



Original Article

Correlation of pelvic incidence and pelvic parameters in lumbar spondylolisthesis

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ABSTRACT

Background: Pelvic incidence (PI) and pelvic parameters (PP) regulate the sagittal alignment of the spine and the pelvis in normal populations. Correlation of PI even more so than PP with lumbar spondylolisthesis (LS) would be useful for surgical planning.

Methods: This study included 45 patients randomly selected with LS. They were divided into two groups; Group S had LS and Group C had low back pain due to other causes. All patients received lateral standing radiographs of the spine and pelvis. Based on these films, we measured the sacral slope, pelvic tilt, PI, and lumbar lordosis (LL).

Results: There were significant correlations between the PI and the sacral slope, pelvic tilt, and LL in Group S ($P < 0.05$). The majority of patients with LS presented with middle (60%) followed by high PIs (26.67%). Low PI was observed among just 13.33% patients with LS.

Conclusion: Changes in spinopelvic parameters reflecting pelvic compensatory mechanisms differ depending on the extent of PI in patients with LS. In short, higher PI values correlated with more significant degrees of degenerative LS in Group S population.

Keywords: Lumbar lordosis, Lumbar spondylolisthesis, Pelvic incidence, Pelvic parameters

INTRODUCTION

The previous reports demonstrate that the pelvic incidence (PI) determines the sagittal spinal and pelvic alignment in normal populations. Understanding sagittal balance, including spinal alignment and the pelvic orientation, is critical for spine surgeons. Here, we evaluated the role of PI as it related to lumbar spondylolisthesis (LS) in patients under consideration for lumbar surgery.

MATERIALS AND METHODS

Clinical population

We randomly selected 45 patients with LS. Patients were all above 18 years of age and had LS. Those who had prior surgery were excluded from the study. Patients were divided into two groups; Group S (45 patients) had LS, while Group C (45 patients) had low back ache due to other causes. Patients

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Table 1: Clinical parameters.

Age and sex	Number of patients	Percentage
Age group (years)		
≤20 years	01	02.22
21–40 years	10	22.22
41–60 years	21	46.67
>60 years	13	28.89
Sex		
Male	17	37.78
Female	28	62.22
Dysplastic spondylolisthesis	08	17.78
Isthmic spondylolisthesis	11	24.44
Degenerative spondylolisthesis	17	37.78
Traumatic spondylolisthesis	06	13.33
Pathologic spondylolisthesis	03	06.67

Table 2: Pelvic incidence.

PI	No. of patients	Percentage
Low <45	06	13.33
Middle 45–60	27	60.00
High >60	12	26.67
Total	45	100

Table 3: Correlation of PI and PP.

Correlation	Group S (n=45)		Group C (n=45)	
	r	P	r	P
PI-sacral slope	0.541	<0.001	0.872	<0.001
PI-pelvic tilt	0.501	<0.001	0.719	<0.001
PI-LL	0.471	<0.001	0.312	0.021

PI: Pelvic incidence, PP: Pelvic parameters, LL: Lumbar lordosis

were assessed utilizing lateral standing radiographs to determine sacral slope, pelvic tilt lumbar lordosis (LL), and the PI.

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences version 20.0 software. For qualitative data, various rates, ratios, and percentage (%) were calculated. For quantitative data, mean, SD, median, etc., were calculated. A two-tailed test with $P < 0.05$ was considered as statistically significant.

RESULTS

Table 1 shows the age distribution. The table also shows distribution based on etiology. Most patients had degenerative LS (37.78%-17 patients) followed by isthmic spondylolisthesis (24.44%-11 patients). Spondylolisthesis was overwhelmingly present at the L5 level (77.78%) followed by L4 level (15.56%). In addition patients predominantly

Table 4: Liertaure review of pelvic parameters.

Wang <i>et al.</i> (International Journal of Clinical and Experimental medicine-2015 8[12])	Relation between PI and spinopelvic parameters in (DLS)	Changes in spinopelvic parameters differed according to PI in patients with DLS
Bae <i>et al.</i> (The Spine Journal Volume 12 issue 11-2012)	Spinopelvic parameters in LDK	LDK with a low PI strongly correlated with a pronounced kyphosis, LDK with a high PI was associated with a flat or lordotic (TLJ)
Present study	Relation between PI and spinopelvic parameters in LS	Changes in spinopelvic parameters reflect pelvic compensatory mechanisms that differ depending on the extent of PI in patients with LS

DLS: Degenerative lumbar scoliosis, PI: Pelvic incidence, LDK: Lumbar degenerative kyphosis, TLJ: Thoracolumbar junction, LS: Lumbar spondylolisthesis



Figure 1: Lateral x ray of lumbar spine showing a grade 3 spondylolisthesis. Pelvic incidence is measured as 70 degrees.

exhibited Grade 1 (57.78%) followed by Grade II (35.56%) LS. The majority of patients with LS exhibited middle (60%: 27 patients) followed by high PI (26.67%: 12 patients). Low PI was observed among only 13.33% (06) of patients with LS. Table 2 demonstrates the number of patients having high, middle and low PI. For Group S patients, we observed no significant correlation between PI and the sacral slope, degree of pelvic tilt, and extent of LL ($P < 0.05$). The majority of patients were between the ages of 41 and 60 (46.67%), with 28.89% above 60 years of age. Table 3 shows the relation of pelvic incidence with other pelvic parameters. There was a significant correlation between PI and sacral slope, pelvic tilt

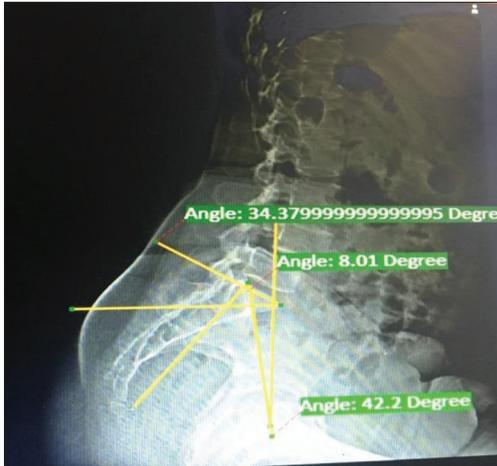


Figure 2: Lateral x ray of lumbar spine showing a grade 1 spondylolisthesis. Pelvic incidence measured as 42 degrees.

and lumbar lordosis in Group S ($p < 0.05$). Table 4 is a review of literature on articles based on pelvic parameters.

Figure 1 is a lateral x ray of lumbar spine with grade 3 spondylolisthesis. Pelvic incidence is measured as 70 degrees.

Figure 2 is a lateral x ray lumbar spine with grade 1 spondylolisthesis. Pelvic incidence measured as 42 degrees.

DISCUSSION

Wang *et al.* identified the influence of PI on spinopelvic parameters in patients with degenerative lumbar scoliosis (DLS).^[2] They found that all DLS patients showed a high PT, low sacral slope (SS), kyphotic TLJ, lumbar hypolordosis and thoracic hypokyphosis. They concluded that the changes in spinopelvic parameters differed according to PI in patients with DLS. They noted that restoration of LL (i.e., based on individual PI) could better “balance” spinopelvic alignment. Bae *et al.* also looked at spinopelvic parameters for patients with lumbar degenerative kyphosis (LDK).^[1] They found LDK with a low PI strongly correlated with a pronounced kyphosis, while LDK with a high PI was associated with a

flat or TLJ. We found that changes in spinopelvic parameters and pelvic compensatory mechanisms differed according to PI in patients with spondylolisthesis. The higher the PI value reflected the various pathogenesis of spondylolisthesis and the higher incidence of degenerative LS among Group S patients. In the asymptomatic participants, a high PI was associated with a long-curved LL and a lower PI correlated with a short flat LL. In conclusion, spinopelvic parameters in LDK differ according to PI and this needs to be taken into consideration before undertaking corrective deformity surgeries. Table 4 is a tabular representation of review of literature.

CONCLUSION

Changes in spinopelvic parameters reflect pelvic compensatory mechanisms that differ depending on the extent of PI in patients with LS.

Declaration of patient consent

Institutional Review Board (IRB) permission obtained for the study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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