



## SACRALIZATION OF FIFTH LUMBAR VERTEBRA ANITHA

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**Abstract :** Sacrum is a wedge shaped bone formed by the fusion of five sacral vertebrae with ossification of the intervertebral joints. Broadest superiorly, the sacrum articulates with the fifth lumbar vertebra, while inferiorly, it narrows to articulate with the coccyx forming four pairs of sacral foramina. But during the osteology demonstration class of undergraduate MBBS students a sacrum with five pairs of sacral foramina was detected. The sacrum may contain six vertebrae with five pairs of sacral foramina. It may be due to the development of an additional sacral element or fusion of fifth lumbar vertebra with first sacral vertebra or fusion of first coccygeal vertebra with fifth sacral vertebra. Sacralization of fifth lumbar vertebra has come into considerable prominence on account of fact that radiography has thrown its beam of light upon a condition about which very little was known.

**Keyword :** Sacrum, fifth lumbar vertebra, sacralization, sacral foramina.

### INTRODUCTION

Sacrum is a large, triangular fusion of five vertebrae and forms the posterosuperior wall of the pelvic cavity, wedged between the two innominate bones. Its blunted caudal apex articulates with the coccyx and its superior wide base with the fifth lumbar vertebra, forming four pairs of sacral foramina(1). Lumbosacral transitional vertebra (LSTV) are congenital anomalies of lumbosacral spine, involving lumbarization and sacralization(2). A lumbosacral transitional vertebra (LTV) is a congenital anomaly that occurs in 3% to 21% of people with and without low back pain (LBP)(3). At the cranial end of sacrum there is fifth lumbar vertebra which when fused with first sacral vertebra is known as sacralization of fifth lumbar vertebra. Similarly at the caudal end, the first coccygeal vertebra when fuses with the apex of sacrum, it is called as sacralization of coccygeal vertebra. Both these processes may generate additional fifth pair of sacral foramina (4). In this case, the sacrum had five pairs of sacral foramina due to the fusion of fifth lumbar vertebra to first sacral vertebra. Case is reported for variation in anatomy of sacrum and its clinical implications among Indian population as it is a less known variant.

### MATERIALS AND METHODS

During the osteology demonstration class of undergraduate MBBS students, a sacrum with five pairs of sacral foramina was detected. The transverse process, inferior articular facets and the body of the fifth lumbar vertebra fused with the first sacral

vertebra. This complete fusion resulted in the formation of five pairs of sacral foramina.



Dorsal view of sacrum showing five sacral foraminas



Ventral view of sacrum showing five sacral foraminas

### DISCUSSION

Normally the sacrum is formed by the fusion of five sacral vertebra and it contains four pairs of sacral foramina. Sometimes the fifth lumbar vertebra may fuse with the first sacral vertebra to form sacralization of fifth lumbar vertebra. It leads to the formation of five pairs of sacral foramina. Sacralization is commoner than lumbarization(4). The incidence of sacralization to lumbarization is approximately is 2:1(2). The Hox genes play an important role in the development of vertebrae. The Notch/Delta pathway genes are important both in somite production and as upstream links to Hox genes; FGF8 is also important in determining segment boundaries as well as axial identity. Recent research has provided convincing support for the Hox gene complex as a primary contributor in determining the final identity of a vertebra. The Hox genes responsible for determining lumbar and sacral vertebrae are Hoxa-9 (L1-L3) and Hoxd-9 (L3-Ca1) (6,7). Apart from Hox genes, the presence of ilium is required for the sacral transverse processes to develop. Hox genes are

not expressed in the developing ilium, instead, homeobox containing *Emx2* is expressed(6,7). O'Connell in 1951, has described occult sacralization, where the sacrum is high in the pelvis and the spinous process of the last lumbar vertebra may be with or just below the iliac crests. The lumbar spine shows five vertebrae, but the sacrum may be composed of six vertebral segments. Since these are not the cases of frank sacralization of fifth lumbar vertebra it is described as occult sacralization. Complete sacralization consists of complete body union between the abnormal transverse process and the sacrum. Incomplete sacralization shows a well defined joint line between the transverse process and sacrum. Both incomplete and complete sacralization may be either unilateral or bilateral(8). In 1984, Castellvi et al described a radiographic classification system identifying four types of Lumbo Sacral Transitional Vertebrae (LSTV) on the basis of morphologic characteristics. The system defines four types of LSTV with two sub groups. Subgroup(a) has the characteristic findings unilaterally and the findings are found bilaterally in Subgroup(b). Type I includes unilateral(Ia) or bilateral (Ib) dysplastic transverse processes, measuring at least 19 mm in width (craniocaudal dimension). Type II exhibits incomplete unilateral (IIa) or bilateral (IIb) lumbarization/sacralization with an enlarged transverse process that has a diarthrodial joint between itself and the sacrum. Type III LSTV describes unilateral (IIIa) or bilateral (IIIb) lumbarization /sacralization with complete osseous fusion of the transverse processes to the sacrum. Type IV involves a unilateral type II transition with a type III on the contralateral side.

In our present study, it comes under Type IIIb (LSTV), where sacralization with complete osseous fusion of the transverse processes to the sacrum has occurred bilaterally (3,5). Sometimes transitional vertebra can be associated with cervical rib. The presence of a cervical rib might be a clue to the existence of sacralisation or vice versa(9). In Bertolotti Syndrome, LSTV is associated with low back pain(5). There are many factors associated with LSTV that may potentially be the source of pain. The factors include disc degeneration, disc prolapse, spinal stenosis, nerve root compression, spondylolisthesis, sacroiliac joint pain, muscle, tendon or ligament strain or sprain, chemical irritation, vertebral collapse and damage to other nearby structures receiving innervation. Mogara et al. reported a fairly high incidence (21.5%) of LBP when associated with sacralization(2).Tini et al, in a series of 4000 patients, reported no correlation between low back pain and transitional vertebrae (5). It has been reported that the incidence of L5 sacralization is higher in patients with degenerative spondylolisthesis at L4-L5 than in the general population. It is possible that L5 sacralization contributes to the development of degenerative spondylolisthesis, lumbar disc degeneration and herniation, and low back pain. The sacralization of L5 is thought to cause stress concentration on L4-L5, which can accentuate development of degenerative spondylolisthesis and promote degenerative changes(11). Thus the sacralization of fifth lumbar vertebra is of paramount importance to surgeons.

#### REFERENCES

1. Standring S, ed. Gray's Anatomy, The Anatomical Basis of Clinical Practice. 40th Ed., London, Churchill Living Stone. 2008; 724-28.
2. Eyo M U, Olofin A, Noronha C, Okanlawon A, Incidence of Lumbosacral Transitional Vertebrae in Low Back Pain Patients. West African J of Radiology. April 2001; Vol. 8, No.1: 1- 6.
- 3.Brenner A K, Use of Lumbosacral Region Manipulation and Therapeutic Exercises for a Patient with a Lumbosacral Transitional Vertebra and Low Back Pain, J Orthopaedics Sports Physical Therapy. 2005; Vol. 35(6) : 368-376.
4. Rajani S, Sacrum with Five Pairs of Sacral Foramina . Indian J. of Anatomical Variations. 2011 ;Vol .4 : 138-140.

5. Konin G P , Walz D M, Lumbosacral Transitional Vertebrae: Classification, Imaging Findings and Clinical Relevance American Journal of Neuro Radiology. 2010;31:1778-86.
6. Pilbeam D, The Anthropoid Postcranial Axial Skeleton: Comments on Development, Variation and Evolution. Journal of Experimental Zoology. 2004; Vol.302B : 241-267.
7. Fromental-Ramain C et al. Specific and Redundant Functions of the Paralogous Hoxa-9 and Hoxd-9 genes on Forelimb and Axial Skeleton Patterning. Development 1996;122:461-472.
8. Prakash B S, Dr Padmalatha K, Dr Jagdish L Menda, Sacralization of Fifth Lumbar Vertebrae. Anatomica Karnataka J.2011;Vol.5,(1):65-68.
9. Kanchan T, Shetty M, Nagesh K R, Menezes R G, Lumbosacral Transitional Vertebra: Clinical and Forensic Implications. Singapore Medical J. 2009; 50(2): e85-87.
10. MacGibbon B, Farfan H F, Yochum and Rowes Essentials of Skeletal Radiology , A Radiologic Survey of Various Configurations of the Lumbar Spine. 3rd Ed., Lippincott, Williams & Wilkins.1979; Spine 4(3) : 258-266.
11. Chae-Gwan Kong, Jong-Soo Park, Jong-Beom Park, Sacralization of L5 in Radiological Studies of Degenerative Spondylolisthesis at L4-L5. Asian Spine Journal. 2008; vol.2, 1: 34- 37.

