ORIGINAL ARTICLE

Prevalence of Lumbosacral Transitional Vertebrae among Patients Presenting with Low Back Pain at a Tertiary Care Hospital

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Abstract

Introduction: Low back pain (LBP) is a widespread health issue affecting millions globally and is projected to increase due to population growth and ageing. Lumbosacral transitional vertebra (LSTV) is a congenital anomaly implicated in spinal pathology and pain, yet its clinical significance remains debated. This study aims to determine the prevalence of LSTV among patients with LBP in a tertiary hospital setting and classify it using Castellvi's classification.

Methods: This was a descriptive cross-sectional observational study conducted after an ethical clearance from the Institutional Review Committee. The study was conducted from April to June 2024. Anteroposterior lumbosacral spine radiographs of patients presenting with LBP at the pain clinic of Shree Birendra Hospital were analyzed. X-rays were evaluated for LSTV presence and classified according to Castellvi's criteria. Data were analyzed using IBM SPSS version 22.

Results: A total of 150 patients were included in the study with a mean age of 46.53 ± 14.78 years. The prevalence of LSTV was 29 (19.3%) in the study. Type IIa 18 (62%) was the most common subtype, followed by types IIIb 8 (27.5%) and Ia 3 (10.3%). Sacralization was more prevalent 20 (68.9%) compared to lumbarization 9 (31.1%). The prevalence of LSTV was higher in females 23 (79.3%) than in males 6 (20.6%).

Conclusions: The prevalence of LSTV among patients with LBP was higher than in the general population, with Type II being the most frequent.

INTRODUCTION

Low back pain (LBP) is a common health issue affecting millions globally. There were around 619 million cases in 2020 and is projected to reach 843 million by 2050.[1] The aetiology of LBP is multifaceted, with Lumbosacral Transitional Vertebra (LSTV) being potentially linked to spinal pathology and pain.[2] LSTV is a congenital condition where there is an abnormal connection between the lumbar and sacral spine segments. The sacrum may have six vertebrae referred to as sacralization or reduction of sacral components termed as lumbarization.[3] The prevalence of LSTV varies widely, reported between 4% to 35.9%.[4] LBP associated with LSTV, known as Bertolotti syndrome, was first described in 1917. Its incidence is around 4% to 8% in the general population, and is believed to be underdiagnosed.[5-6]

The underlying causes of LBP in patients with LSTV is multifactorial. It is resulted due to the degeneration of the anomalous articulation between the LSTV and the sacrum, pathology of the disc and spinal canal at the level above the transitional vertebra, and posterior element pathology. Other contributing factors may include extraforaminal

stenosis due to the broadened transverse process of the LSTV, reduced paraspinal muscle volume, increased lumbar lordosis, and facet joint arthrosis on the side opposite to a unilateral fused or articulating LSTV.[7-9]

This study aims to evaluate the prevalence of LSTV among low back pain patients at a tertiary hospital in Nepal and classify it using Castellvi's system[10] to understand its clinical relevance.

METHODS

This was a descriptive cross-sectional observational study conducted in a tertiary-level referral hospital in Kathmandu, Nepal. It was conducted from 25 April 2024 to 25 June 2024, at the Department of Anaesthesiology in Shree Birendra Hospital, Kathmandu, Nepal. The study was commenced after obtaining an ethical clearance from the IRC (Institutional Research Committee) of the institute, vide letter no 1058 dated 24 April 2024. A non-probability purposive sampling technique was used for the study. All patients aged 18 years and older and presenting with LBP were included in the study after obtaining consent. Each patient underwent an anteroposterior (AP) lumbosacral spine radiograph, which was jointly evaluated by the anesthesiologist (the principal investigator) and the radiologist (one of the authors) at the institute. The sample size was calculated using the formula:

$$n = \frac{Z^2 \times p \times q}{e^2}$$

$$= \frac{1.96^2 \times 0.0948 \times 0.9.52}{0.05^2}$$

$$= 131$$

Where,

N = minimum required sample size

Z = 1.96 at 95% Confidence Interval (CI)

P = prevalence of LSTV from a similar previous study, 9.48%.[11]

q = 1- p

e = margin of error, 5%

The minimum sample size calculated was 131.

X-rays of patients who underwent plain radiographs of the lumbosacral spine AP view for back pain were evaluated through the Hospital Information Management System. Only radiographs displaying good-quality lumbosacral spine images were considered for inclusion. Good quality X-rays exhibited clear visibility of specific anatomical structures, such as the last rib's vertebral body articulation, all lumbar transverse processes, and the complete sacral wing. Radiographs with poor visibility, structural abnormalities, cases of post-spinal surgery, and histories of traumatic spinal injury were excluded. LSTV were classified according to the Castellvi radiographic classification method.[10] The Castellvi radiologic classification for LSTV includes the following types:

i. Type Ia (unilateral) and Ib (bilateral): Characterized by dysplastic, triangular-shaped transverse processes measuring at least 19 mm.
ii. Type IIa (unilateral) and IIb (bilateral): Defined by incomplete lumbarization or sacralization, where a diarthrodial joint forms between the enlarged transverse process (es) and the sacrum.
iii. Type IIIa (unilateral) and IIIb (bilateral): Involves complete lumbarization or sacralization, with a total bony union of the transverse processes to the sacrum.
iv. Type IV: A mixed form, combining unilateral type II and contralateral type III.

Data was entered into a Microsoft Excel sheet and IBM SPSS version 22 was used for analysis. Descriptive statistics were presented as frequencies and percentages for categorical variables. A point estimate with a 95% confidence interval was calculated, along with frequency and percentage for binary data.

RESULTS

The study population consisted of 150 patients, including 68 males and 82 females, with a mean age of 46.53 ± 14.78 years (ranging from 20 to 76 years) as depicted in Table 1. Of the total patients, 29 (19.3%) exhibited LSTV. The mean age of patients with LSTV was 41.45 ± 14.56 years (20 to 76 years). LSTV was more prevalent in females {23 (79.3%)} than in males {6 (20.6%)}.

Table 1. Demographic characteristics of patients

Characteristics	LBP (150)	LSTV (29)
Mean age	46.53 ± 14.78	41.45 ± 14.56
Sex		
Male	68 (45.3%)	6 (20.6%)
Female	82 (54.6%)	23(79.3%)

The majority of cases with transitional vertebrae were classified as Castellvi radiographic type IIa 18 (62%), followed by types IIIb eight (27.5%) and Ia three (10.3%), respectively, Table 2.

Table 2. Distribution of patients according to Castellivi classification

Castellivi classification	Number of patients (N = 29) (N) (%)
Ia	3 (10.3%)
Ib	0
IIa	18 (62%)
IIb	0
IIIa	0
IIIb	8 (27.5%)
IV	0

Out of the patients with LSTV, 20 (68.9%) showed sacralization, and nine (31.1%) showed lumbarization, Figure 1.

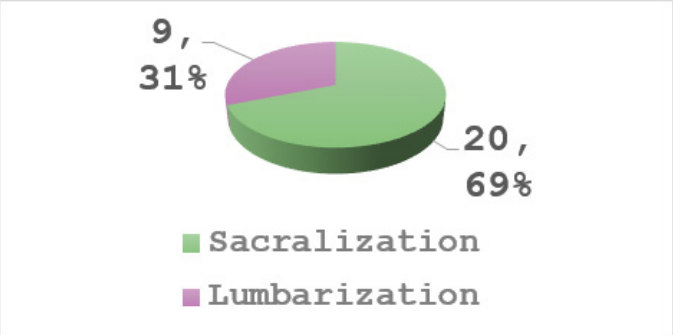

Figure 1. Distribution of LSTV among the patients

DISCUSSION

The LSTV was present in almost one-fifth of the patients presenting with LBP in our study. It is a common congenital anomaly of the lumbosacral junction, with a reported prevalence in the literature ranging from 4% to 35.9% across different study populations.[4] The prevalence of LSTV specifically in patients with LBP in various studies is found to be between 22% and 37%.[12-14] The prevalence in our study was lower than those reported in these previous studies. However, studies conducted in the general Nepalese population revealed a prevalence of 9.48%, 13.1% and 14.7% respectively, which is lower than that found in our study.[4] This suggests that LSTV is more prevalent in patients with LBP than in the general population. The presence of LSTV alters normal spine biomechanics and anatomy. Due to its widespread prevalence, Quinlan et al recommend that physicians should include Bertolotti's syndrome in the differential diagnosis of LBP, particularly in younger patients.[5] Recent studies from various countries have reported that the prevalence of LSTV among patients with LBP ranges from 13% to 38.33%.[12,16-19]spondylolysis, spondylolisthesis, facet lesions, discal abnormalities, vertebral instability, degenerative osteoarthritis, etc., These causes of low back pain are seen commonly in >50 years of age. Lumbosacral transitional vertebra (LSTV This variability in prevalence could be attributed to several factors, including differences in the study population, the imaging techniques employed, inter-observer variability, and other potential confounding factors. Additionally, variations in sample size, study design, and regional differences might also have contributed to the observed discrepancies in these findings.

In our study, LSTV was found to be more prevalent among females, accounting for 79.3% of cases, which is consistent with findings from similar studies conducted in Nepal among the general population, where prevalence rates were reported as 52.3%, 57.8%, and 65.9%.[4] However, some studies have indicated that LSTV is more common in males, highlighting the variability in prevalence across different populations and settings.[21,22]

In our study, using the Castellvi classification, type IIa emerged as the most common form of LSTV, identified in nearly two-thirds of the patients. This was followed by types IIIb and Ia. These findings are in line with previous studies that also reported a higher prevalence of type II LSTV, particularly type IIa, in patients with LBP. The association between type II LSTV and backache is believed to be linked to pseudoarthrosis, which may contribute to early arthritic changes and, consequently, a higher incidence of pain.[12,22,23] In a study involving 211 participants, Apazidis et al identified Type IA as the most prevalent.[2] However, Type I is typically considered clinically insignificant and does not have a relationship with back pain. Nardo et al found that Type I and Type II each accounted for over 40% of all LSTV cases, whereas Type III and Type IV represented 11.5% and 5.25% of the cases respectively in asymptomatic population.[22] In general population studies conducted in Nepal, Type II LSTV was consistently found to be the most prevalent subtype, however, they did not specifically look in patients with LBP.[4,11] Our observation aligns with the findings of studies conducted by Basel et al and Bhattarai et al, both of which reported Type II as the most common type of LSTV in their respective research.[4,11] These results suggest a recurring pattern in the prevalence of Type II LSTV within the Nepalese population.

In the context of lumbarization and sacralization, our study found that sacralization was present in more than two-thirds of patients. This higher incidence of sacralization in our study population is consistent with the previous research, which has also reported sacralization as the more common variant compared to lumbarization ranging from 70% to

88%.[2,4,11,12] as is the role of occupational physical activity and radiological spinal abnormalities suggestive of other spinal disorders (OSDs). However, some studies have reported that lumbarization is more common than sacralization. This discrepancy may be attributed to differences in the classification criteria used in various studies. For instance, in certain studies, type I LSTV, characterized by vertebrae with broad transverse processes, were not included or counted as transitional vertebrae.[12,25] This exclusion could lead to an underestimation of sacralization cases, thereby making lumbarization appear more prevalent.

The limitation of this study is that it was conducted at a single centre, focusing on patients with LBP who visited the pain clinic. Moreover, the study population only included army personnels and their dependents. These facts may lead us to difficulty in interpreting these results which may not be representative of the entire general Nepali population. The documented observations were based solely on X-ray findings, which could lead to underdiagnosis of the condition. Although CT is a superior imaging modality for identifying and classifying LSTV, it was not used due to the additional radiation exposure and financial burden.

CONCLUSIONS

The prevalence of LSTV in LBP patients was higher compared to studies in the general population both abroad and in Nepal, with type II being the most common. This indicates that LSTV frequently occurs in patients with LBP, emphasizing the importance of recognizing it for accurate diagnosis and management.

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