MEDICO RESEARCH CHRONICLES
ISSN NO. 2394-3971
DOI No. 10.26838/MEDRECH.2022.9.1.578
Contents available at www.medrech.com

LUMBOSACRAL TRANSITIONAL VERTEBRA: PREVALENCE AND ASSOCIATION WITH LOW BACKACHE.

Dr. Kavish Kapoor[1], Dr. Anurag Shukla[2]
1. DMRD, DNB, DHCM, MNAMS, Department of Radiology, Military Hospital, Jalandhar Cantt.
2. DNB, Department of Radiology, Military Hospital, Jalandhar Cantt.

ARTICLE INFO

Article History
Received: December 2021
Accepted: January 2022
Keywords: Lumbosacral transitional vertebra, low backache, Castellvi's classification.

Corresponding author
Dr. Anurag Shukla *

ABSTRACT

ORIGINAL RESEARCH ARTICLE

Study Design-Retrospective observational analysis of radiological images.
Purpose- To determine the prevalence of lumbosacral transitional vertebra (LSTV) in patients symptomatic with low backache and study the association of type of LSTV with low backache.
Materials & Methods: Standard standing lumbosacral spine AP radiographs were obtained for 6000 patients aged between 18-60 years of age. The lumbosacral spine was assessed for the presence of lumbosacral transitional vertebra which was further classified into type I, II, III, IV based on Castellvi's method. The association of low backache (LBA) with the subtypes of LSTV was also studied.
Results: The prevalence of lumbosacral transitional vertebra was found in 6.45 % (387 out of 6000), of which type II (pseudoarticulation, unilateral or bilateral) was the commonest type found in 62.7 %, followed by type I (dysplastic transverse process) in 23.2 %, type III (true fusion) in 10.1 % and type IV (mixed, unilateral pseudoarticulation and contralateral true fusion) in 3.8 %. The subtype IIA was found strongly associated with low backache.
Conclusions: In this cohort based study, the prevalence of LSTV was studied and positive association of LSTV was established to be considered as one of the differential of low backache.

2022, www.medrech.com

1. INTRODUCTION

Backache is one of the leading cause in middle and elderly age group for which patient report to surgical or orthopaedic OPDs for consultation. Plain radiography of lumbosacral spine is usually the first investigation asked in such cases. Lumbosacral transitional vertebra (LSTV) is a common congenital anomaly detected in such radiographs. Lumbosacral transitional vertebra is defined as a unilateral or bilateral, total or partial fusion of the enlarged transverse process of the lowest lumbar vertebra to the sacral ala [1,2].

The prevalence of LSTV varies between 4 % to 36 % in various studies [3]. However, the association between LSTV and LBA is a matter of debate in the literature since it was first described by Bertolotti et al in 1917 and is termed Bertolotti syndrome thereafter [4]. Many studies have been done in the past to describe the relationship between LSTV and LBA. Most of these studies show a positive correlation between the both; however, few authors suggested no positive association between the two. Also few studies reported that patients with LSTV have increased risk for accelerated disc degeneration or disc herniation.

Till date there has been only a few large scale studies done on Indian population to study the prevalence of LSTV in patients with LBA. The goal of this study was to study the prevalence of LSTV in diverse Indian subgroup population with LBA and its association with the subtypes of LSTV.

2. MATERIALS AND METHODS

2.1 Study Design

This retrospective observational study was carried out in one of the tertiary care hospital of North India catering to diverse Indian population from various parts of the country. 6000 patients, comprising of both males and females in the age group 18-60 yrs., with complaints of LBA were included in the study. Patients with definitive past history of spinal trauma or surgery and patients with other diagnosed causes of arthropathy were excluded from the study. Prior approval from the ethical committee of the institution was obtained before the start of the study, and written informed consent was taken from the patients included in the study.

2.2 Imaging technique and analysis

Plain radiograph of lumbosacral spine including visualization of vertebral column from D12 to S3 were taken including bilateral sacroiliac joints. Standard antero-posterior(AP) and lateral projection of lumbo-sacral spine were taken. Images were acquired on identical equipment and appropriate exposure settings (80-90 kV and 20-30 mA). For AP projection the central ray was directed towards the midline at the level of the lower costal margin (LV3). For lateral projection, the central ray was directed at right-angle to the line of spinous processes and towards a point 7.5 cm anterior to the third lumbar spinous process at the level of the lower costal margin. All the images were read independently by two radiologists. Out of the 6348 plain radiographs of lumbosacral spine taken, radiographs of 348 patients were excluded because of technical errors. LSTV was determined manually by assessing the cranio-caudal width of the L5 transverse process, with a cutoff of 19 mm or more, or by the presence of unilateral or bilateral pseudoarticulation or complete fusion of L5 transverse process with the sacral ala. Radiographs were studied for the presence of LSTV, further classified into the subtype as per the Castellvi classification of LSTV (Table 1). Baseline demographic data of LSTV was compared with non LSTV group with additional emphasis to the subtypes of LSTV.

3. RESULTS

Lumbosacral transitional vertebra prevalence in our study population was found to be 6.45% (387 out of 6000). Of 6000 patients presented with LBA, 4338 patients were males and 1548 were females. Out of 4338 male patients, 3090 patients (71%) were of < 40 yrs age group. However, on the contrary, out of 1548 female patients only 717 patients (46%) were of < 40 yrs age group. The prevalence of LSTV among male patients was 6.3 % (273 out of 4338 males) and among female patients was 7.3 % (114 out of 1548). There was no significant difference for clinical symptoms in either gender with LSTV.

As per the Castellvi classification of LSTV (Table 1), the prevalence of LSTV type I was found in 23.2% (90 out of 387), type II LSTV was seen in 62.8 % (243 out of 387), type III LSTV was seen in 10.1 % (39 out of

387) and the prevalence of type IV LSTV was seen in 3.9 % (15 out of 387). Subtype IIA of LSTV was found the commonest with a prevalence of 40.3 % (156 out of 387).

Table 1: Castellvi classification of LSTV.

Castellvi type	Definition
Type I : Dysplastic transverse process	Unilateral (A) or bilateral (B) dysplastic transverse process with height > 19 mm.
Type II: Incomplete lumbarization/ sacralisation	Enlarged transverse process with unilateral (A) or bilateral (B) pseudoarticulation with the adjacent sacral ala.
Type III: Complete lumbarization/ sacralisation	Enlarged transverse process with unilateral (A) or bilateral (B) complete fusion with the adjacent sacral ala.
Type IV : Mixed	Type II on one side and type III on other side.

The distribution of subtypes in percentages in our study as per the Castellvi classification is shown as Figure 1. Radiographs of various types of LSTV in our study as per the Castellvi's classification are shown in Figure 2.

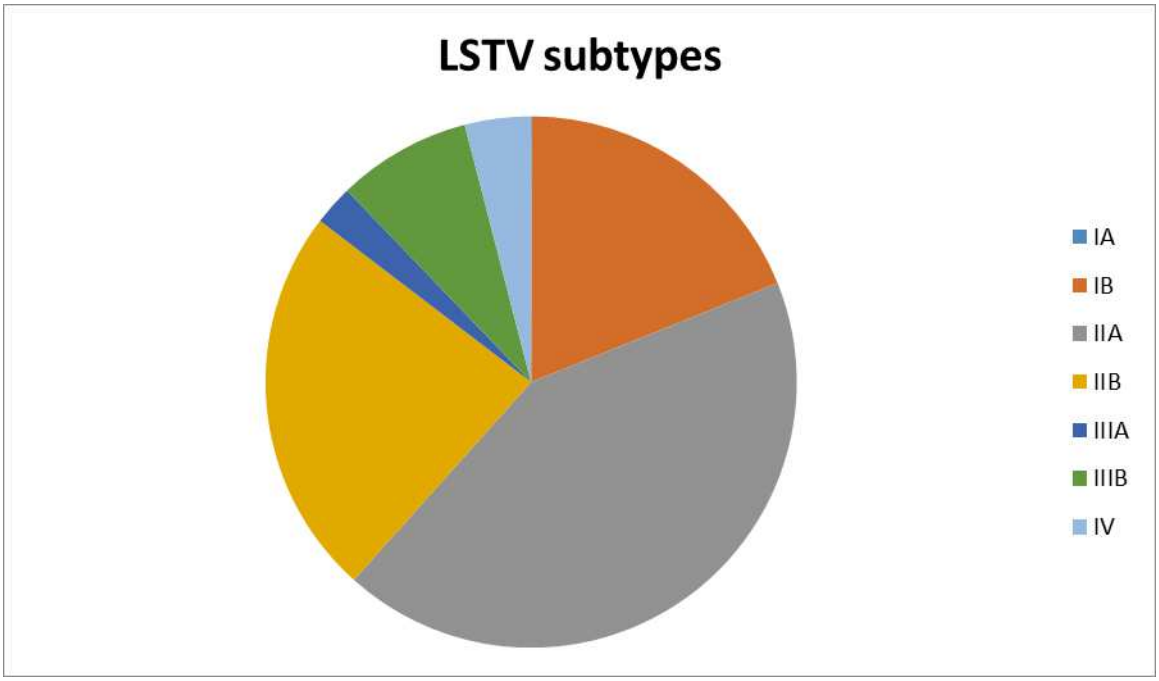

Figure 1: Pie chart depicting percentage of cases of LSTV grouped as per the Castellvi classification.

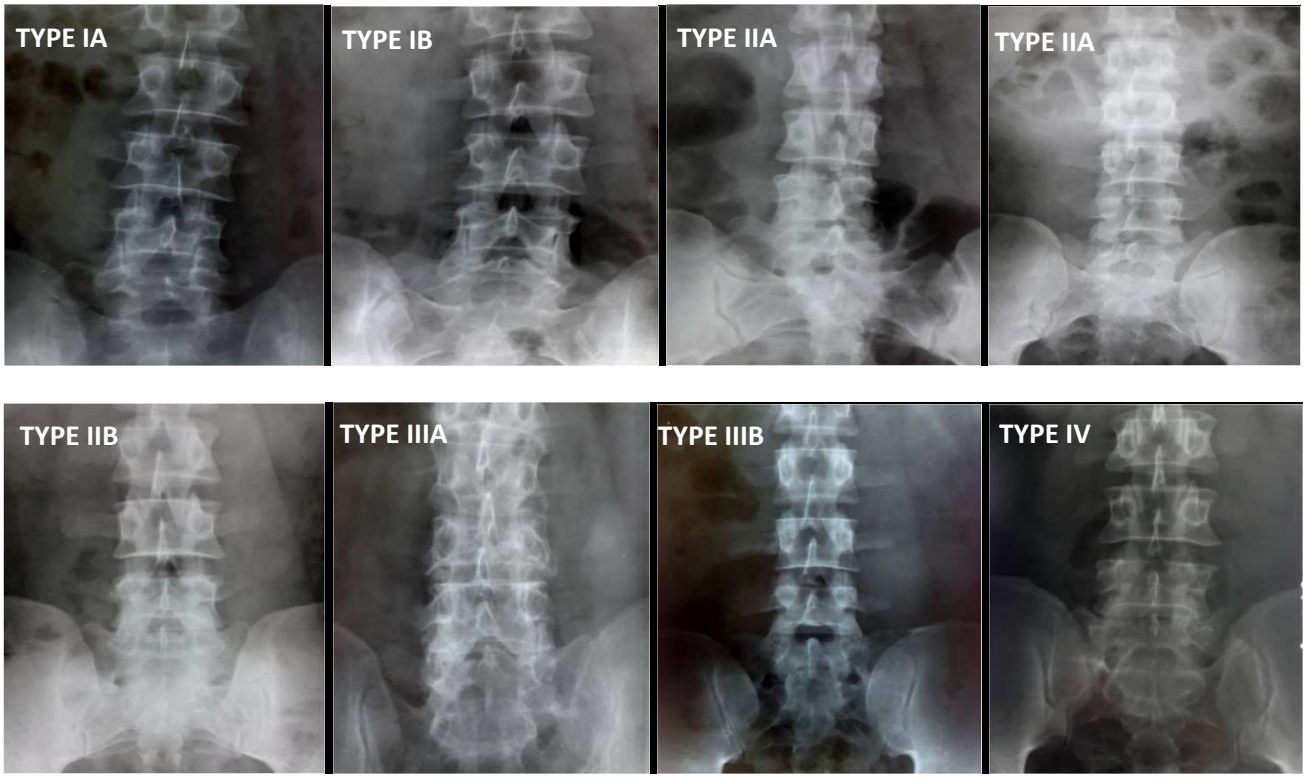

Figure 2: Pictures of patient's radiographs showing various subtypes of LSTV as per the Castellvi classification.

4. DISCUSSION

The study was targeted to study and establish correlation between LSTV and low backache in Indian population. Our study was conducted on patients in one of the largest tertiary care hospital in Northern India who presented to our hospital with complaints of low backache, excluding other diagnosed definitive causes of LBA. Variable outcomes have been shown in some of the studies which however had narrow criteria for selection of cohort population viz young males, young females, labourers, symptomatic LBA patients etc. Our study had an advantage of having a heterogeneous diverse population with a wider age range of patients including both males and females. Although the pathophysiology of pain in LSTV remains unclear, possible mechanisms include extraforaminal stenosis, prolapsed intervertebral discs and spinal canal stenosis.

LSTV is a common congenital spinal anomaly seen as either sacralisation of the lowest lumbar segment or lumbarization of the superior-most sacral segment of the spine. Depending upon the number of vertebral segments, the transitional vertebra may be either considered as lumbarized S1 or sacralized L5. The variation of morphology in these segments ranges from broadening/ elongated transverse processes of L5 vertebra to its pseudoarticulation or complete fusion with the sacral ala.

The reported prevalence of LSTV reported by various researchers in the last twenty years' ranges from 4-36 % in adult population (Table 2).

Table 2: Survey of prevalence of LSTV in previous studies since last 20 years.

Study authors	Year of study	Patient numbers	LSTV prevalence (%)
Daniel P et al [5]	2020	100	22.0
Gopalan B et al [6]	2018	596	24.3
Ucar BY et al [7]	2012	500	23.6
Quinloye OI et al [8]	2009	561	9.1
Quinlan et al [9]	2006	769	4.6
Hughes et al [10]	2006	500	13.4
Delport et al [11]	2006	300	30.0
Peterson et al [12]	2005	353	12.2
Taskaynatan et al [13]	2005	881	4.7
Luoma et al [14]	2004	163	30.0
Steinberg et al [15]	2003	464	18.3
Kim et al [16]	2003	690	5.9
Chithriki et al [17]	2002	441	8.4
Otani et al [18]	2002	1009	11.8
Erken et al [19]	2002	729	35.9
Santiago et al [20]	2001	138	18.4
Hsieh et al [21]	2000	1668	4.0

This wide variability of prevalence may be attributed to various limitations faced by various studies viz. small sample size, narrow age bracket, regional population group, etc. The higher prevalence of LSTV has been reported in select population based studies (such as patients with LBA) rather than in a community based study. Most of the studies done by researchers like Oyinloye OI et al [8], Quinlan et al [9] and Stinchfield et al [22] described the positive association of LSTV with LBA. Similar positive correlation between LBA and LSTV was also found in recent studies done by Ucar BY et al in year 2012 [7], Gopalan B et al in year 2018 [6] and Daniel P et al in the year 2020 [5] to the extent of 23 %. However, there are also studies which negate the positive correlation between LBA and LSTV like the one done by Tini et al in the year 1977 [23] with a cohort of 4000 patients and another one done by Luoma et al in the year 2004 [14].

As regard to gender variation, the data in previous studies were found equivocal. The study done by Ahmadinejad et al in the year 2009 [24] and by Quinlan et al in the year 2006 [9] depicts higher prevalence of LSTV in females as compared to males (M:F ratio = 1:2). Study done by Eyo et al in the year 2001 [25] documented high prevalence of LSTV in males (M: F ratio = 3:2). However, in a recent study done by Daniel et al in the year 2020 [5] showed equal distribution of LSTV among males and females with LBA.

In our study of 6000 patients, comprising of heterogenous cohort of mixed age group and demography, the prevalence of LSTV was found to be 6.45%. LBA was found to be more prevalent in male patients (4338 males among 6000 patients); however, the prevalence of LSTV in patients with LBA was found more in females (7.3% females as compared to 6.3% males). In our study, prevalence of LSTV in young patients (< 40

years) was also studied as compared to middle aged patients (> 40 years), wherein the data suggested a variation in both the sexes. Young patients with LBA and LSTV are more common in males, with middle aged patients with LBA and LSTV figuring more in females. In our study, significant positive correlation between the LBA and LSTV was found, which further substantiates the role of LSTV as one of the differential cause of LBA patients, when no other significant discal/ osseous cause can be associated with LBA.

The most common subtype of LSTV also differs in various previous studies. Dai et al [26] reported type II LSTV as the most common type in the year 1999. In the year 2006, Delport et al [11] reported type III LSTV as the most common one. In a study done by Ahmadinejad et al in the year 2009 [24], type II LSTV was reported as the most common type with equal prevalence of 24.2 % in both type IIA and type IIB. Type IA LSTV was found as the most common type in a study done by Ucar et al in the year 2012 [7], with a prevalence of 6.8 %. Daniel et al in the year 2020 [5] showed type II LSTV as the most common type with a prevalence rate of 45 %, with type IIA being most common (31.9 %). The most common subtype of LSTV found in our study, as per the Castellvi classification on LSTV, was type II with an overall prevalence of 62.8 %, followed by type I (23.2 %), type III (10.1 %) and type IV (3.9 %). Type IIA (unilateral pseudoarticulation) with a prevalence of 40.3 % in our study was found to be more prevalent than type IIB (bilateral pseudoarticulation) with a prevalence of 22.4%.

Our study had many limitations. The major one includes non-exclusion of non-osseous discal causes of LBA by cross sectional imaging, which can't be assessed on radiographs alone. Another major limitation was selection of patients on the basis of symptom of LBA, which precludes true estimation of prevalence in the general population.

5. CONCLUSION

Our study highlights the importance of LSTV in LBA, the association of which has been debated since long. It further substantiates the most common prevalent subtype of LSTV as type IIA and its significant role in LBA. LSTV should always be considered as a differential cause of LBA, when no other significant cause of pain could be found.

6. CONFLICTS OF INTEREST

There were no conflicts of interest reported between the authors.

7. REFERENCES

1. Castellvi A, Goldstein L, ChanD. Lumbosacral transitional vertebrae and their relationship with lumbar extradural defects. Spine 1984;9:493-5.
2. Konin GP, Walz DM. Lumbosacral transitional vertebrae : classification, imaging findings and clinical relevance. AJNR Am J Neuroradiol 2010;31:1778-86.
3. Bron JL, van Royen BJ, Wuisman PI. The clinical significance of Lumbosacral transitional anomalies. Acta Orthop Belg 2007;73:687-95.
4. Bertolotti M. Contributo alla conoscenza dei vizi di differenzazione regionale del rachide con special riguardo all' assimilazione sacrale dellav. lombare. Radiol Med 1917;4:113-144.
5. Daniel P, Joel JJ, Rana PK. Lumbosacral transitional vertebrae in patients with low back pain: Radiological classification and morphometric analysis. J Anat Soc India 2019;68:123-8.
6. Gopalan B, Yerramshetty JS. Lumbosacral transitional vertebra – related low back pain : Resolving the controversy. Asian Spine J 2018;12:407-15.
7. Ucar BY, Ucar DE, Bulut M, Azboy I, Demirtas A. Lumbosacral transitional

vertebrae in low back pain population. J Spine 2012;2:125.
8. Oyinloye OI, Abdulkadir AY, Babalola OM. Incidence and patterns of Lumbosacral transitional vertebrae, in patients with low back pain in a Nigerian hospital. Nig Q J Hosp Med 2009;19(2):95-99.
9. Quinlan JF, Duke D, Eustace S. Bertolotti's syndrome. A cause of back pain in young people. J Bone Joint Surg Br 2006;88:1183-6.
10. Hughes RJ, Saifuddinn A. Imaging of lumbosacral transitional vertebrae. Clin Radiol 2004;59:984-91.
11. Delport EG, Cucuzzella TR, Kim N, Marley J, Pruitt C, Delport AG. Lumbosacral transitional vertebrae: Incidence in a consecutive patient series. Pain Physician 2006;9:53-6.
12. Peterson CK, Bolton J, Hsu W, Wood A. A cross-sectional study comparing pain and disability levels in patients with low back pain with and without transitional lumbosacral vertebrae. J Manipulative Physiol Ther 2005;28(8):570–574.
13. Taskaynatan MA, Izci Y, Ozgul A, Hazneci B, Dursun H, Kalyon TA. Clinical significance of congenital lumbosacral malformations in young male population with prolonged low back pain. Spine (Phila Pa 1976) 2005;30(8):E210–E213.
14. Luoma K, Vehmas T, Raininko R, Luukkonen R, Riihimäki H. Lumbosacral transitional vertebra: relation to disc degeneration and low back pain. Spine (Phila Pa 1976) 2004;29(2):200–205.
15. Steinberg EL, Luger E, Arbel R, Menachem A, Dekel S. A comparative roentgenographic analysis of the lumbar spine in male army recruits with and without lower back pain. Clin Radiol 2003; 58(12):985–989.
16. Kim NH, Suk KS. The role of transitional vertebrae in spondylolysis and spondylolytic spondylolisthesis. Bull Hosp Jt Dis 1997;56:161-6.
17. Chithriki M, Jaibaji M, Steele RD. The anatomical relationship of the aortic bifurcation to the lumbar vertebrae: a MRI study. Surg Radiol Anat 2002;24(5):308–312.
18. Otani K, Konno S, Kikuchi S. Lumbosacral transitional vertebrae and nerve-root symptoms. J Bone Joint Surg Br 2001;83:1137-40.
19. Erken E, Ozer HT, Gulek B, Durgun B. The association between cervical rib and sacralisation. Spine 2002;27:1659-64.
20. Santiago FR, Milena GL, Herrera RO, Romero PA, Plazas PG. Morphometry of the lower lumbar vertebrae in patients with and without low back pain. Eur Spine J 2001;10:228–33.
21. Hsieh CY, Vanderford JD, Moreau SR, Prong T. Lumbosacral transitional segments: classification, prevalence and effect on disk height. J Manipulative Physiol Ther 2000: 23: 483-89.
22. Stinchfield FE, Sinton WA. Clinical significance of the transitional lumbosacral vertebra; relationship to back pain, disk disease, and sciatica. J Am Med Assoc 1955;157:1107-9.
23. Tini PG, Wieser C, Zinn WM. The transitional vertebra of the lumbosacral spine: Its radiological classification, incidence, prevalence, and clinical significance. Rheumatol Rehabil 1977;16:180-5.
24. Ahmadinejad N, Ghanaati H, Firouznia K, Khaghani A, Salavati A, Shakiba M. Pathological findings of spinal MRI in patients with lumbosacral transitional vertebra. Res J Biol Sci 2009;4:166-70.
25. Eyo MU, Olofin A, Noronha C, Okanlawon A. Incidence of lumbosacral transitional vertebrae in low back pain patients. West Afr J Radiol 2001;8:1-6.
26. Dai L. Lumbosacral transitional vertebrae and low back pain. Bull Hosp Jt Dis 1999;58:191-3.