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Spino-pelvic radiological parameters in patients presenting with low back pain in a tertiary care centre in India

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Abstract
Objectives: Low back pain is one of the most common and disabling morbidities in the world and its relationship with spino-pelvic parameters is not yet fully understood in the Indian population. Our objective was to study the spino-pelvic parameters in patients who presented to the OPD with low back ache (LBA).
Materials and Methods: Cross-sectional study conducted at SGITO, Bangalore between March-August 2018. 90 patients with LBA were asked to take standing lateral radiographs showing the pelvis with both hips and lumbar spine. The lumbar lordosis (LL), pelvic incidence (PI), pelvic tilt (PT), and sacral slope (SS) were calculated; and statistical analysis was done.
Results: The mean age of patients was 46 years. The average duration of LBA was 14.5 months. The average PI, SS, PT, and LL among the patients was found to be 52.53 (+/-10.85), 35.08 (+/-9.17), 17.56 (+/-7.72), and 49 (+/-3) respectively.
PI had statistically significant association with PT and SS but not with LL among both men and women in all age groups. Mean PI and PT was found to be higher in women (53.82+/- 11.85) (18.35 +/- 8.45) and in above 50 years age group (54.58 +/-11.41). Similarly, the mean PT was higher in among women (18.35 +/- 8.45) and in the above 50 years age group (18.93 +/- 8.02). The duration of lower back pain was found to be positively associated with PI, SS, PT, and LL but didn't reach statistical significance.
Conclusion: Spino-pelvic alignment is maintained in patients with low back pain and differences in sagittal alignment in patients with low back ache are minor and clinically, multiple factors contribute to LBA. However, further studies need to be conducted to corroborate these findings in the Indian population which may help in early detection and management of patients prone to develop lumbar disc degeneration and low back ache.

Keywords: low back ache, spino-pelvic parameters, pelvic morphology, pelvic incidence

1. Introduction
Low back pain is one of the most common and disabling morbidities in the world today. It has a multifactorial etiology which may be due to psychosocial, environmental, postural, morphological or pathological factors [1]. The chronicity of low back ache is found to be mainly determined by the psychosocial factors, however spino-pelvic malalignment is also found to be one of the proven causes for persistent back ache. Once the normal spino-pelvic alignment is lost, there is more energy consumption by the body to maintain balance with a horizontal gaze without using any external aid [2]. Hence, understanding the elements that compose sagittal alignment is essential for learning about its role in body balance and locomotion.
In all individuals after puberty, pelvic incidence is found to be a fixed anatomical parameter and does not change with age or pathology. Pelvic incidence is defined as the angle between the line perpendicular to the sacral plate at its midpoint, and the line connecting this point to the axis of the femoral heads [3, 4]. Hence, it can be used as a reference guide to understanding variations among individuals and its relationship in people with low back ache.
Although there are many studies that describe the spino-pelvic parameters among the normal population [5-8], its relation with low back ache is poorly understood in the Indian population.

Patients with low back ache are found to have a more vertical sacrum, less distal lumbar lordosis and more proximal lumbar lordosis [9-11]. In contrary, Gautier *et al*. [12] and During *et al*, [13] found no relationship between lumbar lordosis and pelvic parameters when they compared asymptomatic subjects with LBA subjects. Tsuji *et al*. [14] found that lumbar lordosis was reduced in patients with LBA, whereas Christie *et al*. [15] demonstrated increased lumbar lordosis in patients with chronic LBA when compared to controls.

The objective of this study was to analyse the sagittal spino-pelvic parameters in patients presenting with low back ache and to find out the relationship between LBA, demographic and spino-pelvic parameters.

2. Materials and Methods

2.1 Study design

This was a cross-sectional study that was conducted at Sanjay Gandhi Institute of Trauma and Orthopaedics, Bangalore during the period between March to August 2018 after obtaining approval from the institution ethical committee.

2.2 Inclusion criteria

1. Age >18 years
2. Patients suffering from Low Back Ache (LBA) for minimum of 3 months

2.3 Exclusion criteria

1. Spinal deformities- scoliosis, spondylolisthesis.
2. Associated spine fractures, spine tumours.
3. Presence of motor deficits.
4. Patients having previous history of spine/hip surgery.
5. Hip and pelvic disorders.

Fig 1: Lumbar Lordosis

Fig 2: Pelvic Incidence

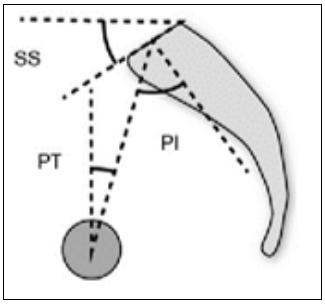

Fig 3: Pelvic Parameters

Table 1:

Parameter	Description
Pelvic Incidence (PI)	Angle subtended by a line drawn between the center of the femoral head and the center of the sacral endplate and a line drawn perpendicular to the center of the sacral endplate.
Sacral Slope (SS)	Angle subtended by a line drawn along the endplate of sacrum and a horizontal reference line extended from the posterior superior corner of S1
Pelvic Tilt (PT)	Angle subtended by a line drawn from the midpoint of the sacral endplate to the center of the bicoxofemoral axis and a vertical plumb line extended from the bicoxofemoral axis.
Lumbar Lordosis (LL)	Segmental angle of spinal segment in lordosis (down to L5)

90 patients who had presented to the OPD with low back ache and had met the inclusion and exclusion criteria were asked to take standing lateral radiographs showing the pelvis with both hips and lumbar spine using a 36 inch cassette placed at 72 inches from the xray tube. Radiographs were acquired in digital format and relevant angle measurements were then done using Synapse (Fujifilm Corporation) software.

The lumbar lordosis (LL) using cobb method, pelvic incidence (PI), pelvic tilt (PT), and sacral slope (SS) angles were calculated (Table 1); Statistical analysis was done.

3. Results

Demographic variables of the patients; mean age of the patients in the study was 46.4 years with 44 males (48.9%) and 46 females (51.1%). Majority of the patients were between 40-60 years of age (44.5%).

Duration of pain experienced by majority of the patients were in the range of 6-12 months (N-40) (Fig 2). The average VAS score experienced by the patients who presented with LBA were 4.8, 5.2, 6.2 in the age groups of 18-40 years, 40-60 years and more than 60 years respectively (Fig 3). A trend was seen towards more degree of pain as age increased.

Majority of the patients (No- 38) had no radiation of pain; 13 patients complained of pain radiation to right leg; 17 patients to left leg and 22 patients had pain radiating to both legs (Fig 4).

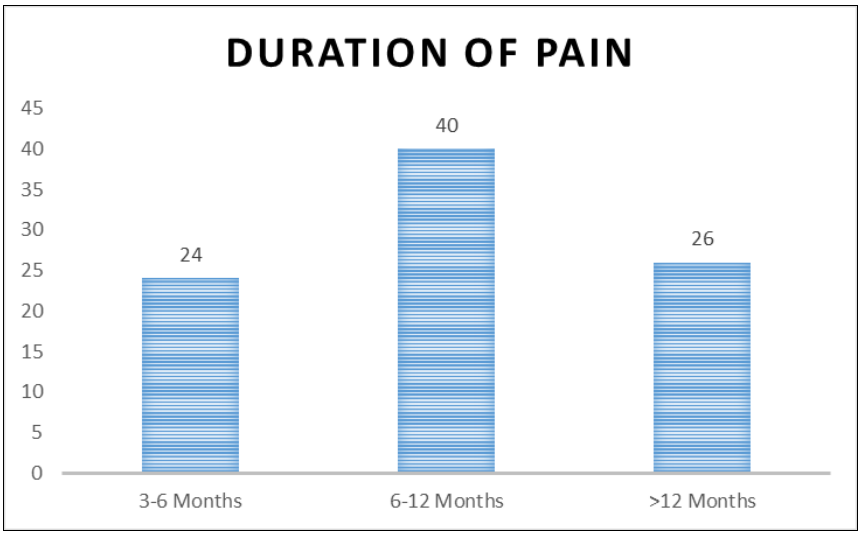

Fig 2: Duration of Pain

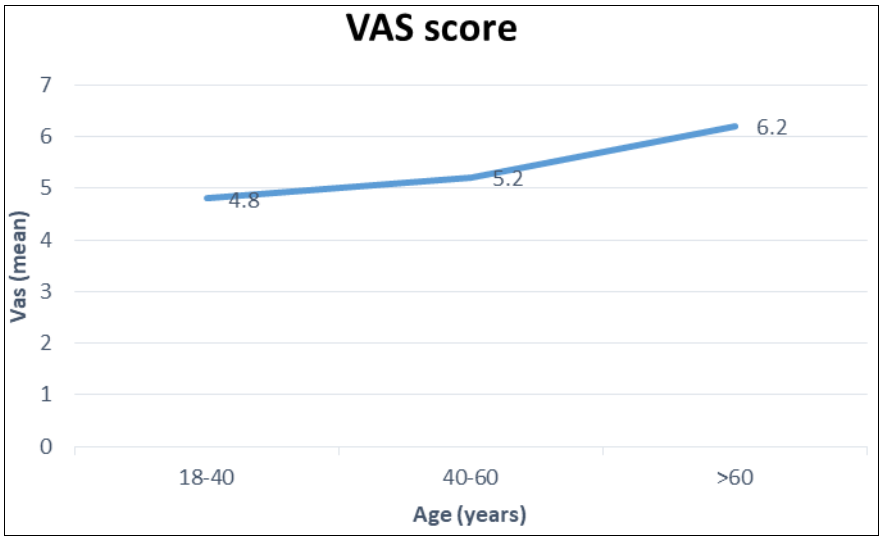

Fig 3: VAS score

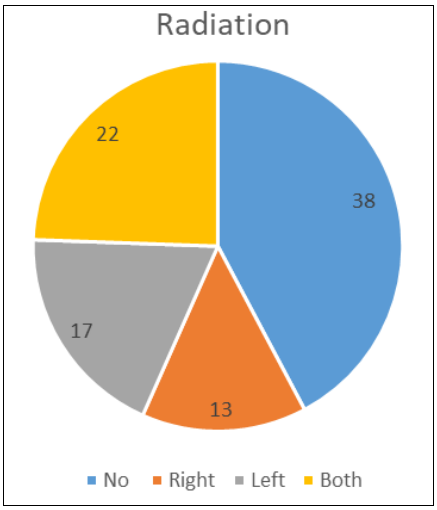

Fig 4: Radiation of Pain

Table 2: Pelvic Incidence

Pelvic Incidence	Mean	SD
Mean PI	**52.53**	**10.85**
Mean PI among Men	51.18	9.64
Mean PI among Women	53.82	11.85
Mean PI among <50 years	51.21	10.36
Mean PI among >50 years	54.58	11.41

Table 3: Pelvic Tilt

Pelvic Tilt	Mean	SD
Mean PT	**17.56**	**7.72**
Mean PT among Men	16.73	6.87
Mean PT among Women	18.35	8.45
Mean PT among <50 years	16.68	7.46
Mean PT among >50 years	18.93	8.02

Table 4: Sacral Slope

Sacral Slope	Mean	SD
Mean SS	**35.08**	**9.17**
Mean SS among Men	34.67	8.91
Mean SS among Women	35.47	9.49
Mean SS among <50 years	34.71	9.45
Mean SS among >50 years	35.65	8.81

Table 5: Lumbar Lordosis

Lumbar Lordosis	Mean	SD
Mean LL	49	3
Mean LL among <50 years	48.4	9.8
Mean LL among >50 years	45.2	10.2

The mean PI among patients in the study were found to be 52.53 (+/- 10.85). The mean PI was found to be higher in women (53.82+/- 11.85) when compared to men (51.18+/- 9.64). Mean PI was also found to be higher in the above 50

years age group (54.58 +/-11.41) (Table 2).
Similarly, the mean PT was 17.56 (+/-7.72) which was also found to be higher in among women (18.35 +/- 8.45) and in the above 50 years age group (18.93 +/- 8.02) (Table 3)
Mean SS was found to be 35.08 (+/- 9.17) and did not show much variation with regard to sex or age (Table 4).
Mean Lumbar Lordosis was 49 (+/- 3). Lumbar lordosis was found to be more in the age group less than 50 years (48.4 +/- 9.8) and less in patients above 50 years (45.2 +/- 10.2) (Table 5)
Among all subjects the PI was found to be positively correlated with SS, PT and LL and the association was found to be statistically highly significant with SS and PT ($p<0.001$) and statistically not significant with LL.
There was found to be negative correlation between SS and PT but not statistically significant. No statistically significant association between LL and other pelvic parameters were found (Table 6).

Table 6: Correlation between Pelvic parameters and Lumbar Lordosis

Correlations					
		PI	**SS**	**PT**	**LL**
PI	Pearson Correlation	1	.696**	.563**	.121
	Sig. (2-tailed)		.0001	.0001	.256
SS	Pearson Correlation	.696**	1	-.195	.088
	Sig. (2-tailed)	.0001		.065	.409
PT	Pearson Correlation	.563**	-.195	1	.058
	Sig. (2-tailed)	.0001	.065		.584
LL	Pearson Correlation	.121	.088	.058	1
	Sig. (2-tailed)	.256	.409	.584	
*Correlation is significant at the 0.01 level (2-tailed).					

Table 7: Correlation between Pelvic parameters and Lumbar Lordosis with Duration of LBA

Correlations						
		Duration of LBA (months)	**PI**	**SS**	**PT**	**LL**
Duration of LBA (months)	Pearson Correlation	1	.111	.083	.050	.193
	Sig.(2-tailed)		.296	.439	.638	.068
	N	90	90	90	90	90
*Correlation is significant at the 0.01 level (2-tailed).						

The spino-pelvic alignment was maintained in patients with low back pain and there was found to be a positive correlation between duration of pain and pelvic incidence but was found to be not significant. There was found to be no statistical relationship between duration of low back ache with other pelvic parameters or lumbar lordosis (Table 7).

4. Discussion

Despite many authors conducting studies on sagittal spinal balance, the relationship between spino pelvic parameters and low back ache is not yet fully understood. The spino pelvic parameters in patients presenting with low back ache in our study were comparable to the normal population as determined by other studies [5-8]. Our study was one of the initial studies done to determine PI and LL parameters in patients with low back ache and may serve as a reference for future studies.
Pelvic incidence was found to have a highly significant correlation with both SS and PT even in patients with LBA; and the PI and LL was also maintained indicating the symbiotic relationship between the lumbar spine and pelvis which is paramount for maintaining body balance. In patients with low back ache it was found that there is decreased SS, increased PT, and decreased LL which was in agreement with other studies [4, 9, 10] but not found to reach statistic significance.
We found that in patients with LBA there was a trend of reducing lumbar lordosis as age increased although it was not found to be significantly associated with other pelvic indices. The type of Lumbar Lordosis as observed by Jackson *et al*. [9], may play a role in determining patients with risk of developing back pain and degenerative disk disease in the future. Roussoully *et al*. [11] who classified Lumbar lordosis into 4 types found that subjects with Type 2 LL (Lordotic level involving more than 3 vertebrae with SS of less than 35 degree) are more prone to develop Back Pain and degenerative disk disease.
All these findings may help us in identifying people who are prone to develop degenerative disk disease in the future and may suffer from chronic low back ache. We may also be able to develop specific remedies and physiotherapies for people prone to develop low back ache. However, more larger and randomized studies need to carried out for definitive conclusions which may help in reducing the burden of low back ache in the population.

5. Conclusion

Low back ache has multifactorial etiology. Differences in sagittal spino-pelvic alignment in patients with low back ache are minor and that clinically, multiple factors contribute to Low Back Ache and lumbar disk degeneration.
Conflicting results between sex and age related changes in pelvic indices; needs further and larger studies in the Indian population. A longitudinal study to assess age related sagittal spine changes is needed which may help in early detection of patients prone to develop back pain.

Conflict of Interest: None

6. References

1. Jacklyn G, Punnett L, Lim S *et al*. The global burden of occupationally related low back pain: estimates from the Global Burden of Disease 2010 study. Ann Rheum Dis. 2014; 73(6):975-981.
2. Schwab F, Klineberg E, Lafage V, Smith JS, Gupta MC, Bess S. Sagittal Spinal Pelvic Alignment. Neurosurg Clin N Am. 2013; 24(2):157-162.
3. Legaye J, Benaim C, Marty C *et al*. Sagittal alignment of spine and pelvis regulated by pelvic incidence: standard values and prediction of lordosis. Eur Spine J. 2005; 15(4):415-422.
4. Barrey C, Jund J, Noseda O, Roussouly P. Sagittal balance of the pelvis-spine complex and lumbar degenerative diseases. A comparative study about 85 cases. Eur Spine J. 2007; 16(9):1459-1467.
5. Kobayashi T, Atsuta Y, Matsuno T, Takeda N. A longitudinal study of congruent sagittal spinal alignment in an adult cohort. Spine (Phila Pa 1976). 2004; 29(6):671-676.
6. Vaz G, Roussouly P, Berthonnaud E, Dimnet J. Sagittal

morphology and equilibrium of pelvis and spine. Eur Spine J. 2002; 11(1):80-87.
7. Asai Y, Tsutsui S, Oka H *et al*. Sagittal spino-pelvic alignment in adults: The Wakayama Spine Study. PLoS One, 2017.
8. Sudhir G, Acharya S, K.l K, Chahal R. Radiographic Analysis of the Sacropelvic Parameters of the Spine and Their Correlation in Normal Asymptomatic Subjects. Glob Spine J. 2015; 6(2):169-175.
9. Jackson RP, McManus AC. Radiographic analysis of sagittal plane alignment and balance in standing volunteers and patients with low back pain matched for age, sex, and size. A prospective controlled clinical study. Spine (Phila Pa 1976). 1994; 19(14):1611-1618.
10. Rajnics P, Templier A, Skalli W, Lavaste F, Illes T. The importance of spinopelvic parameters in patients with lumbar disc lesions. Int Orthop. 2002; 26(2):104-108.
11. Roussouly P, Gollogly S, Berthonnaud E, Dimnet J. Classification of the normal variation in the sagittal alignment of the human lumbar spine and pelvis in the standing position. Spine (Phila Pa 1976). 2005; 30(3):346-353.
12. Gautier J, Morillon P, Marcelli C. Does spinal morphology influence the occurrence of low back pain? A retrospective clinical, anthropometric, and radiological study. Rev Rhum Engl Ed. 1999; 66(1):29-34.
13. During J, Goudfrooij H, Keessen W, Beeker TW, Crowe A. Toward standards for posture. Postural characteristics of the lower back system in normal and pathologic conditions. Spine (Phila Pa). 1976; 10(1):83-87.
14. Tsuji T, Matsuyama Y, Sato K, Hasegawa Y, Yimin Y, Iwata H. Epidemiology of low back pain in the elderly: correlation with lumbar lordosis. J Orthop Sci. 2001; 6(4):307-311.
15. Christie HJ, Kumar S, Warren SA. Postural aberrations in low back pain. Arch Phys Med Rehabil. 1995; 76(3):218-224.