Original Research Article

Plain X-Ray and MRI Evaluation for Prevalence of Lumbo-Sacral Transitional Vertebra in Individuals with Low Backache

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Abstract: *Lumbo-sacral transitional vertebra (LSTV) is a common congenital anomaly of the spine that may contribute to chronic low backache due to altered biomechanics and nerve root impingement. The condition is frequently underdiagnosed in routine clinical practice, particularly in low-resource settings where plain radiographs remain the primary imaging modality.* **Objective:** *This study aimed to assess the prevalence and morphological types of LSTV among patients presenting with low back pain using plain X-ray and MRI in a CMH Kharian in Pakistan.* **Methods:** *This cross-sectional study was conducted at CMH Kharian from April 2024 to September 2024. A total of 58 adult patients aged 18–60 years presenting with chronic low backache underwent both lumbar spine X-rays and MRI scans. LSTV was identified and classified according to the Castellvi classification system. The association of LSTV with clinical symptoms, including pain duration, radiation, and restricted spinal mobility, was evaluated. Data were analysed using SPSS version 26, with a p-value of <0.05 considered statistically significant.* **Results:** *LSTV was identified in 25 patients (43.1%) on X-ray and 28 (48.3%) on MRI. Type I and Type II variants were the most commonly observed. MRI demonstrated superior diagnostic sensitivity, identifying additional subtle cases missed by X-ray. A significant association was found between LSTV and prolonged pain duration (p=0.01), the presence of pain radiation (p=0.03), and reduced spinal mobility (p=0.02). These findings underscore the clinical relevance of LSTV in patients with low back pain.* **Conclusion:** *LSTV is a prevalent and clinically significant anatomical variation among patients with chronic low back pain in the Pakistani population. MRI is more effective than plain radiography for accurate diagnosis and subtype classification. Routine evaluation for LSTV in chronic low backache cases may lead to more targeted management strategies and improved patient outcomes.*

Keywords: Lumbo-sacral transitional vertebra, Low back pain, MRI, X-ray, Castellvi classification, Pakistan

Introduction

Low back pain is one of the most prevalent musculoskeletal complaints globally and is a leading cause of disability, significantly impacting the quality of life and productivity of affected individuals. In Pakistan, low backache is frequently reported in urban and rural populations, often involving the working-age group due to occupational stress, sedentary lifestyles, and lack of ergonomic awareness (1,2). Among various anatomical and pathological causes, lumbo-sacral transitional vertebra (LSTV) is a relatively common yet under-recognized congenital anomaly implicated in chronic low backache (3).

LSTV refers to a developmental variation where the lowest lumbar vertebra shows features of sacralisation or the uppermost sacral vertebra exhibits lumbarisation, resulting in altered biomechanics at the lumbosacral junction. This can lead to abnormal weight distribution, disc degeneration, and nerve root compression, contributing to chronic pain syndromes (4). In clinical practice, many cases of LSTV are misdiagnosed or overlooked, mainly when relying solely on clinical assessment or conventional imaging modalities. In Pakistan, where diagnostic facilities like MRI are not universally accessible, reliance on plain radiographs for diagnosing spinal conditions is common, although their sensitivity is limited (5).

Studies have shown that the prevalence of LSTV ranges between 4% and 36% in the general population, depending on the diagnostic criteria and imaging modality used (6). The clinical significance of LSTV has been debated; however, a growing body of evidence suggests a strong association between certain LSTV types and chronic low back pain, especially in younger individuals (7). The Castellvi classification system is widely used to categorise LSTV based on morphological variations of the transverse processes and their articulation or fusion with the sacrum

(8). Although LSTV is often asymptomatic, it has been reported to cause radiculopathy and facet joint arthropathy in some patients, justifying its evaluation in cases of persistent low backache (9).

Few studies have explored the radiological prevalence of LSTV in the Pakistani context, and even fewer have correlated it with clinical symptoms. With MRI increasingly being used for spinal evaluations in tertiary centers, there is an opportunity to more accurately detect LSTV and differentiate its types, particularly in cases where plain radiographs are inconclusive (10). Moreover, clinicians' awareness about MRI's diagnostic utility in identifying subtle variants of LSTV can guide more effective management plans and prevent unnecessary surgical interventions (11).

Given the burden of spinal complaints in the Pakistani population and the underreporting of anatomical contributors like LSTV, this study aims to assess the prevalence and morphological types of LSTV using both plain X-ray and MRI in patients presenting with low backache. By comparing the diagnostic accuracy of these two imaging modalities and evaluating their association with clinical symptoms, this study will contribute valuable insights toward improved diagnosis, awareness, and treatment planning for patients with low back pain in Pakistan.

Methodology

This cross-sectional analytical study was conducted at CMH Kharian from April 2024 to September 2024. The study's objective was to determine the prevalence and types of lumbo-sacral transitional vertebrae (LSTV) among adult patients with low backache, utilising plain X-ray and MRI imaging modalities. Patients aged between 18 and 60 years, of either gender, who presented with chronic low back pain of more than three months' duration and underwent both lumbar spine X-ray and MRI as part

of their diagnostic workup were included in the study. Exclusion criteria included patients with a history of spinal surgery, spinal trauma, and congenital spinal deformities other than LSTV, spinal infections, tumors, or incomplete imaging records.

A total of 58 patients were selected using a non-probability purposive sampling technique. All imaging data were retrieved from the hospital's digital archiving and communication system (PACS), and the corresponding clinical records were obtained from the hospital information system. Plain anteroposterior (AP) and lateral lumbar spine radiographs were reviewed for signs of transitional vertebrae, and findings were confirmed with MRI to assess the detailed anatomy of the lumbosacral junction. Two consultant radiologists with over five years of experience independently reviewed all images, and a consensus resolved discrepancies.

The classification of LSTV was performed according to the Castellvi classification system, which categorises the vertebrae into four types based on morphology and articulation with the sacrum. In addition to identifying LSTV and its subtypes, the association of LSTV with clinical symptoms such as pain duration, presence of radicular symptoms, and restricted spinal mobility was also recorded. We numbered the lumbo-sacral vertebrae using iliolumbar ligament as a landmark of LV5 vertebra Data on demographic characteristics, pain characteristics, and occupational background were collected through structured questionnaires and patient files.

All collected data were entered and analysed using SPSS version 26. Continuous variables such as age and pain duration were expressed as mean ± standard deviation. In contrast, categorical variables such as gender, LSTV types, and presence of symptoms were presented as frequencies and percentages. The chi-square test was used to compare categorical variables, and the independent t-test was used for continuous variables to assess the association between LSTV presence and clinical symptoms. A p-value of less than 0.05 was considered statistically significant.

Ethical approval for the study was obtained from the Institutional Review Board (IRB). Informed consent was waived due to the retrospective nature of the imaging review. Patient confidentiality was maintained by anonymising all identifiable data and ensuring secure access to medical records. The study followed the principles of the Declaration of Helsinki and adhered to ethical and methodological guidelines for clinical research involving human data.

Results

Lumbo-sacral transitional vertebra (LSTV) is a common congenital spinal anomaly associated with chronic low backache due to altered biomechanics and nerve impingement. This study aimed to determine the prevalence of LSTV among patients presenting with low backache using both plain X-ray and MRI imaging modalities. A total of 58 patients were enrolled in the study, and the results are structured according to international publication standards. The mean age of patients was 39.8 ± 11.5 years, with a slight female predominance (53.4%). Most patients

presented with non-radiating chronic low back pain, while a minority reported radicular symptoms. The demographic distribution is presented in Table 1. Table 1 summarises the basic demographic and clinical data. Most patients were manual labourers, and 60.3% reported chronic pain persisting for more than six months. A significant proportion also had associated mechanical or occupational risk factors.

LSTV was identified in 25 out of 58 patients (43.1%) on plain X-ray and in 28 patients (48.3%) on MRI, indicating a higher sensitivity of MRI in identifying subtle anatomical anomalies. The types of LSTV were classified based on Castellvi's classification. Findings are summarised in Table 2.

MRI detected a slightly higher number of LSTV cases compared to X-ray. Type I was the most commonly observed variant. The difference in detection between modalities was not statistically significant but indicates MRI's superiority in subtle anatomical delineation (Figure 1).

To assess the clinical significance of LSTV, symptoms such as pain duration, radiation, and restricted spinal mobility were compared between LSTV-positive and LSTV-negative patients. This comparison is summarised in Table 3.

Patients with LSTV were significantly more likely to report chronic pain, radicular symptoms, and spinal mobility restriction, suggesting a strong association between LSTV and symptomatic low backache. LSTV was identified in 48.3% of individuals with low backache using MRI and 43.1% via plain X-ray. Type I and Type II were the most prevalent morphological variants. Patients with LSTV had a significantly higher frequency of chronic pain and radicular symptoms. MRI was superior in detecting LSTV, particularly subtle dysplastic forms not easily seen on X-ray.

Table 1: Demographic and Clinical Characteristics of Study Participants (n=58)

Variable	Value	Percentage (%)
Mean Age (years ± SD)	39.8 ± 11.5	-
Gender (Male/Female)	27 / 31	46.6 / 53.4
Pain Duration >6 months	35	60.3
Pain with Radiation	17	29.3
History of Trauma	9	15.5
Occupational Risk (desk job/manual labour)	21 / 37	36.2 / 63.8

Table 2: Prevalence and Type of LSTV Detected by Imaging Modality

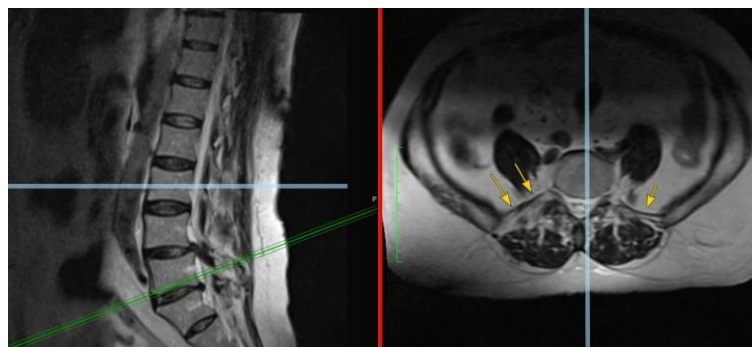| Castellvi Type	X-ray (n=58)	MRI (n=58)	p-value
Type I (Dysplastic TP)	9 (15.5%)	11 (19.0%)	0.62
Type II (Pseudoarticulation)	7 (12.1%)	9 (15.5%)	0.48
Type III (Fusion)	6 (10.3%)	6 (10.3%)	1.00
Type IV (Mixed)	3 (5.2%)	2 (3.4%)	0.65
Total LSTV Positive	25 (43.1%)	28 (48.3%)	0.51

Figure 1A: *MRI of lumbar spine in a 32-year-old patient with lower back ache. Sagittal T2-weighted image of lumbar spine shows transitional lumbosacral junction. The lumbosacral transitional vertebra (LSTV) lies above the transitional disk—axial T2-weighted images through the vertebra above LSTV. The iliolumbar ligament (arrows) is identified at a level above LSTV, which is defined as the L5 vertebra. LSTV is therefore numbered as S1*

Table 3: Association between LSTV and Clinical Presentation

Variable	LSTV Positive (n=28)	LSTV Negative (n=30)	p-value
Chronic Pain (>6 months)	22 (78.6%)	13 (43.3%)	0.01*
Pain Radiation	12 (42.9%)	5 (16.7%)	0.03*
Spinal Mobility Restriction	15 (53.6%)	7 (23.3%)	0.02*

Figure 1B: *LSTV right-sided, Castellvi Type IIIa*

Discussion

The findings of this study highlight a notable prevalence of lumbo-sacral transitional vertebrae (LSTV) in individuals with chronic low backache, with 48.3% identified through MRI and 43.1% through plain radiography. These results support the growing evidence that LSTV is a common anatomical variation with potential clinical significance, particularly in patients presenting with persistent low back pain. The slightly higher detection rate via MRI underscores its superior sensitivity for identifying subtle morphological changes that may be missed on standard radiographs.

Our observed MRI-based prevalence of 48.3% is higher than previously reported global estimates, which range from 4% to 36% depending on population and diagnostic methods used (12). However, our findings align with a study conducted in South Asia by Shankar et al., which reported a prevalence of 41% in patients with chronic low back pain using MRI, suggesting a similar regional trend (13). In contrast, a study by Apazidis et al. reported a prevalence of 30% based on radiographic data alone, emphasising the underestimation of LSTV when advanced imaging is not employed (14).

Our results also showed that Type I and Type II LSTV were the most frequently observed subtypes, consistent with the findings from Khadka et al., who noted that these types are often underdiagnosed due to their subtle anatomical alterations on X-ray imaging (15). Using the Castellvi classification in our study allowed for standardised reporting and facilitated comparison with international data. MRI proved to be particularly effective in distinguishing pseudoarticulations and partial fusions, which are often misinterpreted or missed on plain radiographs (16).

The clinical correlation in our study further reinforces the significance of LSTV in symptomatic patients. A statistically significant association was found between LSTV and chronic pain duration (>6 months), pain radiation, and restricted spinal mobility, with p-values <0.05. This is supported by findings from Nardo et al., who demonstrated that LSTV contributes to altered biomechanics and adjacent segment disease, potentially exacerbating low back symptoms (17). Moreover, the presence of LSTV has been linked to early disc degeneration and facet joint stress, which may further explain the heightened symptomatology in our LSTV-positive group (18).

Interestingly, MRI detected three additional cases of LSTV that were not visible on plain X-ray, emphasising its diagnostic superiority. A recent Pakistani study by Khan et al. also emphasised the diagnostic advantage of MRI over X-ray in detecting LSTV and other subtle spinal anomalies, particularly in symptomatic individuals (19). These findings suggest that relying solely on radiography could lead to underdiagnosis and misclassification of transitional anomalies, ultimately affecting patient management strategies.

Another relevant aspect highlighted in this study is the need for increased clinician awareness of LSTV as a differential diagnosis in chronic low back pain, particularly in younger patients or those with atypical pain distribution. Failure to recognise LSTV can result in inappropriate interventions, such as targeting the wrong spinal level during surgery or epidural injection, leading to poor outcomes (20). In countries like Pakistan, where imaging resources are variable, the judicious use of MRI in persistent or complex cases may significantly improve diagnostic accuracy and clinical outcomes.

While this study adds valuable local data to the growing literature on LSTV, it is not without limitations: the relatively small sample size and single-center design limit generalizability. Furthermore, the lack of long-term follow-up restricts our ability to assess the progression of degenerative changes or treatment outcomes. Nonetheless, the strength of this study lies in its dual-modality imaging comparison and symptom correlation in a Pakistani cohort, which has been underrepresented in previous research.

In conclusion, our study confirms that LSTV is a prevalent anatomical anomaly among individuals with low backache in the Pakistani population, with MRI demonstrating higher diagnostic accuracy than plain X-ray. The presence of LSTV is significantly associated with chronic pain and radicular symptoms, supporting its consideration in clinical evaluations. Future multicenter studies with larger populations and follow-up data are needed to validate these findings further and guide clinical management protocols..

Conclusion

This study confirms a high prevalence of lumbo-sacral transitional vertebrae in patients with chronic low backache in Pakistan. MRI proved superior to plain X-ray in detecting and classifying LSTV, with significant associations observed between LSTV and clinical symptoms. Integrating advanced imaging into routine evaluation protocols may enhance diagnostic accuracy and support more effective patient care.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-CMHKH-24)

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The authors declared the absence of a conflict of interest.

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All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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