilt which was lower in Korean population.

[Table 4] Compares the analyzed parameters in males of the study subjects with the published data from different population, which shows no statistical significance in the parameters amongst Indian and Brazil populations, while Indian and European populations shows statistical significance in sacral slope which was on the higher side in European populations. Assessing the Indian and Korean population, there was statistical significance in the pelvic tilt which was the lower side in the Korean population.

[Table 5] Compares the analyzed parameters in female of the study subjects with the published data from different population, which shows no statistical significance amongst parameters of Indian and Brazil, while Indian and European populations shows significance in pelvic incidence and sacral slope which were higher in European populations. Assessing the Indian and Korean population, there was no significant difference in all parameters.

Spinopelvic Parameters	Indian (n=84)		Brazil (n=50)		Europe (n=300)		Korea (n=86)		p1 *value	p2 ** value	p3 *** value
	Average	SD	Average	SD	Average	SD	Average	SD			
Pelvic Incidence (°)	49.04	±7.6	48.7	±9.6	54.7	±10.6	47.8	±9.5	0.83	<<0.001	0.34
Sacral Slope (°)	37.4	±6.6	38	±8.4	41.2	±8.5	36.3	±8.6	0.66	<<0.001	0.44
Pelvic Tilt (°)	13.9	±5.8	12.15	±6.2	13.2	±6	11.5	±5.4	0.10	0.33	0.005
Table 3: Comparison between different populations											

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*p1: comparison of Indian population with Brazil
**p2: Comparison of Indian Population with Europe
***p3: Comparison of Indian Population with Korea

Spinopelvic Parameters	Indian (n=55)		Brazil (n=25)		Europe (n=110)		Korea (n=54)		p1 value	p2 value	p3 value
	Average	SD	Average	SD	Average	SD	Average	SD			
PI(°)	49.8	±6.8	49.1	±6.4	53	±10.6	48.8	±7.3	0.65	0.02	0.46
SS(°)	37.6	±6.4	38.2	±6.9	41	±8.5	37.3	±7.1	0.71	0.004	0.81
PT(°)	14.3	±7.1	12.1	±6.2	13	±6	11.4	±5.4	0.16	0.24	0.01

Table 4: Comparison between male populations

*p1: comparison of Indian population with Brazil.
**p2: Comparison of Indian Population with Europe.
***p3: Comparison of Indian Population with Korea.

Spinopelvic Parameters	Indian (n=29)		Brazil (n=25)		Europe (n=190)		Korea (n=32)		P1 value	P2 value	P3 value
	Average	SD	Average	SD	Average	SD	Average	SD			
Pelvic Incidence (°)	47.6	±9.2	48.3	±9.6	56	±10	46.1	±9.5	0.78	<<0.001	0.01
Sacral Slope (°)	37.1	±7.2	37.8	±8.4	43.2	±8.4	34.4	±8.6	0.81	<<0.001	0.18
Pelvic Tilt (°)	13.2	±6.4	12.2	±5.3	13.6	±6	11.6	±5.1	0.45	0.75	0.28

Table 5:Comparison between female populations

*p1: comparison of Indian population with Brazil
**p2: Comparison of Indian Population with Europe
***p3: Comparison of Indian Population with Korea

The normal adult sagittal alignment falls within a narrow margin in the pelvis, with an average sagittal vertical axis value in asymptomatic adults described as 0.5cm(±2.5cm) from the posterior-superior corner of the sacrum.[3] Since the work of Legaye and Duval-Beaupere,[7] various studies have stressed the importance of the pelvis in the sagittal alignment of adults.[13] Analysis of the pelvis in the sagittal plane is obtained by measuring three angles: pelvic incidence (PI), pelvic tilt (PT), and sacral slope (SS).

Glassman et al[16] demonstrates the importance of analyzing sagittal balance both in the evaluation of patients with complaints of backache and functional limitations and for the outcome of surgical treatment. However, for us to correctly understand the effects of the loss of sagittal balance on the quality of life of each individual, we must know the normal values of the parameters used to evaluate sagittal and spinopelvic balance in the population. Although India is a country of continental proportions and a mixed population, this study presents the results of analysis of a small sample of healthy individuals. It can be noticed that the values obtained from the sample are within the values described as normal in the literature.[8,11,17,14] In our study, there were no differences in the radiographic parameters when compared by sex of the individuals evaluated.

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CONCLUSION: There were no differences in any radiographic parameter between males and females in the present study. Further, the values obtained are compatible with the values presented as normal in the literature. The Indian and European population's shows significance in pelvic incidence and sacral slope which were higher in European populations and Indian and Korean population showed significant difference in pelvic tilt which was lower in Korean population.

IMPLICATION: The importance of spino pelvic parameters are important in assessing the patients presenting with lower back pain when considering the etiology and also to be considered while surgical correction is needed for treatment of conditions like spondylolysthesis, degenerative disc disease and scoliosis. This study also serves as baseline for comparing the spinopelvic parameters in normal Indian populations with the patients having spinal degenerative changes or deformity requiring treatment.

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