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LUMBOSACRAL TRANSITIONAL VERTEBRAE AND ITS CLINICAL SIGNIFICANCE

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Abstract

Background: The human sacrum is a wedge shaped bone formed by fused five sacral vertebrae having four pairs of sacral foramina and forms the postero-superior wall of the bony pelvis. Lumbosacral transitional vertebra (LSTV) is a congenital anomaly which involves either the sacralization of the lowest lumbar and first coccygeal vertebra or lumbarization of uppermost sacral vertebra. These vertebral bodies demonstrate varying morphology, ranging from broadened transverse processes to complete fusion.

Material and methods: This study was carried out on 100 dry human sacra (70 male and 30 female) from Department of Anatomy, United Institute of Medical Sciences, UP, India. Morphological study was done on the sacrum and classified as per Castellvi's classification.

Result: We have highlighted 6 cases of LSTV out of 100 sacrum. Out of 6, 1 sacrum showed simultaneous sacralisation of 1st coccygeal vertebrae and incomplete lumbarisation of 1st sacral vertebrae, 4 sacrum showed complete sacralisation of 5th lumbar vertebrae and 1 sacrum showed complete lumbarisation of 1st sacral vertebrae.

Conclusion: Total incidence of LSTV was observed to be 6% in the present study. Obstetricians, radiologists, anesthetists, neurologists and orthopedic surgeons must know about the existence of this variation to be able to correctly investigate, diagnose and treat the patients presenting with unusual signs and symptoms. Also the awareness of this possible congenital anomaly is important before any spinal surgery to avoid the incorrect numbering of vertebrae and consequently wrong level spinal surgery.

Keywords: Lumbosacral Transitional Vertebra (LSTV), congenital anomalies, Low back pain.

Introduction

Lumbosacral transitional vertebrae (LSTV) are congenital anomalies of the lumbosacral spine, involving lumbarization of first sacral vertebrae and sacralization, either of last lumbar or first

coccygeal vertebrae. Its prevalence is 4-30% in general population [1]. Most frequently, the fifth lumbar vertebra shows signs of assimilation to the sacrum, a condition often referred to as sacralisation. In case of lumbarisation, the first sacral vertebra shows signs of transition to a lumbar configuration. Complete transition results in numerical abnormalities of the lumbar and sacral segments the lumbosacral junction is renamed according to the transition type, resulting in L4-S1 (sacralisation) and L6-S1 (lumbarisation) [2].

The Lumbosacral spine is important for protecting the spinal cord and spinal nerves, it plays role in posture and locomotion, supports the weight of the body,ransmits the weight of the head and trunk to the lower limbs. Low Back Pain in the presence of a LSTV is often referred to as Bertolotti‘s syndrome [3].

The major weight of the trunk when in the upright position is borne by skeletal structures. It is probable that the lumbar spine experiences more abuse from normal functions than any other part of the human skeleton [4]. To be able to give support to, and bear the weight of the body, the integrity of all the vertebrae in the spine, particularly in the lower back must be maintained. It is expected that jeopardy of this integrity by any pathology, either congenital or acquired, will affect the stability of the spine and therefore its biomechanics. It is on this basis that the presence of LSTV is believed to be associated with an increased liability for a person to develop various spinal complications.

The most accurate method of determining the lumbosacral transition is using AP and lateral lumbosacral radiographs combined with a 30° angled cranially directed AP plain radiograph the lumbar levels can now easily be defined on the radiograph by counting down from the T12 vertebra, defined as the vertebra from which the lowest rib originates. However, when MRI scanning is performed in absence of plain radiographs, particular attention for the existence of LSTV is necessary and additional knowledge and techniques are required [5].

Aim & Objectives

- To study the Lumbosacral vertebrae transition
- To find out the clinical significance of Lumbosacral transitional vertebrae

Material & Methods

The present observational study included an examination of 98 adult sacra (68 male & 30 female) available in the Department of Anatomy, UIMS, Prayagraj for the presence of LSTV. Only 6, out of 98 sacra showed Lumbosacral Transitional Vertebrae. We classified them using Castellvi classification.

Classification of LSTV according to Castellvi et al

Type I	Dysplastic transverse process	Unilateral (a) or bilateral (b) large triangular transverse process, at least 19 mm in width
Type II	Incomplete lumbarisation / sacralisation	Enlarged transverse process with unilateral (a) or bilateral (b) pseudoarthrosis with the adjacent sacral ala
Type III	Complete lumbarisation / sacralisation	Enlarged transverse process, with unilateral (a) or bilateral (b) complete fusion with the adjacent sacral ala
Type IV	Mixed	Type IIa on one side and type IIIa on the other

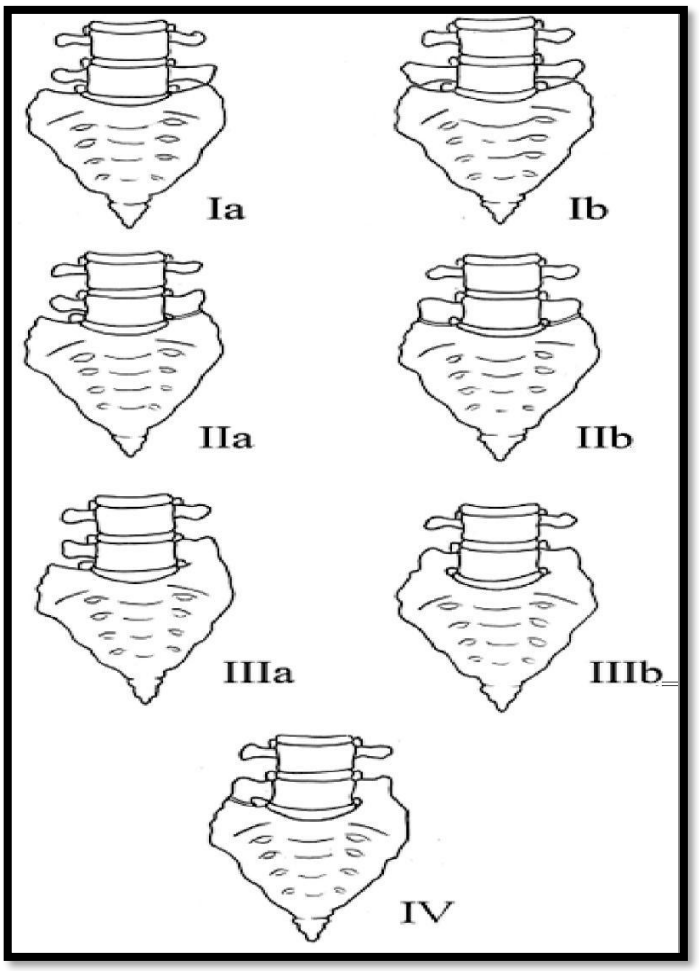

Fig.1. Anterior view of the sacralized transitional L5 vertebra showing left sided dysplastic transverse process


Fig. 2. Posterior view of the sacralised L5 transitional vertebra

Observation & Results

Fig 3: Arrow showing complete fusion on Left Lateral surface of sacralised transitional vertebra

Fig. 4. Anterior view of the transitional vertebra showing complete sacralization of fifth lumbar vertebra

Fig. 5. Posterior view of the transitional vertebra showing complete sacralization of fifth lumbar vertebra

Fig 6: showing complete fusion on right Lateral surface

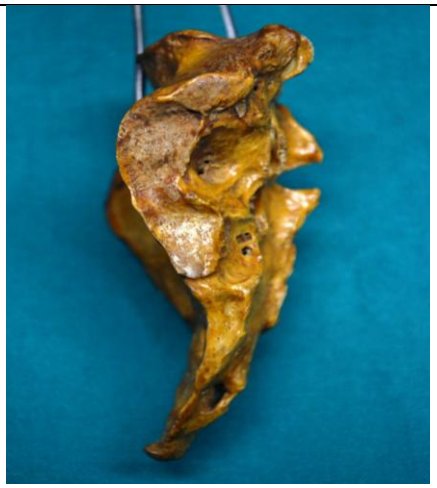

Fig 7: showing complete fusion on left Lateral surface

Fig. 8 Photograph showing Anterior view of the lumbralized transitional vertebra with 3 ventral sacral foramina (arrow marked). S1 is not a part of sacrum

Fig. 9. Photograph showing Posterior view of the lumbralized transitional vertebra with 3 dorsal sacral foramina (arrow marked).

In the present study of 100 sacra, 70%were male and 30% were female. Only 6% showed Lumbosacral Transitional Vertebrae and 94% were normal sacra. Out of 70 male sacra, 4(5.71%) and out of 30 female sacra, 2(6.67%)were found to be Lumbosacral Transitional Vertebrae.

Table 1. Showing incidence of Lumbosacral Transitional Vertebrae in the current study

Types	No. of sacrum	Male	Female
Lumbosacral transitional vertebrae	6 (6%)	4 (5.71%)	2 (6.67%)
Normal vertebrae	94 (94%)	66 (94.3%)	28 (93.33%)
Total	100	70	30

Out of 6 LSTV, 4 sacrum showed complete sacralisation of 5th lumbar vertebrae, 1 sacrum showed simultaneous sacralisation of 1st coccygeal vertebrae and incomplete lumbarisation of 1st sacral vertebrae and 1sacrum showed complete lumbarisation of 1st sacral vertebrae.

Table 2. Showing incidence of sacralisation, lumbarisation & fusion of coccyx in cases of LSTV

Types	Male	Female	Total
Sacralisation	3	1	4
Lumbarization	-	1	1
Coccyx fusion	1	-	1

Out of total 6 Lumbosacral Transitional Vertebrae, 5 fall in Type III of Castellvi classification, all of which were bilateral (IIIb). 1 fall in Type IV (mixed) cateogory of Castellvi classification in which we found unilateral pseudoarthrosis with the adjacent sacral ala on the left side and complete fusion with the adjacent sacral ala on the right side.

Table 3 showing incidence of types of LSTV

Type of LSTV	Male	Female	Total
Type I	-	-	-
Type II	-	-	-
Type III b	4	1	5
Type IV	-	1	1

Discussion

Our present study shows that the prevalence of LSTV is 6%. Prevalence reported by other workers.

Research worker	Year	Transitional vertebrae (%)
Castellvi et al	1984	60(30%)
Hahn et al	1992	24(12%)
Hald et al	1995	792(14%)
Peh et al	1999	17 (13.2%)
Luoma et al	2004	46 (30%)
Delport et al	2006	90(30%)
Mohoto et al	2010	42(12%)
Vandana et al	2011	38(18.4%)

The occurrence of LSTV is linked to its embryological development and ossification defects. Each vertebra is formed from the combination of the caudal half of one sclerotome and the cranial half of succeeding sclerotome [4]. Thus, LSTV is caused by border shifts, cranial shift resulting in sacralisation of last lumbar vertebrae and caudal shift resulting in lumbarisation of first sacral vertebrae. These processes result from mutations in the HOX- 10/11 and paired box Pax1/9 genes [5,6]. Ossification defects are other potential cause of variation but both result in same morphology. LSTV affects the position of the inter-crestal line (Tuffier's line) which is used as a landmark for needle insertion [7]. In the presence of transitional lumbosacral segment, the intervertebral disc is significantly narrower than its counterpart leading to statistically higher incidence of disc herniation with lower mean age of occurrence [8].

In many sports, and golf in particular, the presence of LSTV places lumbar spine under significant unnatural stress that could potentially lead to Bertolotti syndrome in patients too young to normally

be at risk for degenerative spinal changes [9]. LSTV is not a contraindication to any activity, sports participation or employment, but may predispose to back pain or coccygeal pain since this area is mechanically different than normal. Due to fusion of sacrum and coccyx, A-P diameter of pelvic outlet does not increase during second stage of labour which may lead to prolonged labour and perineal tears [10]. It supports the notion of a variant position of lumbosacral dermatomes [11]. In forensic practice, this anomaly may be useful for personal identification of skeletal remains [12]. Caution in numbering of affected segment in symptomatic LSTV is of utmost importance in spinal surgery leading to an interventional procedure at an unintended level. Incorrect numbering can theoretically lead to problems with the administration of epidural or intradural anaesthetics in patients with LSTV [13].

Transitional vertebrae are likely to affect the biomechanics of the lumbar spine. The lack of mobility at a fused transitional level or the decreased mobility at a partially fused or anomalously articulating vertebra lends stabilization to this level. This may be explained by the altered biomechanics from the anomalous joints between the LSTV and sacrum. First, there is restricted mobility between the transitional vertebra and sacrum due to the aberrant articulation and/or bony fusion [14]. The load can, thus be effectively absorbed by the fused transverse process or the anomalous joint decreasing motion and relieving stress on the intervertebral disc. The increased stability between LSTV and the sacrum can potentially lead to hypermobility above the transitional segment, at the ipsilateral anomalous articulation and/or at the contralateral facet joint [15].

Lumbosacral transitional vertebra affects the position of the intercrestal line (Tuffier's line) which corresponds to the level L4/L5 and is used as a landmark for needle insertion [16]. Sacralization of fifth lumbar vertebra may cause greater difficulty during labour because of less mobile pelvis and it may results in low back pain problem. Malanga and Cook reported wrong level emergency decompression surgery, in a patient with cauda equina syndrome due to false assessment of complete lumbarization of S1 [17]. It supports the notion of a variant position of lumbosacral dermatomes. In forensic medicine, this anomaly can be very useful for identification of skeletal remains [15].

Conclusion

Total incidence of LSTV was observed to be 6% in the present study. Obstetricians, radiologists, anesthetists, neurologists and orthopedic surgeons must know about the existence of this variation to be able to correctly investigate, diagnose and treat the patients presenting with unusual signs and symptoms. Also the awareness of this possible congenital anomaly is important before any spinal surgery to avoid the incorrect numbering of vertebrae and consequently wrong level spinal surgery.

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