



## Sacralisation of Lumbar Vertebra

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### ABSTRACT

**Introduction:** *Sacralisation is a congenital vertebral anomaly where there is a fusion of the 5<sup>th</sup> lumbar vertebra with the 1<sup>st</sup> sacral segment. Several studies have described this occurrence as one of the cause of low back ache. This is possibly due to the pressure on nerves or nerve trunks.*

**Methods & Materials:** *A total of 55 sacra from the Department of Anatomy were taken for the study. Non-pathological sacra of both sexes were included for the study. The sacralisation of lumbar vertebra was examined and the results were noted.*

**Results & Conclusion:** *In the present study the incidence of sacralisation of lumbar vertebra is 7.27 %. Prevalence of lumbosacral transition demands clinical and radiological assessment prior to any interventional obstetric and surgical procedure.*

**Keywords:** *low back pain, lumbar discs degeneration*

### INTRODUCTION

LSTV are congenital anomalies of the lumbosacral region which includes lumbarisation and sacralisation<sup>1</sup>. It was reported that there is a strong relationship between LSTV and low back pain. It is possible that L5 sacralisation contributes to the development of orthopaedic diseases like degenerative spondylolisthesis, lumbar disc degeneration, herniation and low back pain<sup>2</sup>. Bertolotti first observed the LSTV and stated that these abnormal vertebrae may produce low back pain due to arthritic changes which occur at the site of false articulation<sup>3</sup>.

Low back pain (LBP) is a common ailment affecting about 80% of the population in their lifetime<sup>4</sup>. The transitional vertebra may have varying formations, the common feature being an atypical lumbosacral articulation between the

transverse process of L5 and the sacrum<sup>5</sup>. Complete sacralisation consists of a complete bony union between the abnormal transverse process and the sacrum. Incomplete sacralisation shows a well defined joint line between the transverse process and the sacrum. Both forms may be either unilateral or bilateral<sup>6</sup>.

### MATERIALS AND METHODS

In the recent study, 55 dry human sacra including those from human skeleton were examined in the department of Anatomy with naked eye. Non-pathological sacra of both sexes were included and studied for lumbosacral transition and numerical variations.

The sacra consisting of 6 vertebrae due to incorporation of the fifth lumbar vertebra were selected and further classified as unilateral and

bilateral sacralisation. The observed data were analysed and recorded.

### OBSERVATION

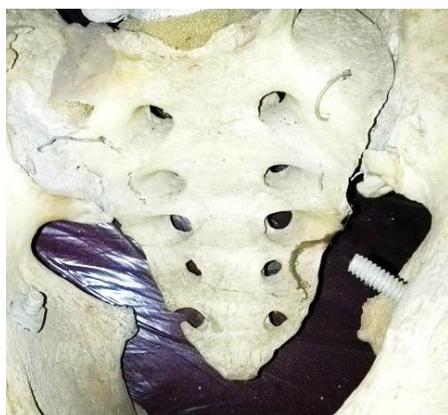
It was observed of the 55 human dry sacra that were studied four of them showed sacralisation. Out of the four, two showed unilateral sacralisation and two showed bilateral sacralisation. Thus the incidence of sacralisation of lumbar vertebra was found to be 7.27%



i : unilateral sacralisation of lumbar vertebra on the left side.



ii : unilateral sacralisation of lumbar vertebra on the left side.



iii : bilateral sacralisation of lumbar vertebra.



iv : bilateral sacralisation of lumbar vertebra.

### DISCUSSION

In the present study the incidence of sacralisation of lumbar vertebra is 7.27%. The incidence of this anomaly vary greatly ranging from 4% to 24%<sup>7</sup>. Karan BK and Manish BR found the incidence of sacralisation to be 6.6%<sup>8</sup>. Kubavat D et al in their study on Gujarat population found the incidence of sacralisation to be 11.1%<sup>9</sup>. Vandana A et al showed the prevalence of LSTV as 18.4% among which sacralisation accounted for 14.1%<sup>10</sup>. Chet Savage found 7% incidence in their study<sup>11</sup>. Magora and Schwartz found 20.8% sacralisation in their study<sup>12</sup>. Peter et al reported 6.2% incidence in their study<sup>13</sup>. Otani et al stated that a lumbosacral transitional vertebra was found more often in patients with disc herniation (17% than in the control group which was 11%)<sup>14</sup>.

A transitional vertebra is a congenital anomaly that has the characteristics of two types of vertebrae. Normally five sacral vertebrae fuse to form the wedge shaped sacrum with ossification of intervertebral joints<sup>5</sup>. Broadest superiorly, the sacrum articulates with the L5 vertebra, which inferiorly, it narrows to articulate with the coccyx. The first sacral vertebra may not fuse with the second, in which case there is lumbarisation of S1 where the individual appears to have 6 lumbar vertebrae. The converse can also occur, called sacralisation of L5, where the individual appears to have 4 lumbar vertebrae<sup>15</sup>. In order to understand sacralisation of lumbar vertebra it is necessary to first understand the normal anatomy of lumbar and sacral vertebra as well as the embryological development of the human vertebral column and the factors that can lead to

developmental variation. Lumbar vertebra is irregular having large body, stout pedicles and thick lamina. It shows slender transverse process, short, thick, square spinous processes<sup>8</sup>.

The embryological origin of lumbar vertebra commences at 3<sup>rd</sup> week of intrauterine life. All vertebra originates from somites that form along the cranio-caudal axis, on either side of the notochord from pre-somatic mesoderm. These somites differentiate further into dermomyotome and sclerotome. Each sclerotome consists of loosely packed cells cranially and densely packed cells caudally. Some densely packed cells move cranially opposite the centre of myotome where they form intervertebral disc. The remaining densely packed cells fuse with loosely packed cells of immediately caudal sclerotome to form mesenchymal centrum, the body of the vertebra. The mesenchymal cells surrounding the neural tube forms the neural arch. Ossification of vertebra begins in 8<sup>th</sup> week and ends by 25<sup>th</sup> year. There are two primary centres and five secondary centres in each vertebra<sup>16</sup>. Secondary centres are one for the tip of spinous process, one for the tip of each transverse process and two each for annular epiphysis. The primary cause of LSTV is cranial shifts which means sacralisation of the last lumbar vertebra and partial shifts which mean unilateral fusion of the transverse processes. It is likely a product of both genetic predisposition (Hox gene product concentration) and developmental influences<sup>8</sup>.

Lumbosacral transitional vertebra is caused by border shifts, cranial shift resulting in sacralisation of the last lumbar vertebra and a caudal shift resulting in lumbarisation of the first sacral segment. Improper formation, migration, differentiation and union of somites results into segmental vertebral abnormalities. The cranial shifts often occur at only one or two transitional border areas but caudal shifts involve three/ four border and the shifts are often in the same direction. The cranial shifts are dominant over the caudal shifts, so the sacralisation is more common than lumbarisation<sup>17</sup>.

Lumbar vertebrae are known for their characteristic biomechanics. Biomechanics and function of lumbar vertebra is to support the upper body, transfer weight from axial to appendicular skeleton and provide mobility in the lower back. Lumbar vertebra strong enough to support the upper body and yet flexible enough to allow the needed mobility. But at the same time if anything subject to failure, which may cause low back pain<sup>8</sup>.

Sacralisation is one of the important factors in the emergence of lumbar disc herniation (LDH). LDH frequently occurs at the level above the lumbosacral transitional vertebra rather than at the level of transitional vertebra in patient with low back pain. The various causes for LBP in sacralisation are actual pressure on nerves / nerve trunks, ligamentous strain, compression of soft tissue between bony joints, by an actual arthritis if a joint is present or by a bursitis if a bursa is present<sup>9</sup>. Due to sacralisation of lumbar vertebra, the fusion of lumbosacral joint may cause greater difficulty during labour because of less mobile pelvis and it may be the reason of low back pain problem<sup>9</sup>.

Knowledge of sacralisation is thus crucial for clinical anatomists, orthopedicians, radiologists and forensic experts. Awareness of this kind of anomalies may prevent wrong numbering of vertebra during spinal surgery and making a differential diagnosis for low back ache patients.

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