

A STUDY OF SACRALISATION OF FIFTH LUMBAR VERTEBRA

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ABSTRACT

Introduction: Sacrum consists of five fused sacral vertebrae. These are fused to provide strength and stability to the pelvis and transmit the weight of the body to the pelvic girdle through the sacro-iliac joints. The vertebral column can bear a weight of nearly 355 kg without crushing and a tearing strain of nearly 152 kg. Its weakest part is in the neck, which normally carries least weight. Lumbosacral transitional vertebrae (LSTV) are congenital anomalies of the lumbosacral region, which includes sacralisation of fifth lumbar vertebra and lumbarisation of first sacral vertebra observed for the first time by Bertolotti in 1917. This condition occurs due to defect in the segmentation of the lumbosacral spine during development and the combined effect of mutation of homeobox (HOX 11) & paired-box (PAX1 & PAX9) gene expression causes several types of sacralisation. Low back pain is quite a common ailment affecting about 80% of the population in their life time. This abnormality can be diagnosed by plain radiography.

Materials and Methods: In the present study 100 adult human sacra were examined in the department of Anatomy, Mysore Medical College and Research Institute, Mysore, Karnataka.

Observations and Results: In the present study of 100 adult human sacra 71 were male and 29 were female sacra. Out of 100 sacral bones 16 sacra showed sacralisation of fifth lumbar vertebrae and remaining 84 was normal vertebra. Out of 16 sacralised bones, 15 bones showed bilateral sacralisation and only 01 bone showed unilateral sacralisation.

Conclusion: Knowledge of sacralisation is not only enlightening for the orthopaedic surgeons, also vital for the Clinical Anatomists, Radiologists, Forensic experts, Morphologists, Architectures and Anthropologists. Hence we are presenting such variation with emphasize on its clinical relevance. Incorrect numbering during the planning of spinal surgery may have serious consequences.

KEY WORDS: Sacralisation, Lumbar vertebra, Sacrum, Genes, Low back pain.

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INTRODUCTION

Sacrum consists of five fused sacral vertebrae. These are fused to provide strength and stabil-

ity to the pelvis and transmit the weight of the body to the pelvic girdle through the sacro-iliac joints. The vertebral column can bear a weight

of nearly 355 kg without crushing and a tearing strain of nearly 152 kg. Its weakest part is in the neck, which normally carries least weight [1].

The sacrum may contain six vertebrae, by development of an additional sacral element or by incorporation of the fifth lumbar or first coccygeal vertebrae. Inclusion of the fifth lumbar vertebra (sacralization) is usually incomplete and limited to one side. In the most minor degree of the abnormality a fifth lumbar transverse process is large and articulates, sometimes by a synovial joint, with the sacrum at the posterolateral angle of its base. Reduction of sacral constituents is less common but lumbarisation of the first sacral vertebra does occur: it remains partially or completely separate [2].

Lumbosacral transitional vertebrae (LSTV) are congenital anomalies of the lumbosacral region, which includes sacralisation of fifth lumbar vertebra and lumbarisation of first sacral vertebra observed for the first time by Bertolotti in 1917. This condition occurs due to defect in the segmentation of the lumbosacral spine during development [3].

Low back pain is quite a common ailment affecting about 80% of the population in their life time [4] and it may also cause greater difficulty during labour. This abnormality can be diagnosed by plain radiography.

Knowledge of sacralisation is not only enlightening for the orthopaedic surgeons, also vital for the Clinical Anatomist, Radiologists, Forensic experts, Morphologists, Architectures and Anthropologists.

Thus the present study is carried out to know the proportion and type of sacralisation of the fifth lumbar vertebra.

Aims and objectives: To study the proportion and type of Sacralisation of the fifth lumbar vertebra.

MATERIALS AND METHODS

Source of data: In the present study 100 adult human sacra were examined in the department of Anatomy, Mysore Medical College and Research Institute, Mysore, Karnataka. Fully ossified adult human sacra of both sexes were included. Damaged, mutilated and deformed

sacra were excluded.

Data was collected by naked eye observation for different types of sacralisation of fifth lumbar vertebra depending on fusion (complete and incomplete) and right or left side sacralisation. Sacralised sacra were classified as follows:

1. Complete fusion (fig: 1) between the fifth lumbar vertebra and the first sacral vertebra.
2. Incomplete fusion (fig: 2 & 3) between the fifth lumbar vertebra and the first sacral vertebra.
3. Bilateral sacralisation (fig: 2) consists of a bony union between the abnormal transverse process and the sacrum on both sides.
4. Unilateral sacralisation (fig: 3) shows a bony union between the abnormal transverse process and the sacrum either on right side or left side.

Study design: Descriptive statistics is done by measuring measures of proportions.

OBSERVATIONS AND RESULTS

In the present study of 100 adult human sacra 71 were male and 29 were female sacra. Out of 100 sacral bones 16 sacra showed sacralisation of fifth lumbar vertebrae and remaining 84 was normal vertebra (Table 1).

Out of 16 sacralised bones, 08 bones showed complete fusion (fig: 1) between fifth lumbar vertebra and first sacral vertebra, remaining 08 bones showed incomplete fusion (fig: 2 & 3) between fifth lumbar vertebra and first sacral vertebra (Table 3).

Out of 16 sacralised bones, 15 bones showed bilateral sacralisation (fig: 1 & 2) and only 01 bone showed unilateral sacralisation (fig: 3) and (Table 2).

Table 1: Gender (sex) wise distribution of sacralisation of fifth lumbar vertebra.

	Male	Female	Total
No of sacrum	71	29	100
Sacralisation of L-5	10	6	16

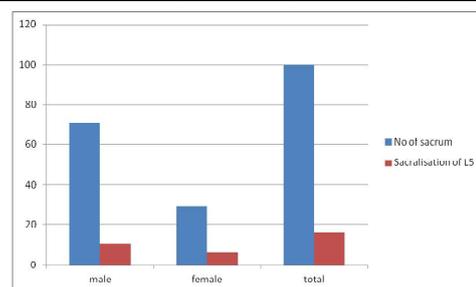


Table 2: Classification of Sacralisation of fifth lumbar vertebra (Total 100 sacra).

Sex	Unilateral sacralisation		Bilateral sacralisation	Total
	Right Side	Left Side		
Male	1	0	0	9
Female	-	-	-	6
Total	1	-	1	15

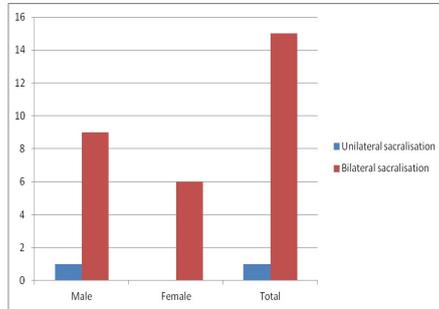


Table 3: Classification of Sacralisation of fifth lumbar vertebra (Total 100 sacra).

	Male	Female	Total
Complete sacralisation	4	4	8
Incomplete sacralisation	6	2	8

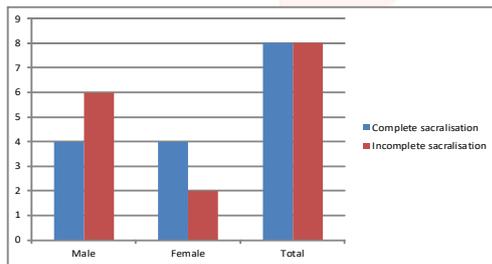


Fig. 1: Bilateral Sacralisation of fifth lumbar vertebra with Complete fusion of fifth lumbar and first sacral vertebrae.

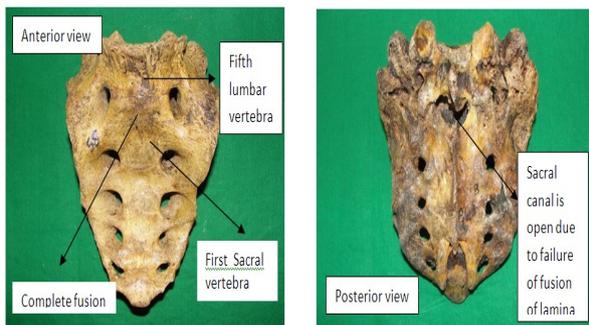


Fig. 2: Bilateral Sacralisation of fifth lumbar vertebra with Incomplete fusion of fifth lumbar and first sacral vertebrae.

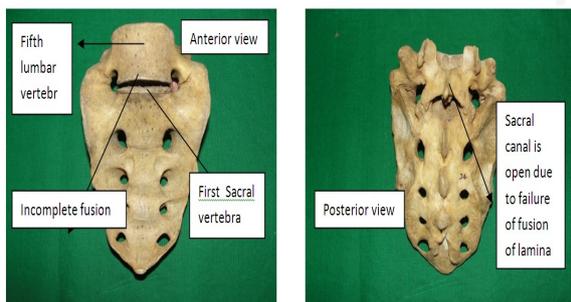
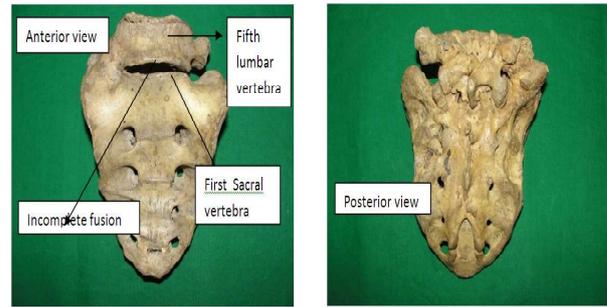


Fig. 3: Unilateral Sacralisation of fifth lumbar vertebra on Right side with Incomplete fusion of fifth lumbar and first sacral vertebrae.



DISCUSSION

The present study shows that the incidence of sacralisation of the fifth lumbar vertebra is 16, out of which 10 are male sacra and 06 are female sacra. Based on the literature, the incidence of sacralisation 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 Bustami F respectively and much higher than the races like Americans 3.6%, Natives of Britain 8% and Arabs 10%. The incidence of sacralisation was close to the authors reported like Steinberg 14%, Vandana Sharma 14%, and the incidence was higher than the authors reported like Kim 1.7% Hughes 9.2%, Hald 7.8%, Hahn 7.5%, Kubavat 11.1%, Chithrika 5%. The incidence among Gujarati population is 11.1% which is more in males than females and Central India region is 14% [5].

Embryology: 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 hand 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 neighbour. Patterning of the shapes of the different vertebrae is regulated by HOX genes [6].

The HOX 11 Group is essential for the genesis

of sacral and caudal vertebrae (Wellik and Capecchi, 2003) and the overexpression of HOX11 genes is expected to produce signs of sacralisation or caudalisation at other levels of the axial skeleton. This over expression 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 homeobox (HOX11) and paired-box (PAX1 and PAX 9) gene expression causes several types of sacralisation [7].

Some authors proposed that sacralisation of the fifth lumbar vertebrae may cause symptoms such as back pain, lumbar disc herniations, spinal pain, radicular pain or lumbar scoliosis. It may cause difficulty during labour because of less mobile pelvis and it may be the reason of low back pain problem.

Table 4: Incidence of sacralisation of fifth lumbar vertebra by various authors.

Race	Incidence	Author
Australian aboriginals	18%	Mitchell, 1936
Indians	16%	Bustami [8] 1989
Arabs	10%	Bustami [8] 1989
Natives of Britian	8.10%	Brailsford [9] 1928
Americans	3.60%	Moore & Illinois [10] 1925

CONCLUSION

Knowledge of sacralisation is not only enlightening for the orthopaedic surgeons, also vital for the Clinical Anatomist, Radiologists, Forensic experts, Morphologists, Architectures and Anthropologists. Hence we are presenting such variation with emphasize on its clinical relevance. Incorrect numbering during the planning of spinal surgery may have serious consequences.

Conflicts of Interests: None

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