Original Article

Prevalence of lumbosacral transitional vertebra in a tertiary care hospital

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Abstract

Background: Lumbosacral transitional vertebra (LSTV) are congenital anomalies which need to be identified for accurate diagnosis of level of various pathologies involving the spine . Aim of this study was to determine the prevalence of LSTV **Material and Methods:** This hospital based retrospective study was done on patients who underwent abdominal computed tomographic examination in Yenepoya Medical College, Mangalore during a period of four months between April 2016 to July 2016 **Observations:** A total of 144 cases were included in this study. 14 patients (10%) were identified with LSTV and were classified according to Castellvi's classification and O'Driscoll classification systems. The most common type of LSTV according to the Castellvi's classification is Type IIa and in the O' Driscoll classification was type II, we did not encounter any Type I O' Driscoll LSTV in this study. **Discussion and Conclusions:** Lumbosacral transitional verterbra are common amongst the patients who present with back ache due to various causes. We found 10% prevalence of LSTV in our study population .These were further classified into various types using Castellvi's and O'Driscoll classification using CT imaging .Improper numbering of LSTV leads to treatment at the wrong spinal cord level and patient morbidity.

Keywords: Castellvi's classification, Computed tomography, Lumbosacral transitional vertebra, Low back ache, O'Driscoll classification.

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Received Date: 23/10/2016 Revised Date: 19/11/2016 Accepted Date: 14/12/2016

Access this article online	
Quick Response Code:	Website: www.medpulse.in
	DOI: 21 December 2016

INTRODUCTION

Lumbosacral transition vertebrae (LSTVs) represent a group of congenital spinal anomalies defined as either sacralisation of the lowest lumbar segment or lumbarisation of the superior most sacral segment of the spine[1]. Lumbarisation of the S1 vertebrae means assimilation of S1 to lumbar spine with anomalous articulation, well-formed lumbar type facet joints, squared appearance of the vertebrae, and formed disk. Sacralisation of the L5 vertebrae includes fusion of S1 to lumbar spine by broadened elongated transverse processes to complete fusion to the sacrum. Transition can be incomplete / unilateral or bilateral. The prevalence of LSTV previously reported in the literature ranges from 4 to 35%[2]. LSTV's are divided radiologically, by a classification system devised by Castellvi *et al*. into 4 types based on the morphologic characteristics[3,4] (Fig.1). This system categorizes LSTV into one of four groups: type I, dysplastic transverse process (a unilateral, b: bilateral); type II (a: unilateral, b: bilateral); incomplete lumbarisation /sacralisation with a unilateral or bilateral pseudoarthrosis; type III, complete lumbarisation/sacralisation (a; unilateral, b: bilateral); and type IV, mixed.

How to site this article: Harsha Kumar, K M Adarsh, Devdas Acharya, G Ravichandra, U S Vinayaka. Prevalence of lumbosacral transitional vertebra in a tertiary care hospital. *MedPulse – International Medical Journal.* December 2016; 3(12): 1097-1101. http://www.medpulse.in (accessed 26 December 2016).

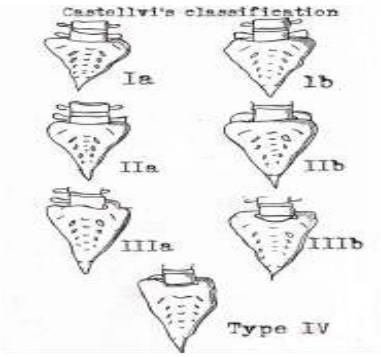

Figure 1: Diagrammatic illustration of Castellvi's classification of lumbosacral transitional vertebrae

Further these anomalies are classified using O' Driscoll 4-type classification system of S1-2 disc morphology in sagittal lumbar spine images[1,] depending on the presence or absence of disc material (Fig 2). In Type 1 no disc material is present. Type 2 denotes a small residual disc not extending for the whole AP diameter of the sacrum. Type 3 represents a well-formed disc extending for the whole AP diameter of the sacrum, while Type 4 is identical to Type 3 but with an abnormal upper sacral outline analogous to the "squaring" appearance on sagittal radiographs. Type 4 correlates with a fused LSTV (Castellvi Type III or Type IV)

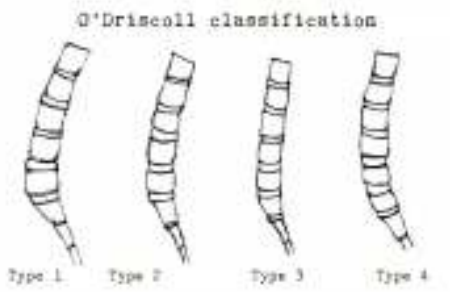

Figure 2: Diagrammatic illustration of O' Driscoll classification of lumbosacral transitional vertebra

On computed tomography (CT), these variants will be seen in the coronal and sagittal views in bone window setting with presumed last rib as 12[th3]. Inaccurate numbering may lead to an interventional procedure or surgery at an unintended level[5,6]. Bertolotti syndrome, the association between an LSTV and low back pain, is still controversial since Bertolotti first described it in 1917[7]. Various causes for the pain have been described[8], the pain may be caused by the hypermobile disc above LSTV; nerve root compression between the LSTV and the sacral ala can cause pain (Castellvi type II); the pseudoarticulation between the enlarged transverse process and the sacral ala or ilium may cause pain; patients with unilateral LSTV may have contralateral pain from the facetal joint.

MATERIALS AND METHODS

This is a hospital based retrospective study. All the patients who underwent abdominal CT between April 2016 to July 2016 (4 months) at Yenepoya Medical College Hospital, Mangalore meeting the inclusion and exclusion criteria were considered for the study. Sample size was calculated using the formula n =$4pq/D^2$= $4*10*90/ (5)^{2 =}$ 144. GE Bright speed 16 slice CT scanner was used for the study. Inclusion criteria included patients aged between 18 year to 85 years who have CT abdomen performed, with coronal and sagittal views of the spine. Images were attained by searching the imaging database and were reviewed by a radiologist. Exclusion criteria included cases with poor image quality, inadequate exposure of the lumbar spine and Inability to identify transitional vertebrae due to instrumentation. Transitional vertebra was assessed by identifying the last rib on both sides of the lower chest on coronal views and the corresponding vertebra were labelled as T12. Lumbar and sacral vertebra was identified by counting down from that level .If hypoplastic ribs were identified, the vertebra immediately beneath would be designated as L1. L5 vertebra with enlarged transverse process (more than 19mm) or transverse process psuedoarticulation with S1 vertebra were identified as lumbosacral transition vertebra and were further classified as lumbarisation of S1 or sacralisation of L5 vertebra.3D volume rendered reconstruction CT images was used to depict LSTV whenever possible . The findings of CT were divided in to six groups based on Castellvi classification 1) Type 1 A, B, 2) Type 2 A, B, 3) Type 3 A, B, 4) Type 4 O' Driscoll classification of lumbosacral junctions were identified and divided into the following four groups 1)Type 1, 2)Type 2, 3)Type 3, 4)Type 4

OBSERVATIONS

We gathered 144 patients with LSTV, 41% (N=59) were women and 59% (N=85) were male, with a mean age of 42 at the time of diagnosis. All patients were detected by reviewing plain CT scans. The prevalence of LSTV in our study was 10 % (N=14). The morphologic distribution based on Castellvi's classification (Figure 3) was 7% type Ia (n=1), 14% type 1b (n=2), 30% type Iia (n=4), 14% type Iib (n=2), 14% IIIa (n=2), 7% IIIb (n=1) and 14% type IV (n=2), type IIa being the most prevalent type among the population studied.(Figures 4,5,6,7).

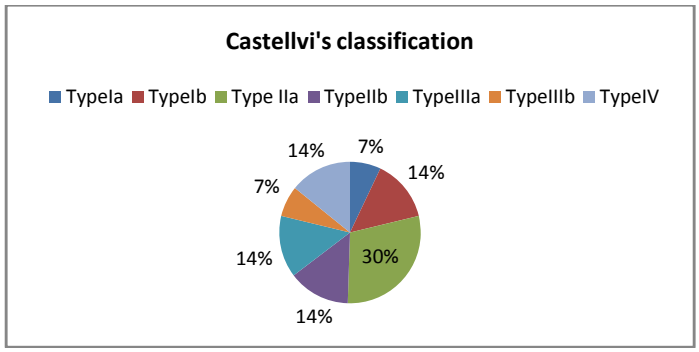

Figure 3: Pie chart demonstrating distribution of LSTV types according to Castellvi's classification

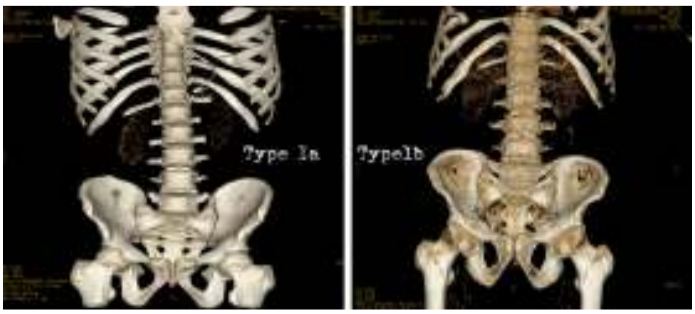

Figure 4: Volume rendered reconstruction of Type Ia and Type Ib types of LSTVs according to Castellvi's classification

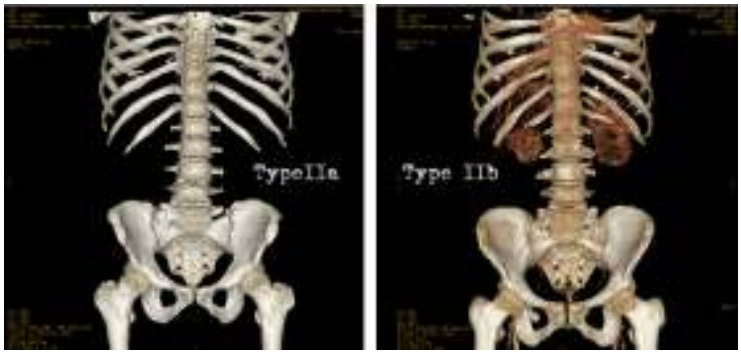

Figure 5: Volume rendered reconstruction of type IIa and IIb LSTVs according to Castellvi's classification

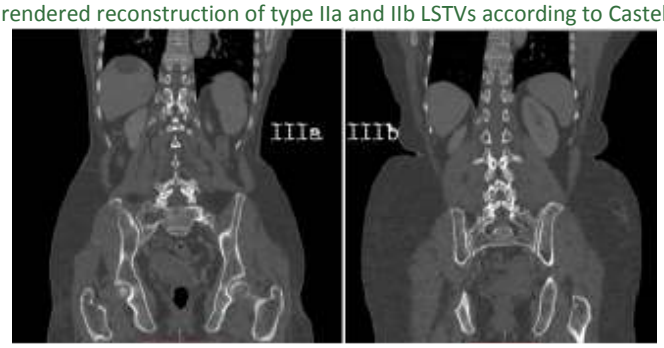

Figure 6: Coronal sections of the lumbosacral spine showing Type IIIa and IIIb of LSTVs based on Castellvi's classification.

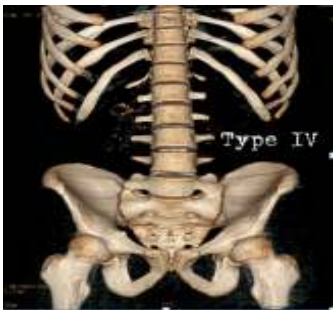

Figure 7: Volume rendered reconstruction of Type IV type of LSTVs according to Castellvi's classification.

The morphologic distribution based on O' Driscoll classification (Figure 8) was 50% type II (n= 7), 29% III (n= 4) and 21% type IV (n= 3), type II being the most prevalent type among the population studied. (Figures 9, 10, 11). We did not encounter any case of O' Driscoll type I LSTV in this study.

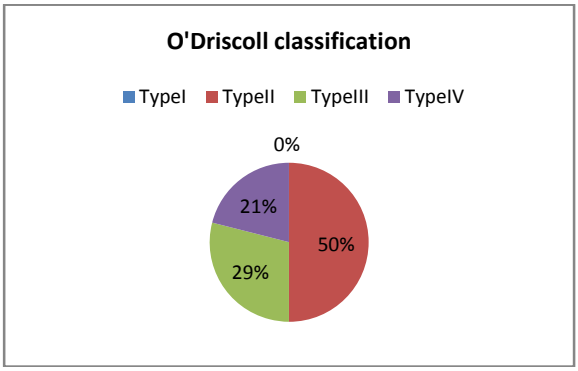

Figure 8: Pie chart demonstrating distribution of LSTV types according to O'Driscoll classification

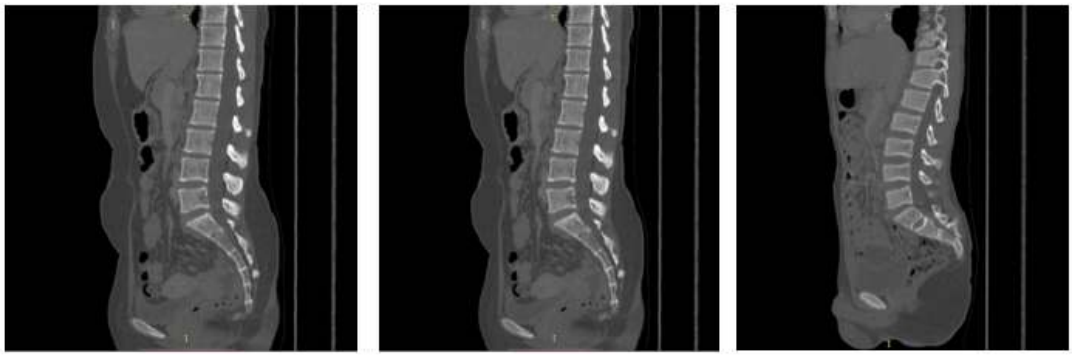

Figure 9: Sagittal CT sections shoing O'Driscoll Type 2 LSTV
Figure 10: Sagitall CT section showing O'Driscoll Type3 LSTV
Figure 11: Sagittal CT sections showing O'Driscoll Type4 LSTV

Other anatomic landmarks we used were useful to detect LSTV were the level of aortic bifurcation at the L4 vertebra in 70% of cases, the right renal artery at the L1-L2 intervertebral disc in 88% cases.

DISCUSSION

Improper numbering of lumbosacral transitional vertebra leads to increased patient costs and consultations for evaluation of back pain which is frequently associated with this condition. In our study we found 10% (n=14) prevalence of LSTV which is in keeping with other study populations[4] . As described in previous studies by Konin and Walz[3], we used Castellvi and O' Driscoll classification system to determine the types of LSTVs. The prevalent types were Castellvi LSTV type II and O' Driscoll LSTV type II. Treatments like steroid injections that need to targeted, may be inadequate due to injection into an anomalous articulation of LSTV And erroneous surgeries for degenerative interverterbal disc disease which leads to morbidity and repeated surgeries. In our study LSTVs were reliably indentified by counting down

from last rib and identifying enlarged transverse process of L5 vertebra or psuedoarticulation of L5 transverse process with S1 Several methods have been employed to detect a lumbarized S1 or a sacralized L5 including MR localisers [9], counting vertebrae from S5 upwards, locating the iliolumbar ligaments on MRI[10], the position of the aortic bifurcation[11], the right renal artery or the conus medullaris as the landmarks[12] .On plain radiography the lumbar vertebra with the longest transverse process on the frontal view is considered to be L3, horizontally oriented lumbar vertebra on the lateral view is considered to be L4, lateral and Ferguson radiographs have been used in these studies[3.13] .

CONCLUSION

LSTV of the spine are a cause of biomechanical alterations within the spine. CT imaging of the spine may be used to accurately number an LSTV .Prompt identification of LSTV can help avoid unnecessary interventions at the wrong spinal level. Most patients in our study were admitted with chronic back pain, reviewing the history when available showed that patients had several causes for their pain including mechanical pain, lower abdominal pain, sacroiliac joint pain, neurogenic pain and hip pain .Many of these symptoms could be explained by other imaging findings, however few may probably be attributed to LSTV, Further research will be required in this aspect . Possible causes of pain associated with LSTV include degenerative disc disease, nerve impingement by enlarged transverse processes and facetal joint degeneration.

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Source of Support: None Declared
Conflict of Interest: None Declared