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Relation of low back pain with lumbosacral transitional vertebrae in Eastern Indian population

Dona Saha[1], Asutosh Pramanik[2], Gopal Chandra Mondal[3], Suchismita Ghosh[4], Madhushree Pal[5], Falguni Mondal[6]

[1]Associate Professor, [2,5]Assistant Professor, [3]Professor, [4]Senior Resident, Department of Anatomy, Barasat Government Medical College and Hospital, Kolkata, [6]Sister Tutor, Department of Psychiatry, Nursing Training School, Murshidabad Medical College, Berhampore, West Bengal, India

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ABSTRACT

Background: Lumbosacral transitional vertebrae (LSTV) or lumbarization of sacral vertebrae and sacralization of lumbar vertebrae are congenital variations. These are associated with alterations in anatomy and biomechanics of spinal and paraspinal structures, which lead to low back pain (LBP). **Aims and Objectives:** This radiological study was designed to identify the prevalence of LSTV in patients presenting with LBP and to classify the anatomical variations in LSTV according to the Castellvi classification. **Materials and Methods:** This hospital-based, cross-sectional, observational cohort study was conducted in the Department of Radiodiagnosis, in different medical colleges and hospitals of West Bengal. The study was done on 1500 patients aged 20–75 years with a history of LBP. Antero-posterior and lateral lumbosacral radiographs were done to identify LSTV. **Results:** The present study in West Bengal shows that 24.1% of subjects had LSTV among LBP patients, Castellvi Type IIA (33.4%) being the most common anatomical variant, followed by Type IB (19.6%). Sacralization (22.3%) was found more common than lumbarization (1.8%). **Conclusion:** LSTV comprises almost one-fourth of cases of low back ache which can be easily diagnosed by simple radiograph. It has important implications for surgery in the lumbosacral region.

Key words: Lumbosacral transitional vertebrae; Lumbarization; Sacralization; Bertolotti syndrome; Low back pain; Radiograph

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INTRODUCTION

Low back pain (LBP) is a considerable health problem which causes loss of productivity and leads to a huge patient load in pain and orthopedic clinics. The lumbosacral spine protects the spinal cord and spinal nerves and also supports and transmits body weight to the inferior extremity; thus, it plays an important role in posture. The lumbosacral region is a critical area in the spinal column subjected to forces greater than other weight-bearing areas in the body with an acute change in the direction of transmission of forces at this level.[1] By development, the sacrum may contain six vertebrae by incorporation of the fifth lumbar vertebrae or it may contain four vertebrae by separation of the first sacral vertebrae. The inclusion of the fifth lumbar vertebrae in the sacrum is known as "sacralization," and the separation of the first sacral vertebra from the sacrum is known as "lumbarization." Lumbarization and sacralization of the lumbosacral region are termed as lumbosacral transitional vertebrae (LSTV).[2] LSTV as a morphological variation shows a spectrum of partial-to-complete lumbarization or sacralization. The prevalence of LSTV varies from 4.6% to 37% in different regions.[3]

The late Professor Paterson, of Liverpool University, published a monograph in 1893, on the sacrum, in which he figures two unilateral and three bilateral cases

Address for Correspondence:
Dr. Madhushree Pal, Amrapali Dhir, Flat 2B, 2nd Floor, 399, Kalikapur Road, Kolkata 700 019, West Bengal, India. **Mobile:** 9123893509.
E-mail: palmadhushree8845@gmail.com

of sacralization and one embryo of 7 months with the unilateral condition.[4] In 1979, Bertolotti was the first to describe an association between LSTV and LBP due to arthritic changes occurring at the site of pseudoarthrosis. Hence, when the chronic persistent LBP is due to LSTV, it is termed as Bertolotti syndrome.[5] The transitional lumbosacral osseous complex is stressed due to repetitive flexion and extension, which is delineated by the superior disc space above the vertebra and inferiorly by the sacroiliac joint. Stress is greatest at the superior disc space and the articulation between the transitional transverse process and sacrum.[3] Spondylolisthesis is a complication documented arising as a result of sacralization.[6]

Among various classifications of LSTV, Castellvi classified LSTV into four types based on the type of articulation between the transverse processes and the sacrum. Type I comprises unilateral (Ia) or bilateral (Ib) dysplastic transverse processes, measuring a minimum of 19 mm in width. Type II includes incomplete unilateral (IIa) or bilateral (IIb) lumbarization/sacralization with an enlarged transverse process having a pseudo articulation between it and the sacrum. Type III LSTV exhibits unilateral (IIIa) or bilateral (IIIb) lumbarization/sacralization having complete osseous fusion of the transverse processes to the sacrum. Type IV includes a unilateral type II articulation and a type III on the contralateral side.[7]

Cases of families with increased incidence of LSTV suggest a genetic component. HOX10/HOX11 genes influence the axial pattern of lumbar and sacral vertebrae. Mutations in these genes may play a role in the formation of LSTV.[8]

The objective of the present study was to find the prevalence of LSTV among the LBP patients in the West Bengal population and to classify it radiologically for the facilitation of easier detection by pain physicians and orthopedic surgeons on an outpatient basis.

MATERIALS AND METHODS

This was a hospital-based, cross-sectional, observational cohort study conducted in the Department of Radiodiagnosis of different medical colleges and hospitals of West Bengal during June 2023–May 2024. Written consent was taken from every patient included in this study. The study was pre-approved by the Institutional Ethics Committee (No-BSMC/IEC/2328 dated May 31, 2023) for final permission.

Antero-posterior and lateral lumbosacral radiographs of 1500 patients (714 male and 786 female) aged 20–75 years with a history of LBP were obtained. LSTVs were identified and classified based on the Castellvi classification. Patients with a prior history of significant trauma to the lumbosacral region or any spinal tumors, infections, or metabolic bone disorders or who had undergone any spinal surgeries were excluded from the study. The data were tabulated and analyzed.

RESULTS

One thousand and five hundred patients, 714 male and 786 female, of the age 20–75 years were identified as eligible for the study. Of these patients, 362 were classified as positive for transitional lumbosacral vertebra, with a gender distribution of 195 (27.3%) males and 167 (21.2%) females. These numbers resulted in an incidence of 24.1% LSTV and a ratio of 1:3.1. It approximated one case of LSTV to every three patients with normal spines presented with LBP. Of the total 714 males seen, 195 (27.3%) had LSTV and 519 (72.7%) had normal spines. Of the 786 females seen, 167 (21.2%) had LSTV and 619 (78.8%) had normal spines (Table 1).

Of the total number of patients (1500) seen, sacralization (335 patients, 22.3%) was more common than lumbarization (27 patients, 1.8%).

According to Castellvi classification, the most common anatomical variant was Type IIA (33.4%), followed by Type IB (19.6%), Type IIIB (17.1%), Type IIB (13.3%), Type IIIA (9.4%), Type IA (4.7%), and Type IV (2.5%) (Table 2 and Figure 1).

DISCUSSION

The prevalence of LSTV varies with the regions. The present study in West Bengal showed 24.1% had LSTV with 27.3% male and 21.2% female patients. The prevalence is close to the study of Daniel et al., who showed the prevalence of LSTV of 22% in the Punjabi population,[9] and Reddy and Madumdar who found 26.8% LSTV with 23.6% male and 28.4% female patients in Kerala population.[10] Nardo et al. found a much lower prevalence (18.1%) of LSTV with 28.1% male and 11.1% female cases.[11]

In the present study, 22.3% of cases were reported with sacralization and only 1.8% with lumbarization, which is close to the finding of Reddy and Madumdar being 23.6% sacralization and 3.2% lumbarization cases.[11] Daniel et al. found all cases (22%) were of sacralization.[9] The prevalence of LSTV was 24.3% and sacralization (20.9%) was approximately 6 times more frequent than lumbarization (3.3%) in the study of Gopalan and Yerramshetty.[12]

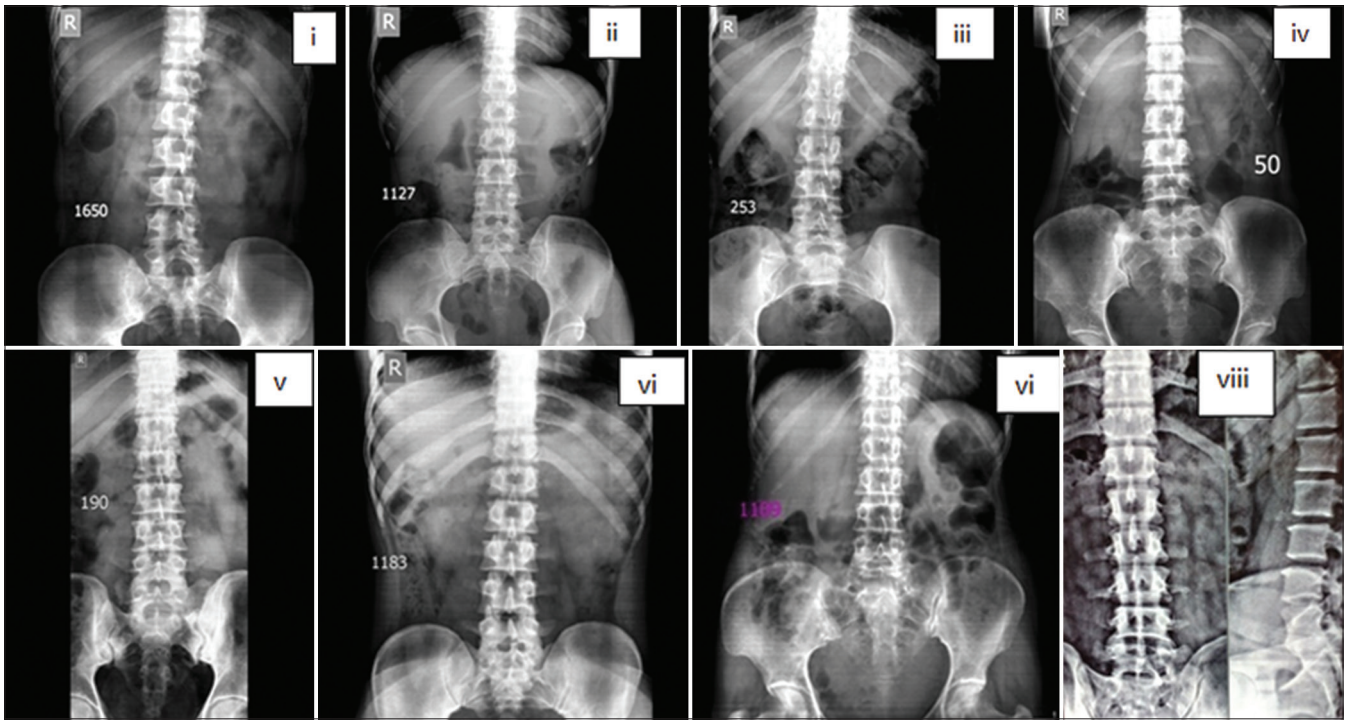

Figure 1: Appearances of lumbosacral transitional vertebrae based on Castellvi et al. (i) Type IA with right-sided enlarged and dysplasic L5 transverse process. (ii) Type IB with bilateral enlarged and dysplasic L5 transverse process. (iii) Type IIA with right-sided pseudoarthrosis. (iv) Type IIB with bilateral pseudoarthrosis. (v) Type IIIA with left-sided fusion of the enlarged transverse process to the sacral ala. (vi) Type IIIB with bilateral fusion. (vii) Type IV appears with fusion on the right side and pseudarthrosis on the left. (viii) Unilateral partial lumbarization

Table 1: Gender distribution (n=1500)

Sex	Sample size	LSTV patients
Male	714	195 (27.3%)
Female	786	167 (21.2%)
Total	1500	362 (24.1%)
		(sacralization - 335, Lumbarization - 27)

LSTV: Lumbosacral transitional vertebrae

Table 2: Case distribution according to Castellvi classification (n=362)

Castellvi types	Number of patients (%)
IA	17 (4.7)
IB	71 (19.6)
IIA	121 (33.4)
IIB	48 (13.3)
IIIA	34 (9.4)
IIIB	62 (17.1)
IV	9 (2.5)
Total	362 (100)

According to Castellvi classification, there was a maximum number of patients with Type II LSTV (46.7%); Type IIA (33.4%) was the most common anatomical variant, followed by Type IB (19.6%) in the present study. This finding corroborates with the study of Daniel et al., where they found a maximum number of patients with Type II LSTV (45%) and Type IIA (31.9%) was the most common type of LSTV.[9] Nardo et al. determined almost equal prevalence of Type I (41.7%) and Type II (41.4%) LSTV.[11] Reddy and Madumdar[10] observed Type IA (7.6%) as the most common type of LSTV. Among LSTV patients, 13% are asymptomatic, but Bertolotti syndrome is diagnosed in only 4–8% of patients with LBP.[13]

The partial or complete fusion at the lower part of the lumbosacral transition makes alterations in normal biomechanics at the levels immediately above and below the LSTV. Bertolotti syndrome can occur due to a narrow lumbosacral intervertebral disc or the presence of disc herniation or slippage in spondylolytic spondylolisthesis.[14] Variations in spinal anatomy may lead to surgical errors.

The intercrestal line generally corresponds with the level L4/L5 and is used as a landmark for needle insertion for spinal anesthesia. LSTV also affects the position of the intercrestal line and the location of the conus medullaris. This finding may help clinicians identify the neurological discrepancies observed among neurologic injuries at the thoracolumbar junction.[15]

Hence, it is very important to accurately identify and number the affected segment, which in turn will help to avoid dreaded complications such as wrong-level spine surgery.

Limitations of the study

Flexion-extension radiograph/computed tomography (CT) scan/magnetic resonance imaging (MRI) was not done in

our study which is superior to exclude other causes of LBP in association with LSTV. Segmental instability is better demonstrated in flexion-extension radiographs. Bony canal stenosis is best picked up by CT where MRI is the best to exclude marrow changes, disc, and soft tissue pathology as cause of LBP.

CONCLUSION

LSTV affects almost one-fourth of the LBP patients in the West Bengal population. Castellvi's Type IIA was the most common in this study. Knowledge of LSTV is very crucial to orthopedic surgeons, radiologists, clinical anatomists, forensic experts, and morphologists. Hence, these variations must be kept in mind during the planning of spinal surgery and for the treatment of chronic LBP.

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Authors' Contributions:
DS- Idea, content, writing, and photography; **AP**- Content, photography, and references collection; **GCM**- Response evaluation and data analysis; **SG**- Photography and reference collection; **MP**- Editing, photography, and communication; **FM**- Reference collection.

Work attributed to:
Barasat Government Medical College and Hospital, Kolkata - 700 124, West Bengal, India.

Orcid ID:
Dr. Dona Saha - https://orcid.org/0000-0003-4707-6160
Dr. Asutosh Pramanik - https://orcid.org/0009-0001-4728-5993
Dr. Gopal Chandra Mondal - https://orcid.org/0009-0004-8219-604X
Dr. Suchismita Ghosh - https://orcid.org/0009-0001-3352-608X
Dr. Madhushree Pal - https://orcid.org/0009-0009-3312-4273
Dr. Falguni Mondal - https://orcid.org/0009-0008-4357-1846

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