

Original article

A Morphometric Study of Complete Agenesis of Dorsal Wall in Dry Human Sacrum in West Bengal Population

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Abstract

Introduction: Congenital malformations such as lumbosacral transitional vertebrae and spina bifida occulta constitute rare anomalies and may cause low back pain. A transitional vertebra is characterized by elongation of one or both transverse processes, leading to the appearance of a sacralized fifth lumbar vertebra or a lumbarized first sacral vertebra. Total spina bifida occulta of sacrum is a developmental anomaly that corresponds to the complete dorsal wall agenesis and incomplete closure of the vertebral column.

Methods: The study was done on one hundred and twenty five completely ossified undamaged dry human sacra of undetermined age and sex in the department of Anatomy in NRS Medical College and Hospital, Kolkata .

Observations: In the present study, among one hundred twenty five dry sacra of unknown sex we found two cases in which one presented with completely sacralised fifth lumbar vertebra and total spina bifida, extended from first to fifth sacral vertebra and another having complete spina bifida.

Results: Sacrum with complete spina bifida was found in 2 among 125 sacrum (1.6%). The sacralised specimens could be incorporated in Castellvi's type IIIb with open spina bifida.

Conclusions: Knowledge of these variations is important to diagnose lower back pain, sciatica, Bertolotti's syndrome and this may lead to failure of caudal epidural block.

Key words: Spina bifida, sacrum, sacralisation, lumbosacral transitional vertebra

INTRODUCTION

The lumbosacral spine not only protects the spinal cord and spinal nerves but also support and transmits weight of the body to the inferior extremity and thus plays an important role in posture. Lumbar vertebrae is characterized by large kidney shaped body, transverse processes, stout pedicle and lamina, articular processes and a short median dorsal spinous process. The fifth lumbar vertebrae have a substantial transverse process which is continuous with the whole of the pedicle and encroaching on the body. The body of the fifth lumbar vertebra articulates with sacrum at the

lumbosacral angle. The sacrum is a large, triangular bone formed by the fusion of five vertebrae and it forms the postero-superior wall of the pelvic cavity, wedged between the two innominate bones. In the dorsal surface median sacral crest is formed by the fusion of three or four spinous processs of sacral vertebrae. Below the fused third or fourth spine there is an arched sacral hiatus in the posterior wall of the sacral canal. The sacral canal contains sacral and spinal nerve roots, the cauda equina, filum terminale externa, fibro fatty tissue, epidural venous plexus and spinal meninges.¹

Sacral spina bifida occulta (SSBO) is a term that corresponds to the incomplete closure of sacral canal. The condition may refer to a range of anomalies, varying from partial defect of the posterior arch of some vertebrae to pan-sacral S1–S5 spina bifida.² It can cause lower back ache due to compression of nerve roots and may also cause the failure of caudal epidural block.

Lumbosacral transitional vertebrae (LSTV) are congenital anomalies of the lumbosacral region, results in transitional or intermediary vertebrae with mixture of lumbar and sacral characteristics which includes sacralisation of fifth lumbar vertebra or lumbarisation of first sacral vertebra.³ Bertolotti 1st observed the LSTV in 1917 and stated that these abnormal vertebrae may produce low back pain due to arthritic changes which occur at the site of false articulation.⁴ The various types of LSTV are also important for anthropological implications, bioarchiological studies, and medicolegal identifications.

AIMS AND OBJECTIVE

To study the incidence of complete agenesis of dorsal wall of sacrum in Indian population & compare it with incidence among various races of the world.

MATERIALS AND METHOD

The present study has been carried out on 125 completely ossified undamaged dry human sacra of undetermined age and sex in the department of Anatomy in NRS Medical College and Hospital, Kolkata during one year time. Each sacrum is examined for the complete agenesis of the dorsal wall. Representative photographs of different sacrum having complete agenesis of the dorsal wall are taken using a digital camera.

RESULTS

Sacrum with complete agenesis of dorsal wall was found in 2 among 125 sacrum (1.6%). In one sacrum total spina bifida occulta with non closure

of median sacral crest from S1–S5 laminae was seen. (Fig: 1) Another sacrum demonstrated total spina bifida occulta as there was non closure of median sacral crest from S1–S5 laminae. Additionally, L5 was found completely fused with the base of the sacrum and presented enlarged transverse processes which joined with the ala of sacrum. (Fig: 2,3)

After careful observation of the studied bones, neither pathological conditions such as tumors, nor traumas such as fractures were documented.

1. Srijit D, Shipra P. Spina bifida with higher position of sacral hiatus: a case report with clinical implications, *Bratisl Lek Listy*, 2007; 108(10–11): 467–9.
2. Keith. L. Moore, T. V. N. Persaud, *The Developing human, clinically oriented embryology Skeletal system*. 8th edition, published by saunders, Elsevier, Philadelphia, 2008: 344-346



Fig 1 : Sacrum showing complete dorsal wall agenesis.



Fig 2 a: Sacrum (dorsal surface) showing complete ageneses of dorsal wall along with bilateral sacralization of fifth lumbar vertebrae, which incorporates in Castellvi’s type IIIb.



Fig 2 b: Sacrum (pelvic surface) showing complete bilateral sacralization of fifth lumbar vertebrae which incorporates in Castellvi’s type IIIb.

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DISCUSSION

In our study the incidence of complete ageneses of dorsal wall in sacrum was 1.6%. The incidence of complete ageneses of dorsal wall in sacrum varies from 0.98% to 4.3% in different literature. The incidence of complete spina bifida in studies of Kumar V et al⁵, Nagar S K⁶ and Ali S et al⁷ nearly correspond with our finding (1.6%). But the studies of Senoglu et al⁸, Kiran VP⁹, Nagendrappa RB et al¹⁰, Mishra M et al¹¹ and Akhtar MJ¹² showed higher prevalence of complete spina bifida. Whereas, lower prevalence was seen in studies of Ukoha UU et al¹³ in Nigerian population and in studies of Shewale S N¹⁴ in Indian population. (Table :1)

Table 1: Comparison of incidence of complete dorsal wall ageneses by different authors

Sr.no.	Author (Year of Study)	Incidence of complete spina bifida (%)
1	Kumar V et al ⁵ (1992)	1.49%
2	Nagar S K ⁶ (2004)	1.5%
3	Senoglu et al ⁸ (2005)	2.08%
4	Kiran V P et al ⁹ (2011)	2%
5	Shewale S N et al ¹⁴ (2013)	0.98%
6	Ukoha UU et al ¹³ (2013)	1.2%

7	Ali S et al ⁷ (2013)	1.6%
8	Nagendrappa RB et al ¹⁰ (2014)	3%
9	Mishra M et al ¹¹ (2014)	4.3%
10	Akhtar MJ ¹² (2015)	2.58%
11	Present study (2016)	1.6%

The prevalence rate of LSTV in general population varies from 4 to 35.9% based on diagnostic criteria, imaging techniques and on the clinical presentation of the patients.¹⁵ Kamanli et al. found LSTV in 37.8% of the cases and in 0.02% of the population, LSTV and SSBO coexisted.¹⁶ In the study of Taskaynatan et al. 4.3% of the patients with low back pain was diagnosed with SSBO, while 0.2% cases coexisted with LSTV and SSBO.¹⁷

Castellvi et al. in 1982 classified the variant LSTVs in four types, in type I, a dysplastic large and triangular in shape transverse process is observed unilaterally (Type Ia) or bilaterally (Type Ib), in type II incomplete lumbarization or sacralization is present unilaterally (Type IIa) or bilaterally (Type IIb), in type III complete lumbarization or sacralisation exists unilaterally (Type IIIa) or bilaterally (Type IIIb), while in type IV a mixed complete and incomplete on the other side lumbarization or sacralization is present (I). Our sacralised case could be incorporated in Type IIIB, as complete sacralisation was observed on the both side.¹⁸

Bertolotti stated that the existence of LSTV may be responsible for unexplained low back pain due to modifications of the biomechanics of the lumbar spine.⁴ Chronic, persistent low back pain and

radiographically identified LSTV constitute the characteristics of Bertolotti's syndrome.

Preoperatively, SSBO may cause failure of caudal epidural block, whereas ultrasonography and fluoroscopy may appear helpful.⁸ The malformation may affect the surgical outcome during screw fixation, jeopardizing iatrogenic injury of the sacral nerves.¹⁹ So, Correct segmentation and visualization by radiographic evaluation of the spine is important before orthopaedic, gynaecological and neurosurgical procedures in the lumbar region.

The occurrence of sacralization may be linked to its embryological development and osteological defects, results from mutations in the HOX- 10 and HOX-11 paralogous genes.²⁰

CONCLUSION

Awareness of the morphological variations of the sacrum is essential for radiologists, anesthesiologists and spine surgeons. Congenital anomalies, such as the lumbosacral transitional vertebrae and the complete agenesis of dorsal wall or complete spina bifida may cause confusion in the differential diagnosis or jeopardize the surgical outcome if not taken in mind. So, understanding about this variation may decrease the failure rate of caudal epidural anaesthesia & minimizes the complications during surgeries.

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