

Partial Lumbosacral Transitional Vertebra: A case of unilateral sacralization and its embryological and clinical implications

Bolla SR

Department of Biomedical Sciences

School of Medicine

Nazarbayev University

Nur-Sultan City, Kazakhstan.

Corresponding Author

Srinivasa Rao Bolla

Department of Biomedical Sciences

School of Medicine

Nazarbayev University

Nur-Sultan City, Kazakhstan.

E-mail: bolla.srinivas@gmail.com

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ABSTRACT

Lumbosacral transitional vertebrae (LSTV) are congenital anomalies of the lumbosacral spine. In lumbosacral transitional vertebrae either sacralization of the lowest lumbar segment or lumbarization of the upper sacral segment of the spine is seen. One of the sacra from macerated cadavers has shown sacralization with unilateral fusion of transverse process on right side, while on left side it was normal, there was no fusion of bodies and left transverse processes of lumbosacral transitional vertebrae and first sacral vertebrae. Since there is association between lumbosacral transitional vertebrae and low back pain (LBP) and other spinal pathology; this anomaly has increased clinical interest. The morphological details of the case, its embryological and clinical implications from the literature are reviewed.

KEY WORDS

Low back pain, Lumbosacral transitional vertebrae, Sacralization

INTRODUCTION

Lumbosacral transitional vertebrae (LSTV) are congenital anomalies of the lumbosacral spine first reported by Bertolotti in 1917.¹ He also described an association between LSTV and LBP. A transitional vertebra may have varying formations, most frequently; the fifth lumbar vertebra shows signs of assimilation to the sacrum, a condition often referred to as sacralization. The common feature; being an atypical lumbosacral articulation or fusion between the transverse process (es) of the most inferior lumbar vertebrae and the sacrum. According to Castellvi's classification system based on the type of articulation between the transverse processes and the sacrum, Type I is defined as a large transverse process measuring at least 19 mm in width, Type II is an actual diarthrodial joint between the last transverse process and the sacrum, and Type III is a bony union between the last transverse process and the sacrum.² This may occur unilaterally or bilaterally. In case of lumbarization, the first sacral vertebra shows signs of transition to a lumbar configuration.³ LSTV has drawn attention because of its clinical implications associated with spinal pathology.

CASE REPORT

Maceration of cadaveric remains is a regular procedure in department of Anatomy. One of the sacra obtained after maceration had shown unilateral fusion of fifth lumbar vertebra with the sacrum, the fusion was incomplete and unilateral on right side. The transverse process on right side was large and fused with transverse process of first sacral vertebra, while the transverse process on left side was normal in size and shape. Viewing anteriorly, it was observed that the height of body of LSTV was more on the right side than the left. Intervertebral gap and diameter of intervertebral foramen between bodies of LSTV and first sacral vertebra was narrow on right side than the left. Viewing posteriorly it was observed that there was no fusion between spinous processes of LSTV and first sacral vertebra.

DISCUSSION

LSTV are congenital anomalies of the lumbosacral spine. The prevalence of LSTV reported in the literature ranges from 4 to over 35%.⁴ Developmental genetics are the predisposing



Figure 1. Posterior aspect of L5TV showing fusion of transverse processes of L5 and S1 on right side.



Figure 2. Anterior aspect of L5TV showing fusion of transverse processes of L5 and S1 on right side.

factors for LSTV. During development of embryo, the axial skeleton is developed from the paraxial mesenchyma that surrounds the neural tube. The mesenchyma undergoes craniocaudal segmentation, resulting in clusters of cells called somites.⁵ The somites are segmentally organized in pairs on both sides of the neural tube and are specific for the axial level at which they are positioned.⁶ This segmental identity of the somites is determined by different Hox-genes in the presomitic mesoderm. The normal patterning of lumbar and sacral vertebrae as well as the changes in the axial pattern, such as LSTV, results from mutations in the Hox-10 and Hox-11 paralogous genes.^{6,7}

Studies have reported association of this anomaly with spinal pathology; Bertolotti syndrome, the association between an LSTV and LBP, is controversial and has been both supported and disputed since Bertolotti first described it in 1917. In most of the literature that supports Bertolotti syndrome, the implicated transitional segments are Castellvi types II-IV.⁸

It was reported that there is a strong relationship between the LSTV and LBP, lumbar disc degeneration, and herniation.⁹ The disc at the level above the fused segment has been found to be at increased risk of degeneration.¹⁰ Elster's study of 2000 patients reported that disc bulging or herniation nine times more likely above the transitional vertebra but with no difference in incidence of structural pathology (disk pathology, spinal and foraminal stenosis) in patients

with LSTV compared with those without transitional.¹¹ The LSTV resulting in overwork at that joint can cause arthritis, disc changes or spinal cord compression. The person is usually asymptomatic or may present with symptoms which include spinal or radicular pain, disc degeneration, L4/L5 disc prolapse, lumbar scoliosis and lumbar extradural defects.^{2,10} Otani et al. study also supports the hypothesis that more mechanical stresses are placed on the level above the transitional vertebra, with 83% of herniations occurring at the level immediately above.¹² Connolly et al. in a series of 48 patients with LBP and an LSTV assumed that when fused, the stress is transferred superiorly or to the contralateral facet joint if the fusion is unilateral.¹³ Tini et al. in a series of 4000 patients, reported no correlation between LBP and transitional vertebrae.¹⁴

Erken et al. found a significant association between sacralisation and cervical rib.⁵ The mechanisms responsible for the development of the lumbosacral spine may therefore influence the development of the cervical spine and vice versa. Kanchan et al. reported that LSTV have medicolegal implications in the forensic identification of the deceased.¹⁵ From a clinical view-point, lumbosacral transitional vertebrae can often be overlooked on plain radiographs and magnetic resonance imaging of the lumbar spine. Failure to recognize LSTV on imaging studies during the planning of spinal procedures may result in wrong level surgery.¹⁶

LSTV is a benign anatomical variation of the lumbosacral spine. However, the clinical significance of the condition is still unknown and its relation with LBP is controversial. In patients who present with LBP and a LSTV revealed by plain radiographs, the physician should be aware of secondary spinal disorders like disc degeneration and disc herniation above the LSTV, and/or facet joint arthrosis. In selected cases therefore, additional imaging methods like CT, MRI and SPECT may be considered. Furthermore, caution in numbering of lumbosacral vertebrae in symptomatic LSTV is of utmost importance in spinal surgery. It is essential to be alert to the possibility of transitional vertebrae when evaluating these imaging studies, particularly in the operative treatment of disc disease to avoid wrong level surgery.

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