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ORIGINAL ARTICLE

The Influence of Lumbosacral Transitional Vertebrae on Lumbar Lordosis and Angle of Pelvic Incidence

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ABSTRACT:

Aim: The purpose of this study is to Examine the Influence of Lumbosacral Transitional Vertebrae on Lumbosacral Lordosis and Angle of Pelvic Incidence. **Methods**: In this Study conducted among the patient having low back ache screened for LSTV using radiographs of Measurements of lumbar lordosis, pelvic tilt, were taken of 100 healthy adults aged 20 to 40 years. This study involved the spinopelvic parameters of those with LSTV were measured using Surgimap software and compared with the parameters of low back ache patients without LSTV. An Independent sample t-test was done and p-values were calculated. **Results:** The results showed that: 1. Pelvic incidence was significantly higher in the group with LSTV (48.5+8.3) when compared to the group without LSTV (40.0+7.8) with a p-value (<0.001). 2. Angle of Pelvic was significantly higher in the group with LSTV (18.4+7.8) when compared to the group without LSTV (12.6+8.8) with a p-value (0.001). 3. Lumbar lordosis was significantly higher in the group with LSTV (58.6+12.2) when compared to the group without LSTV (51.7+11.2) with a p-value (0.006). 4. Sacral slope was (36.2+7.6) in the group with LSTV when compared to the group without LSTV (39.9+7.1) with a p-value (0.155). 5. PI-LL mismatch was (10.3+8.4) in the group with LSTV when compared to the group without LSTV (11.2+8.6) with a p-value (0.111). Both sacral slope and PI-LL mismatch did not show a statistically significant difference between the two groups. **Conclusion:** The spinopelvic parameters are altered the LSTV and spinopelvic parameters predispose to spondylolisthesis, degenerative disc disease, and facet joint arthritis and are important in preoperative planning in spine and pelvic surgeries.

Key words: Lumbar Lordodis , pelvic Angle , lumbosacral,vertebra , LSTV

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INTRODUCTION

Lumbosacral transitional vertebra LSTV is common within the spine, and their association with low back pain has been debated in the literature for nearly a century .this is the congenital anomaly of the lumbosacral junction and is a frequent cause of back pain in young patients with a prevalence of 4.9% to 38% in different regions. LSTVs include sacralization of the lowest lumbar vertebral body and lumbarization of the uppermost sacral segment.[1] These vertebral bodies demonstrate varying morphology, ranging from broadened transverse processes to complete fusion. Low back pain associated with an LSTV may arise from the level above the transition, the contralateral facet when unilateral, and/or the anomalous articulation when present. Although this association is still somewhat controversial, beyond dispute is the importance of identifying an LSTV in patients in whom a surgical or interventional procedure is planned. This is essential to avoid an intervention or surgery at an incorrect level. In this article, each of these issues will be addressed with attention to identifying and correctly numbering LSTVs as well as detecting imaging findings related to the genesis of low back pain.[2,3]A transitional lumbosacral vertebra is first observed by Bertolotti in 1917 . A transitional vertebra may have varying formations, the common feature being an atypical lumbosacral articulation between the transverse processof the most inferior lumbar vertebrae and the sacrum. It is commonly classified based on the type of articulation between the transverse processes and the sacrum.[3,4] According to Castellvi's system (2), Type I is defined as a large transverse process measuring at least 19 mm in width, Type II is an actual diarthrodial joint between the last transverse process and the sacrum, and Type III is a bony union between the last transverse process and the sacrum. This may occur unilaterally or bilaterally . The clinical significance of a transitional vertebra has been frequently debated .Several treatment approaches have been recommended, despite the lack of agreement about the clinical importance of LSTVs. These include radio-frequency ablation and surgical management with partial transverse process resection and/or posterior spinal fusion, as well as conservative nonsurgical management with local injections of anesthetic and corticosteroids within the pseudo articulation or contralateral facet joint.In patients with Bertolotti syndrome for whom surgery is being considered, it is advised that local anesthetic injection be included in the diagnostic workup .[5,6,7] Direct local anesthetic and steroid injection, surgical removal of the aberrant or contralateral facet joint, and other methods have successfully reduced pain while also providing useful diagnostic data.

In certain cases, surgical intervention is advised. For those who exhibit discomfort that is actually coming

from a transitional joint and are unsuccessful with conservative therapy, resection of the transverse process may be useful. An alternative to posterior fusion is if the discomfort originates from a deteriorated disc that is above a level of transition In several case study its documented how resecting the ipsilateral aberrant articulation effectively treated contralateral facetogenic pain. [7,8,9]

MATERIALS AND METHODS

Study population

We compared the lateral radiographs of the lumbosacral spine of two groups to identify the difference in spinopelvic parameters between them. This included 50 low back ache patients with LSTV (cases) and 50 low back ache patients without transitional vertebra (controls) who were selected from among a screening population which included low back pain patients that presented from August 2022 to March 2023 and fulfilled the inclusion criteria.

The inclusion criteria: Patient age between 20-40 years , Patient suffering from chronic low back ache (for more than 5 months).

Exclusion criteria :patients with spine fractures, high grade spondylolisthesis (grade 2 and above), spine tumors, who have undergone spine or hip surgery, those with hip disorders, febrile patients and those with infectious and inflammatory spondylitis were The case group had 30 males and 70 females with a mean age of 35.5 years. The control group had 31 males and 20 females with a mean age of 40 years.

Radiographic protocol

The radiographs of the subjects were obtained and this included:

- Antero-posterior radiographs of the whole spine (stitch views).
- Antero-posterior (Ferguson view) of the lumbar spine
- Lateral view of the lumbosacral spine with both femoral heads in erect standing position.
- This was obtained using GE TEJAS 6000-XR on 14×17 inch cassette with 85-95 kV range and 50-65 mAs depending on the patient were taken for the patients.

Measurements

Identification and classification was done using the antero-posterior and lateral views. Numbering was done using the whole spine radiographs.Radiograph based measurements of the spinopelvic parameters were taken according to the standard criteria (as given in Table 1) for all patients meeting inclusion criteria using SURGIMAP software (v 2.3.2.1). The same observer took all of the measurements. The measurements included pelvic parameters (pelvic incidence, angle of pelvic and sacral slope) and spinal parameters (lumbar lordosis and PI-LL mismatch) as given in Table 1

THE DEFINITION OF PARAMETER

Pelvic Incidence (PI)	The angle formed between a line from the center of the femoral head to the midpoint of the sacral end plate and a line orthogonal to the sacral end plate.
Pelvic Tilt (PT)	The angle formed by a vertical line through the center of the femoral heads and the line from the center of the femoral axis and the midpoint of the sacral end plate.
Lumbar Lordosis (LL)	The sagittal Cobb angle measurement from the superior end plate of L1 to the sacral end plate.
Sacral Slope (SS)	The angle formed between the horizontal and the sacral end plate.
PI-LL mismatch	The difference between PI and LL.

Table 1

Statistical Analysis

Statistical Software SPSS (v 28.0.1.1) IBM Inc. was used to analyze the difference between the spinopelvic parameters of the two groups. Data analysis was done with independent sample t-test. The mean and standard deviation for each of the parameters of the 2 groups were calculated.

Percentages of the numerical values of the nominal variables were calculated. The results from the analysis of the data obtained were reproduced graphically with bar graphs, pie charts and error bars. A *p* value less than 0.08 was considered to be significant.

Among the 51 low back ache patients with lumbosacral transitional vertebrae, 42 (82.3%) had sacralization of the L5 vertebra and 9 (17.6%) were found to have lumbarization of the 1st sacral vertebra (figure 1).

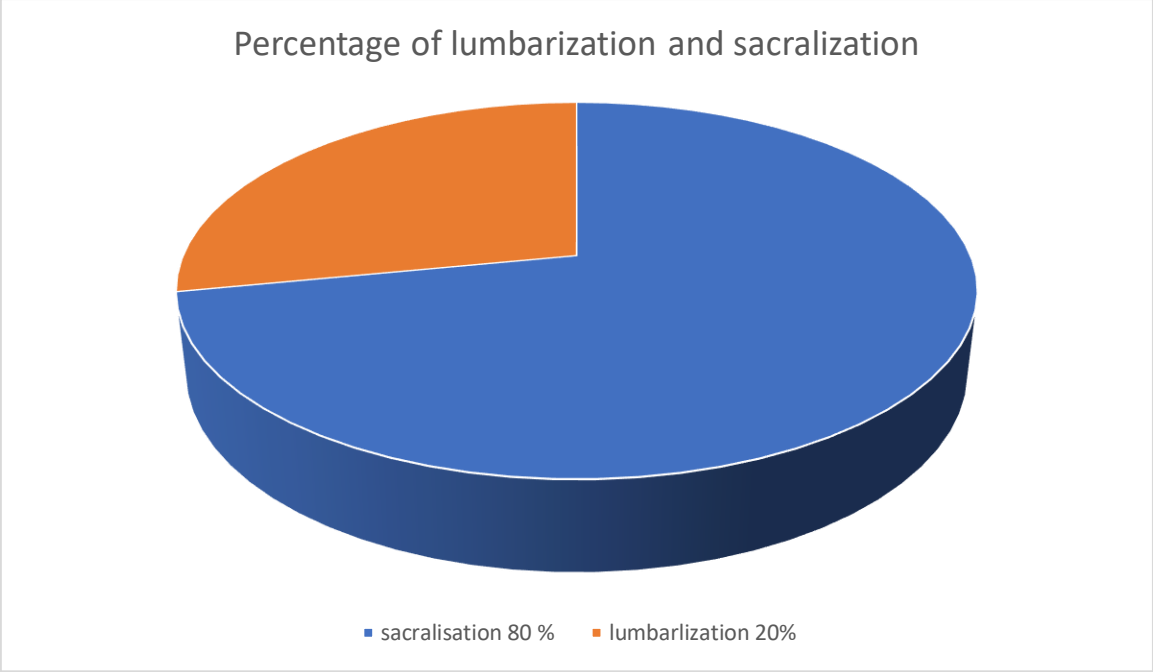

Figure 1

In the study, the radiographs of 100 low back ache patients evaluated were classified as per the Castellvi classification

20 patients were found to have type 1 transitional vertebra (a large transverse process).

- 15 patients belonged to the type 2 category where there is incomplete lumbarization/sacralization, a large transverse process that follows the contour and articulates with the sacrum but is not fused, creating a diarthrodidal joint between the final lumbar vertebra and the first sacral segment.
- Castellvi type 3 had 20 patients among the total 86 where there is complete lumbarization/sacralization - a large transverse process with bony fusion to the sacrum.
- 31 patients belonged to the type 4 category where there is lumbarization/sacralization, incomplete (type II) on one side and complete (type III) on the contralateral side.

From earlier studies, it has been shown that sum of the positional parameters Pelvic tilt (PT) and sacral slope (SS) is roughly equal to pelvic incidence (PI) {PI=PT+SS}. The values in this study satisfy the above equation. To assess the validity of the data obtained, the 2 sets of parameters were compared using independent t-test. Table 2 shows the parameters measured.

Mean and standard deviations of age and spinopelvic parameters of the two groups of patients in the study

	Lumbosacral Transitional Vertebra Absent		**Lumbosacral Transitional Vertebra Present**		***P*-value**
	Mean	**SD**	**Mean**	**SD**	
Age	35.5	13.0	35.5	12.2	0.511
Pelvic Incidence	40.0	7.8	48.5	8.3	<0.001
Angle of Pelvic	12.6	8.8	18.4	7.8	0.001
Sacral Slope	39.9	7.1	36.2	7.6	0.155
Lumbar Lordosis	51.7	11.2	58.6	12.2	0.006
PI-LL	11.2	8.6	10.3	8.4	0.111

Table 2

The results showed that: 1. Pelvic incidence was significantly higher in the group with LSTV (48.5+8.3) when compared to the group without LSTV (40.0+7.8) with a *p*-value (<0.001). 2. Angle of Pelvic was significantly higher in the group with LSTV (18.4+7.8) when compared to the group without LSTV (12.6+8.8) with a *p*-value (0.001). 3. Lumbar lordosis was significantly higher in the group with LSTV (58.6+12.2) when compared to the group without LSTV (51.7+11.2) with a *p*-value (0.006). 4. Sacral slope was (36.2+7.6) in the group with LSTV when compared to the group without LSTV (39.9+7.1) with a *p*-value (0.155). 5. PI-LL mismatchwas (10.3+8.4) in the group with LSTV when compared to the group without LSTV (11.2+8.6) with a *p*-value (0.111). Both sacral slope and PI-LL mismatch did not show a statistically significant difference between the two groups.

DISCUSSION

The primary change in human evolution may be seen in the acquisition of a vertical posture. The evolution of vertical posture and bipedalism was significantly influenced by the spine and spinopelvic complex and Angle of PelvicIt is well recognized that spinal sagittal balance and functional spinopelvic parameters are decisive elements in describing spinal alignment .[10,11] Spinopelvic characteristics offer insight into the pathophysiological underpinnings of lumbar spinal illnesses by assisting in the understanding of the transmission of biomechanical stress across the lumbosacral junction.This study was conducted in a limited population that presented to the Hospital OPD to The study the Influence of Lumbosacral Transitional Vertebrae on Lumbar Lordosis and Angle of Pelvic Incidence**.**The spinopelvic parameters in patients with lumbosacral transitional vertebra with patients without a transitional vertebra.study found a higher prevalence of lumbarized sacral segments (80%) than sacralized lumbar segments (20%) . The significance of these parameters stems from the fact that spinal surgery aims to restore sagittal alignment by taking into account the pelvic morphology and sagittal spinal profile Following spine surgery for various disease conditions, the improvement of pain and function is directly correlated with the restoration of the sagittal profile However, it has been noted that the spinal profile, and therefore the functional spinopelvic characteristics, are very changeable and subject to both short-term changes brought on by daily activities and long-term changes brought on by degeneration .The degree of lumbar lordosis and the posture-dependent pelvic parameters sacral slope and angle of pelvic . This led to the conclusion that patients with a greater pelvic incidence appeared to be at an increased risk of presenting with a spondylolisthesis and that a higher PI may be a significant risk factor for progression in developmental spondylolisthesis.Low back pain has been linked to the sagittal curvature of the spine, and PI has been found to be correlated with spondylarthrosis.The results from this study showed that the angle of pelvic and lumbar lordosis was significantly higher in the group with LSTV.[11,12]

Surgeons must be aware that the position of the acetabulum changes and depends on the position of the patient while planning a complete hip replacement. The positioning of the acetabulum should be adjusted to accommodate both supine and standing position, which differs slightly from a sitting one as well.[13,14] to the LSTV's strong influence on pelvic morphology and spinopelvic characteristics, the accurate identification of the LSTV as well as the appropriate selection of measurement points are of major clinical value.

CONCLUSION

In this study, it was found that:

- Pelvic incidence, Angle of pelvic and lumbar lordosis were higher in the group with LSTV. These differences were statistically significant.
- Sacral slope and pelvic Incidence -Lumbar Lordosis mismatch did not show a statistically significant difference on comparison between the two groups.
- It is hence essential to identify the patients with transitional vertebra and to identify their spinopelvic parameters.

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