

A hospital based plain radiographic observational study of lumbosacral transitional vertebrae in the Nepalese population



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ABSTRACT

Background: Presence of lumbosacral transitional vertebra may lead to number of clinical consequences because of failure to correctly number the problematic vertebra and also has been associated with low back pain. Different studies done at different part of the world have shown wide range of prevalence of lumbosacral transitional vertebra. **Aims and Objective:** This hospital based cross sectional observational study was undertaken to determine the prevalence of lumbosacral transitional vertebra among the Nepalese population. **Materials and Methods:** Plain radiographs (anteroposterior and lateral views of lumbosacral spine and KUB radiographs) of 947 patients (646 with lumbosacral spine and 301 with KUB radiographs) done from August 2015 to July 2016 and meeting inclusion criteria were retrospectively analyzed for the presence of lumbosacral transitional vertebra. **Results:** The overall prevalence of lumbosacral transitional vertebra was 14.7% with prevalence of 16.3% in patients with lumbosacral radiographs and 11.3% in patients with KUB radiographs and was statistically significant. Prevalence of sacralization was higher than lumbarization (11.9% Vs 2.7%). Lumbosacral transitional vertebra was more common in females than in males with Castellvi type I being most common and type IV least common. **Conclusion:** The overall prevalence of lumbosacral transitional vertebra in the studied Nepalese population was 14.7% with significantly higher prevalence in patients with lumbosacral radiographs than with KUB radiographs.

Key words: Lumbarization; Lumbosacral transitional vertebra; Nepalese population; Plain radiographs; Sacralization

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INTRODUCTION

Lumbosacral transitional vertebra (LSTV), with a wide range of prevalence from 4% to 35.9% and a mean prevalence of 12.3% as reported in different studies, is a common congenital anomaly of lumbosacral vertebral junction that presents either as sacralization of fifth lumbar (L5) vertebra (elongated and broadened L5 transverse processes to its fusion with sacrum) or lumbarization of first sacral (S1) vertebra (separation of S1 vertebra from remaining sacral vertebrae).¹⁻⁴ Identification of LSTV is important as its presence may lead to number of clinical

consequences like performing spinal surgery at wrong level, errors in other lumbosacral procedures and poor correlation of patients symptoms because of failure to correctly number the problematic vertebra.⁴ Association between presence of LSTV and low back pain (also known as Bertolotti syndrome) was first described by Bertolotti in 1917,^{1,5} which is still controversial and debatable as the results of various studies are conflicting with some studies showing positive correlation,⁶⁻¹⁰ while no association was found in others.¹¹⁻¹⁴ However higher occurrence of disc herniation or degenerative changes immediately above the level of LSTV has been reported.^{12,14-16}

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Even though detection of LSTV can be made in various imaging modalities including plain radiographs, computed tomography (CT) and magnetic resonance imaging (MRI), there is no well established standard technique to identify and number LSTV. Ferguson radiograph which is anteroposterior radiograph with 30 degrees cranial angulation has been regarded as best for identifying LSTV, but currently role of CT and MRI in this regard have been evaluated. Due to risk of exposure to radiation CT scans are not routinely recommended for sole purpose of evaluation of LSTV. Also determination of LSTV with MRI alone may be challenging when plain radiographs are not available. On MRI different studies have suggested various techniques to number the lumbar vertebrae, of which use of iliolumbar ligament as a landmark is considered to be more accurate.^{1,4,17,18}

As different studies done at different part of the world have shown wide range of prevalence of LSTV, knowledge of local prevalence is important so as to avoid any untoward consequences during patient management due to failure to accurately assign the vertebral number. Hence this hospital based study was undertaken to determine the prevalence of LSTV in the Nepalese population.

MATERIAL AND METHODS

In this cross sectional observational study, plain radiographs (anteroposterior and lateral views of lumbosacral spine and KUB radiographs) of 947 patients done from August 2015 to July 2016 in Department of Radiodiagnosis and Imaging of Nobel Medical College Teaching Hospital (NMCTH), Biratnagar and meeting inclusion criteria were retrospectively analyzed for the presence of lumbosacral transitional vertebra. Of the plain radiographs of 947 patients studied, 646 were of lumbosacral spine and 301 of KUB. Patients of both sexes and all age groups were included in the study. Radiographs of poor image quality hampering adequate evaluation of all lumbosacral vertebrae (mainly transverse processes); not including last thoracic vertebra with rib attached to it and with presence of vertebral fracture, signs of spinal surgery and/or vertebral destruction due to tumor or infection were excluded from the study. First of all twelfth thoracic (T12) vertebra was identified, which was defined as the vertebra to which the lowest rib is attached and then numbering of lumbar vertebrae was done craniocaudally with the vertebra immediately below T12 vertebra numbered as first lumbar (L1) vertebra¹ thus noting presence or absence of LSTV. When present, LSTV were further classified according to the Castellvi radiographic classification^{4,19} into four types as follows:

Type I: Enlarged and dysplastic transverse process(es), measuring ≥ 19 mm in width (craniocaudal dimension).
Ia – Unilateral, Ib – Bilateral.

Type II: Incomplete lumbarization/sacralization with an enlarged transverse process(es) and pseudoarticulation of the transverse process(es) and the sacrum. IIa – Unilateral, IIb – Bilateral.

Type III: Lumbarization/sacralization with complete bony fusion of the transverse process(es) to the sacrum. IIIa – Unilateral, IIIb – Bilateral.

Type IV: Mixed type. A unilateral type II transition with a type III on the contralateral side.

All of these four types of LSTV were included in this study. Record was made of patients age, gender and findings of lumbosacral vertebrae including number of lumbar vertebrae, craniocaudal measurement of transverse process of L5 vertebra and pseudoarthrosis and/or bony fusion of L5 vertebral transverse process(es) with the sacrum.

For statistical analysis acquired data were entered on Microsoft Excel worksheet and then using IBM SPSS statistics 20 software further analysis was done. Frequency, percentage and mean with standard deviation were calculated for various categorical and numerical variables. Chi-square test was applied to examine association between two categorical variables with p-value <0.05 considered to be significant.

RESULTS

Plain radiographs of 947 patients were studied which included 646 (68.2%) radiographs of lumbosacral spine and 301 (31.8%) of KUB. Of these, 452 (47.7%) were male and 495 (52.3%) female with male to female ratio of 1:1.17. Mean age of the patients included in this study at the time of imaging was 44.9 ± 15.6 years (range 15-88 years).

Out of the total 947 patients, LSTV was seen in 139 (14.7%). LSTV was found to be more common in females with its distribution of 64 (46.0%) in males and 75 (54.0%) in females and a prevalence of 14.1% and 15.1% in males and females respectively. This difference in prevalence of LSTV between males and females was statistically insignificant (p value = 0.666).

According to Castellvi classification of LSTV, type I was seen in 61 (43.9%), type II in 42 (30.2%), type III in 26 (18.7%) and type IV in 10 (7.2%) of patients. (Figure 1).

Of the 139 patients with LSTV, 113 (81.3%) had sacralization whereas lumbarization was seen in 26 (18.7%) patients with overall prevalence of sacralization and lumbarization being 11.9% and 2.7% respectively. Sacralization was commonly seen in males than in females (55 (85.9%) Vs 58 (77.3%)), while lumbarization was common in females (17 (22.7%) Vs 9 (14.1%)). However this gender difference in sacralization

and lumbarization was statistically insignificant (p value = 0.830 and 0.174 respectively). (Table 1)

Out of 139 LSTV, 105 (75.5%) were seen in lumbosacral radiographs and the remaining 34 (24.5%) in radiographs of KUB. Overall LSTV was noted in 16.3% of patients with lumbosacral radiographs in comparison to 11.3% with KUB radiographs. This difference in presence of LSTV in lumbosacral and KUB radiographs was statistically significant (p value = 0.044). (Table 2)

DISCUSSION

A common congenital anomaly of lumbosacral junction, LSTV has a wide range of prevalence from 4% to 35.9% in different study population as reported in literature.¹ This variation in prevalence has been attributed to differences in the number of factors taken into consideration while conducting a study, like definition, criteria and classification of transitional vertebra; type of study population, whether

with low back pain (LBP) or not; imaging technique used; error of observer and other study population related confounding factors.^{1,8,16,18,20,21} Erken et al,³ Nardo et al⁸ and Uçar D et al²⁰ included Castellvi type I LSTV in their study, while Hsieh et al,² Sekharappa et al¹⁶ and French et al¹⁸ did not include it, as they considered Castellvi type I to be a normal anatomical variation lacking clinical significance. In this study all four types of LSTV according to Castellvi radiographic classification were included.

Evaluation of LSTV was done in KUB radiographs by Khashoggi et al²¹ and Apazidis et al²²; lumbosacral radiographs by French et al¹⁸ and Uçar BY et al²³; abdominal radiographs by Uçar D et al²⁰; KUB, lumbosacral radiographs and MRI by Sekharappa et al¹⁶ and lumbosacral, KUB and abdominal radiographs by Garg²⁴. This study evaluated plain radiographs of both lumbosacral spine and KUB for the presence of LSTV.

In this study, the overall prevalence of LSTV in the studied Nepalese population was 14.7% with higher prevalence in females in comparison to males. However this gender variation in prevalence of LSTV was statistically insignificant. In another MRI based study from Nepal by Karki et al²⁵ LSTV was seen in 3.8% of patient, which was much lower than that noted in this study. Similarly LSTV prevalence of 10.0% was reported in north Indian population by Garg²⁴ from evaluation of lumbosacral, KUB and abdomen radiographs. Higher prevalence of LSTV in females was also found in study of Sekharappa et al,¹⁶ whereas Nardo et al,⁸ Uçar D et al²⁰ and Uçar BY et al²³ reported higher LSTV prevalence in males than in females. The most common type of LSTV observed in this study was Castellvi type I with type IV being least common,

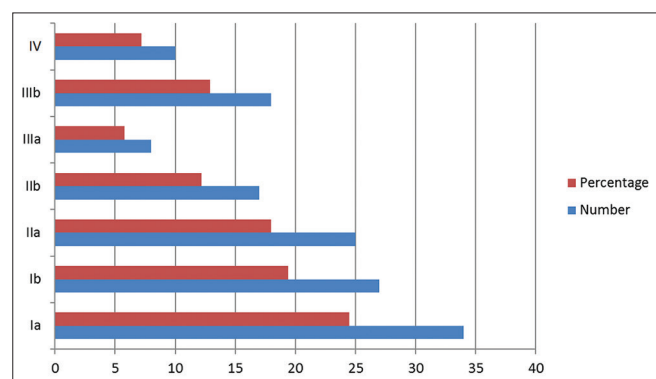


Figure 1: Frequency of LSTV according to Castellvi classification

Table 1: Distribution of sacralization and lumbarization according to gender

LSTV	Male (n = 64) (%)	Female (n = 75) (%)	Total (n = 139) (%)	P value*
Sacralization	55 (85.9)	58 (77.3)	113 (81.3)	0.830
Lumbarization	9 (14.1)	17 (22.7)	26 (18.7)	0.174
Total	64 (100)	75 (100)	139 (100)	0.666

*Chi square test

Table 2: Distribution of findings according to LSTV and radiograph types

Findings	Lumbosacral radiograph (n = 646) (%)	KUB radiograph (n = 301) (%)	Total (n = 947) (%)	P value*
No LSTV	541 (83.7)	267 (88.7)	808 (85.3)	
LSTV present	105 (16.3)	34 (11.3)	139 (14.7)	0.044**
Ia	26 (4.0)	8 (2.6)	34 (3.6)	
Ib	21 (3.3)	6 (2.0)	27 (2.9)	
IIa	19 (2.9)	6 (2.0)	25 (2.6)	
IIb	13 (2.0)	4 (1.3)	17 (1.8)	
IIIa	5 (0.8)	3 (1.0)	8 (0.8)	
IIIb	13 (2.0)	5 (1.7)	18 (1.9)	
IV	8 (1.2)	2 (0.7)	10 (1.1)	

*Chi square test, **Statistically significant

which was similar as seen in study of Nardo et al⁸ but in different proportions.

According to literature, the overall prevalence of sacralization is higher than that of lumbarization,¹ which also holds true for this study with the prevalence of 11.9% and 2.7% for Sacralization and lumbarization respectively. Sacralization was common than lumbarization in the study of Steinberg et al,¹⁰ Sekharappa et al,¹⁶ Hughes et al,¹⁷ Uçar D et al,²⁰ Khashoggi et al,²¹ Uçar BY et al,²³ Garg,²⁴ and Santiago et al,²⁶ whereas lumbarization was reported to be common by French et al,¹⁸ Leboeuf et al²⁷ and Peh et al²⁸. According to French et al¹⁸ the reason given for higher prevalence of lumbarization in their study was may be due to exclusion of type I LSTV causing in decrease in their recorded prevalence of sacralization. Wide range in prevalence of sacralization and lumbarization has been noted in analysis of different studies. The prevalence of sacralization and lumbarization was 14.0% and 4.3%, 11.0% and 2.0%, 9.2% and 4.2%, 3.8% and 5.3%, 17.2% and 1.7%, 21.2% and 2.4%, 11.6% and 7.2%, 5.5% and 6.0% & 6.2% and 7.0% in the studies of Steinberg et al,¹⁰ Sekharappa et al,¹⁶ Hughes et al,¹⁷ French et al,¹⁸ Uçar D et al,²⁰ Uçar BY et al,²³ Santiago et al,²⁶ Leboeuf et al,²⁷ & Peh et al²⁸ respectively with the range of 3.8% - 21.2% for sacralization and 1.7% - 7.2% for lumbarization. Hence the prevalence of sacralization (11.9%) and lumbarization (2.7%) as seen in this study falls within the above mentioned range. Gender difference in occurrence of sacralization and lumbarization was noted with sacralization common in males than in females (85.9% Vs 77.3%) and lumbarization common in females than in males (22.7% Vs 14.1%), but was statistically insignificant. This finding of gender variation in occurrence of sacralization and lumbarization in this study was in concordance with the result of studies by Uçar D et al,²⁰ Khashoggi et al²¹ and Mahato²⁹.

The prevalence of LSTV was higher in the patients with lumbosacral radiographs than with KUB radiographs (16.3% Vs 11.3%). This difference was statistically significant and was in agreement with the study of Sekharappa et al.¹⁶ Higher prevalence of LSTV in the patients with lumbosacral radiographs than with KUB radiographs may be due to additional advantage of lateral view aiding in identification of LSTV in the patients with lumbosacral radiograph. Also as the lumbosacral radiographs are mainly taken in patients presenting with clinical symptoms pertaining to vertebral column particularly LBP, there might be some relationship between the presence of LSTV and LBP. Similarly the radiographs of KUB are indicated for other clinical symptoms rather than for LBP, hence KUB radiographs may closely represent for the general population (although not an ideal or true representation) than for the patients with

LBP. As the clinical symptoms and the exact indication of lumbosacral and KUB radiographs in these patients were not known, the relationship between LSTV and LBP could not be associated confidently in this study. Therefore to determine the causal relationship between LSTV and LBP further large scale prospective study taking consideration of patients clinical symptoms should be carried out.

Limitations of the study

As this was a hospital based single institutional study, the findings may not represent the entire population. Similarly the study population was the patients visiting hospital for treatment; the results may not truly reflect the findings of normal general population. Also exclusion of radiographs due to various technical factors may have an erroneous effect in calculation of prevalence of LSTV.

CONCLUSION

The overall prevalence of LSTV in the studied Nepalese population was 14.7% with significantly higher prevalence in patients with lumbosacral radiographs than with KUB radiographs. As LSTV is a common congenital anomaly of lumbosacral vertebral junction, its identification and thus accurate assignment of vertebral number is important to avoid any untoward consequences during patient management.

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Author's Contribution:

MB- Concept and design of study, literature review, data collection, statistical analysis and interpretation, manuscript preparation, editing and critical revision of manuscript.

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