

A Cadaveric Study of Sacralization of Fifth Lumbar Vertebra

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ABSTRACT

Introduction: In humans, sacrum consists of five fused sacral vertebrae. Anatomically, this fusion provides strength and stability to the pelvis and transmits the weight of the body to the pelvic girdle through the sacroiliac joints. Lumbosacral transitional vertebrae (LSTVs) are congenital anomalies of the lumbosacral region, which include sacralization of fifth lumbar vertebra and lumbarization of first sacral vertebra. Low back pain is quite a common ailment affecting about 80% of the population in their lifetime. Lumbosacral transitional vertebra is one of the causes of low backache.

Objective: (1) Prevalence of sacralization of fifth lumbar bone. (2) Prevalence of various types of fusion.

Materials and methods: In the present study, 100 cadaveric spinal cords were examined in the Department of Anatomy, Sarojini Naidu Medical College, Agra, Uttar Pradesh, India.

Results: In the present study of 100 adult cadaveric human sacra, 61 were male and 39 were female. Out of 100 sacral bones, 17 showed sacralization of fifth lumbar vertebrae and remaining 83 were normal vertebra. Out of 17 sacralized bones, 15 bones showed bilateral sacralization and only 2 bones showed unilateral sacralization.

Conclusion: Being a cause of low backache, knowledge of sacralization is of great importance for not only the orthopedician but also for radiologist and physiotherapist. Correct knowledge of presence of LSTV may help in correct treatment with appropriate rehabilitation.

Keywords: Genes, Low back pain, Lumbar vertebra, Sacralization, Sacrum.

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INTRODUCTION

In humans, sacrum consists of five fused sacral vertebrae. Anatomically, this fusion provides strength and stability

to the pelvis and transmits the weight of the body to the pelvic girdle through the sacroiliac joints. A healthy vertebral column of humans can bear approximately 355 kg weight and approximately 152 kg of tearing strain. Its weakest part is in the neck, which normally carries least weight.¹

Lumbosacral transitional vertebrae are congenital anomalies of the lumbosacral region, which include sacralization of fifth lumbar vertebra and lumbarization of first sacral vertebra. This phenomenon was observed the first time by Bertolotti.² This condition occurs due to defect in the segmentation of the lumbosacral spine during development.

Low back pain is one of the most prevalent morbidity among young and elderly population. Its prevalence may be approximately up to 80% among elderly population.³ This is also the major cause of handicap in doing daily routine activities among sufferers.

Sacralization may cause difficulty during labor in young females because of less mobile pelvis and it may be the reason of low back pain problem.

During embryonic life, vertebral column develops from the sclerotome, portions of the somites, which are derived from the paraxial mesoderm.

During the fourth week, sclerotome cells migrate around the spinal cord and notochord to merge with cells from the opposing somite on the other side of the neural tube. As development continues, the sclerotome portion of each somite also undergoes a process called resegmentation. Resegmentation occurs when the caudal half of each sclerotome grows into and fuses with the cephalic half of each subjacent sclerotome. Thus, each vertebra is formed from the combination of the caudal half of one somite and the cranial half of its neighbor. Patterning of the shapes of the different vertebrae is regulated by homeobox (HOX) genes.⁴

The HOX11 group is essential for the genesis and the overexpression of HOX11 genes is expected to produce signs of sacralization or caudalization at other levels of the axial skeleton. This overexpression in varying degrees may create variants of the sacrum containing six vertebrae with complete and incomplete fusion of the various components of vertebrae. The combined effect of mutation of HOX11 and paired-box (PAX1 and PAX9) gene expression causes several types of sacralization.⁵

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Table 1: Gender (sex)-wise distribution of sacralization of fifth lumbar vertebra (n = 100)

	Male		Female		Total	
	No.	%	No.	%	No.	%
Sacrum examined	61	61	39	39	100	100
Prevalence of sacralization of 5th lumbar vertebrae	11	64.71 (18.03)	6	35.29 (15.39)	17	100 (17)

Therefore, knowledge of sacralization of lumbar vertebrae is helpful for orthopedic surgeons, obstetricians, clinical anatomists, radiologists, forensic experts, morphologists, architects, and anthropologists.

Thus, the present study is carried out to know the prevalence and type of sacralization of the fifth lumbar vertebra.

MATERIALS AND METHODS

Study Design

Cross-sectional study.

Source of Data

All the cadaveric bones available in the Department of Anatomy, Sarojini Naidu Medical College, Agra, Uttar Pradesh, India, after applying inclusion and exclusion criteria were included in the study.

Exclusion Criteria

- Damaged, mutilated, and deformed sacra were excluded.
- Sacrum of children (identified with observation of cadaver and other bones of body).

Data were collected by naked eye observation by two observers separately regarding inclusion or exclusion of bones in the study and type of fusion. In case of any discrepancy, help of third observer was taken.

Types of fusion were classified as follows:

- Complete fusion between the fifth lumbar vertebra and the first sacral vertebra
- Incomplete fusion between the fifth lumbar vertebra and the first sacral vertebra
- Bilateral sacralization consists of a bony union between the abnormal transverse process and the sacrum on both sides.
- Unilateral sacralization shows a bony union between the abnormal transverse process and the sacrum either on right side or left side.

Observations

Totally, 100 adult cadaveric bones were included in the study.

In the present study of 100 adult human sacra, 61 (61%) were male and 39 (39%) were female sacra;

Table 2: Classification of sacralization of fifth lumbar vertebra (n = 17)

Sex	Unilateral sacralization		Bilateral sacralization	Total
	Right	Left		
Male	7	3	1	11
Female	4	1	1	6
Total	11	4	2	17

Table 3: Type of sacralization of fifth lumbar vertebra among different gender

	Male	Female	Total
Complete	5	3	8
Incomplete	6	3	9

17 (17%) sacra showed sacralization of fifth lumbar vertebrae and remaining 83 were normal having no lumbar bone fused. Among 17 sacralized bones, 64% were male bones and remaining 35.29% were female bones. Among males, prevalence of sacralization was 18.03% and among females, prevalence of sacralization was 15.39% (Table 1).

Out of 16 sacralized bones, 15 bones showed bilateral sacralization and only 2 bones showed unilateral sacralization (Table 2).

Out of 17 sacralized bones, 8 bones showed complete fusion between fifth lumbar vertebra and first sacral vertebra, and remaining 9 bones showed incomplete fusion between fifth lumbar vertebra and first sacral vertebra (Table 3).

DISCUSSION

The present study shows that the incidence of sacralization of the fifth lumbar vertebra is 16, out of which 10 are male sacra and 6 are female sacra. Based on the literature, the incidence of sacralization varied by the following races. The incidence in our study was close to the races like Australian aboriginals 18%, Indians 16% reported by Mitchell and Bustami⁶ and much higher than the races like Americans 3.6%, Natives of Britain 8%, and Arabs 10%. The incidence of sacralization was close that reported by Steinberg 14%, Vandana Sharma 14%, and the incidence was higher than reported by Kim 1.7%, Hughes 9.2%, Hald 7.8%, Hahn 7.5%, Kubavat 11.1%, and Chithrika 5%. The incidence among Gujarati population is 11.1%, which is more in males than females and Central India region is 14%.⁷

CONCLUSION

Knowledge of sacralization is not only enlightening for the orthopedic surgeons but also vital for the clinical anatomist, radiologists, forensic experts, morphologists, architects, and anthropologists. Hence, we are presenting such variation with emphasis on its clinical relevance. Incorrect numbering during the planning of spinal surgery may have serious consequences.

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