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Radiology Section

# Sacralisation: A Predisposing Factor of Lumbosacral Degenerative Changes in Young Population

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## ABSTRACT

**Introduction:** Low Back Pain (LBP) is a most common symptom affecting about 80% of the population in their lifetime and results from numerous causes but the role of sacralisation in causing LBP is still controversial. Sacralisation of L5 may leads to stress concentration, which accentuates the degenerative changes and also development of degenerative spondylolisthesis. Therefore, the following study was planned.

**Aim:** To determine whether the presence of sacralisation at L5 level influences radiological findings of the degenerative changes and LBP in young population.

**Materials and Methods:** Fifty patients of both sexes, aged between 20-40 years with chronic LBP were included in the study and all showed the presence of sacralisation. They were subjected to both radiography and MRI examination, after taking detailed clinical history. All patients were assessed for radiographic parameters of degenerative changes like anterior slippage of L4 on L5 (% slip), facet osteoarthritis (by Fujiwara's criteria 1-4 grades) and disc degeneration (by Frymoyer's criteria grades 1-5) of L4-L5.

**Results:** Total 50 patients were observed out of which majority were between 30-34 years age group. Anterior slippage of L4 on L5 was observed among 66% (p=0.033), facet osteoarthritis (p=0.480) among 56% or disc degeneration (p=0.007) among 70% of the patients.

**Conclusion:** The present study showed that sacralisation is a predisposing factor of lumbar degenerative changes in in significant number of young patients with LBP. Further studies with large population are required to clarify the role of sacralisation in influence of degenerative changes.

**Keywords:** Congenital vertebral anomaly, Disc degeneration, Osteoarthritis

## INTRODUCTION

LBP is a most common symptom affecting about 80% of the population in their lifetime [1]. LBP may results from numerous causes but the role of sacralisation in causing LBP is still controversial. Sacralisation is a congenital vertebral anomaly of lumbosacral spine characterised by fusion between L5 and S1 segments which may contribute to incorrect identification of a vertebral segment [2,3]. The prevalence of sacralisation is 7.5%. Sacralisation can be diagnosed by investigations like plain X-rays, CT-scan and MRI.

The normal anatomy of lumbar and sacral vertebrae, the embryological development of the human vertebral column and the factors responsible for developmental variation need to known before to understand sacralisation of lumbar vertebra. Lumbar vertebra is having irregular, large body, stout pedicles and thick lamina and shows slender transverse processes, short, thick, square spinous processes. Biomechanics of lumbar vertebra is to support the upper body, transfer weight from axial to appendicular skeleton and to provide mobility in the lower back [4].

Many studies have shown sacralisation in patients with back pain [5-10]. Some studies have stated that sacralisation is incidentally diagnosed without any clinically significant features. Therefore, this study was undertaken to examine the details of sacralisation in young patients with LBP and establish relationship between it and LBP by plain radiography and MRI.

## MATERIALS AND METHODS

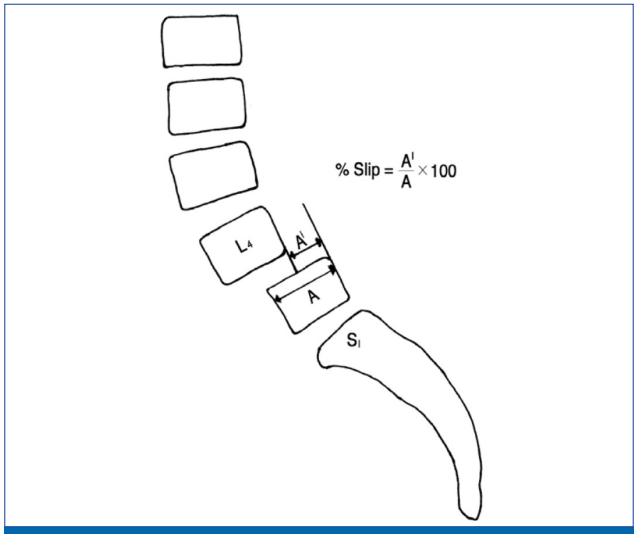
The observational radiological analysis was conducted on 50 patients with chronic lumbar pain in the Department of Radiology, NMCH, Raichur, India. Patients with chronic low backache willing to give written consent and patients of both sexes, aged between 20-40 years were included in the study. Patients with any signs of lytic lesions were excluded from the study. After taking detailed clinical history, all 50 patients were subjected to plain radiographs of the lumbar spine, including anteroposterior and lateral radiographs and MRI (1.5 Tesla unit) investigations.

Both T2-Weighted Images (T2WI) (repetition time TR=3000

ms, echo time TE=80 ms) and T1-Weighted Images (T1WI) (TR=600 ms, TE=20~30 ms) were taken. The slice thickness was 3 mm.

Radiographic parameters of degenerative changes such as anterior slippage of L4 on L5 (% slip), facet osteoarthritis of L4-L5 by Fujiwara's criteria [11] (1-4 grades), and disc degeneration of L4-L5 by Frymoyer's criteria [12] (Grade 1-5) were measured and noted in case record form.

The degree of anterior slippage of L4 on L5 was assessed on lateral radiographs of the lumbar spine. This was expressed as a percentage of the sagittal diameter of the slipped vertebral body: A'/A×100 (%) [Table/Fig-1].




**[Table/Fig-1]:** The degree of anterior slippage of L4 on L5.

According to Fujiwara's criteria Facet osteoarthritis was divided into four grades on axial T1WI: Grade 1 - normal facet joints; Grade 2 - joint space narrowing or mild osteophyte formation; Grade 3 - sclerosis or moderate osteophyte formation and Grade 4 - marked osteophyte formation [11].

The degree of disc degeneration at L4-L5 was measured using sagittal T2WI, and degenerative status was classified into five grades according to the Frymoyer and Moskowitz criteria [12].

## STATISTICAL ANALYSIS

Number of patients with and without degenerative changes (anterior slippage of L4 on L5, facet osteoarthritis of L4-L5 and disc degeneration of L4-L5) were expressed in percentages. Binomial test was used to compare significance of degenerative changes in patients with chronic back pain. The p-value less than 0.05 was considered as statistically significant.

## RESULTS

As shown in [Table/Fig-2], study group includes patients of age ranging from 20 to 40 years and above. Majority of the patients were between the 30-34 age group 18 (36%) and 12 patients (24%) were between 25-29 years.

| Age Group | Number | Percentage (%) |
|---|---|---|
| 20-24 years | 09 | 18 |
| 25-29 years | 12 | 24 |
| 30-34 years | 18 | 36 |
| 35-39 years | 08 | 16 |
| ≥40 years | 03 | 06 |
| Total | 50 | 100 |

**[Table/Fig-2]:** Agewise distribution of patients.

### Anterior Slippage of L4 on L5

According to [Table/Fig-3,4] out of 50 cases, 33 (66%) cases showed presence of anterior slippage of L4 on L5 which is statistically significant with p<0.05 (p=0.033) compared to patients (34%) without anterior slippage of L4 on L5 in our study. Out of 33 (66%) patients, 20 patients showed Grade 1, 9 patients showed Grade 2 and 4 patients were Grade 3 anterior slippage of L4 on L5 [Table/Fig-3,4]. Anteroposterior radiograph of the spine and the MR images show sacralisation of L5 vertebra of a 28 years old female patient with LBP [Table/Fig-5].

| Anterior Slippage of L4 on L5 | | Frequency | Percentage (%) |
|---|---|---|---|
| Grades | I | 20 | 40 |
| | II | 9 | 18 |
| | III | 4 | 8 |
| | NO | 17 | 34 |
| Total | | 50 | 100 |

**[Table/Fig-3]:** Grade wise distribution of patients according to anterior slippage of L4 on L5.

| Category | N | Observed Prop. | Test Prop. | Asymp. Sig. (2-tailed) |
|---|---|---|---|---|
| Grades | 33 | 0.66 | 0.50 | 0.033 <0.05 |
| No | 17 | 0.34 | | Significant |
| Total | 50 | 01.00 | | |

**[Table/Fig-4]:** Binomial test for anterior slippage of L4 on L5 proportions.

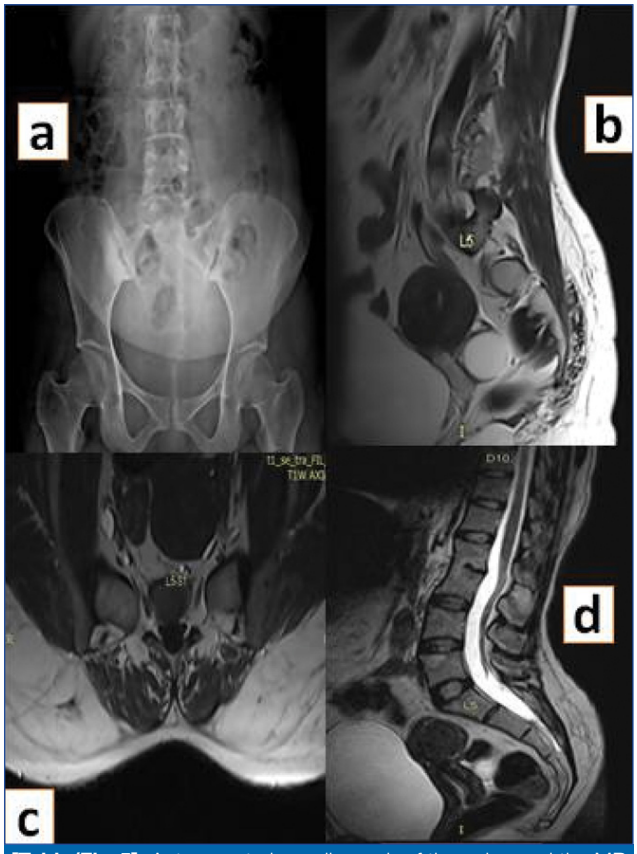
### Facet Osteoarthritis

According to [Table/Fig-6,7] facet osteoarthritis was present in 66% of cases and it was absent in 34% of patients. The difference between the two groups was statistically not significant with p>0.05. Anteroposterior radiograph of the lumbosacral spine and the MR images show sacralisation of L5 vertebra of a 32 years old female patient presenting with lower backache [Table/Fig-8].

### Disc Degeneration

According to [Table/Fig-9,10] disc degeneration was present in 35 cases and it was absent in 15 patients. The difference between the two groups was statistically significant with p<0.01 (p=0.007). Anteroposterior radiograph of the

lumbosacral spine and the MR images show sacralisation of L5 vertebra of a 38 years old female patient presenting with lower backache [Table/Fig-11].



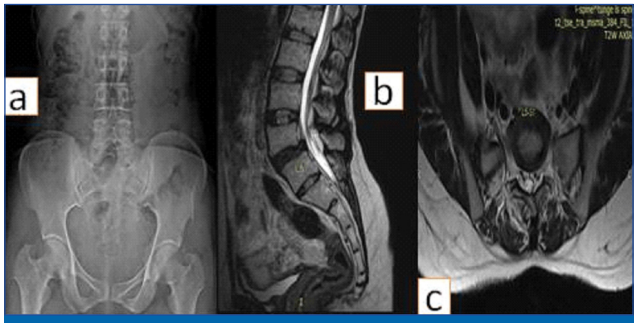

**[Table/Fig-5]:** Anteroposterior radiograph of the spine and the MR images show sacralisation of L5 vertebra of a 28 years old female patient with lower backache. Incidental note made of congenital block vertebrae involving L1 and L2 vertebrae: a) Coronal; b) Sagittal; c) Parasagittal; and d) Axial sections.

| Facet Osteoarthritis | | Frequency | Percentage (%) |
|---|---|---|---|
| Grades | I | 1 | 2 |
| | II | 17 | 34 |
| | III | 8 | 16 |
| | IV | 2 | 4 |
| | No | 22 | 44 |
| Total | | 50 | 100 |

**[Table/Fig-6]:** Grade wise distribution of patients according to facet osteoarthritis.

| | | Category | N | Observed Prop. | Test Prop. | Asymp. Sig. (2-tailed) |
|---|---|---|---|---|---|---|
| Facet Osteoarthritis | Group 1 | Grades | 28 | 0.56 | 0.50 | 0.480>0.05 |
| | Group 2 | No | 22 | 0.44 | | Not Significant |
| | Total | | 50 | 1.00 | | |

**[Table/Fig-7]:** Binomial test for facet osteoarthritis proportions.




**[Table/Fig-8]:** a) Anteroposterior radiograph of the lumbosacral spine and the MR images; b) Sagittal; and c) Axial sections, showing sacralisation of L5 vertebra of a 32 years old female patient presenting with lower backache.

| Disc Degeneration | | Frequency | Percentage (%) |
|---|---|---|---|
| Grades | I | 3 | 6 |
| | II | 4 | 8 |
| | III | 17 | 34 |
| | IV | 9 | 18 |
| | V | 2 | 4 |
| | No | 15 | 30 |
| Total | | 50 | 100 |

**[Table/Fig-9]:** grade wise distribution of disc degeneration of patients.

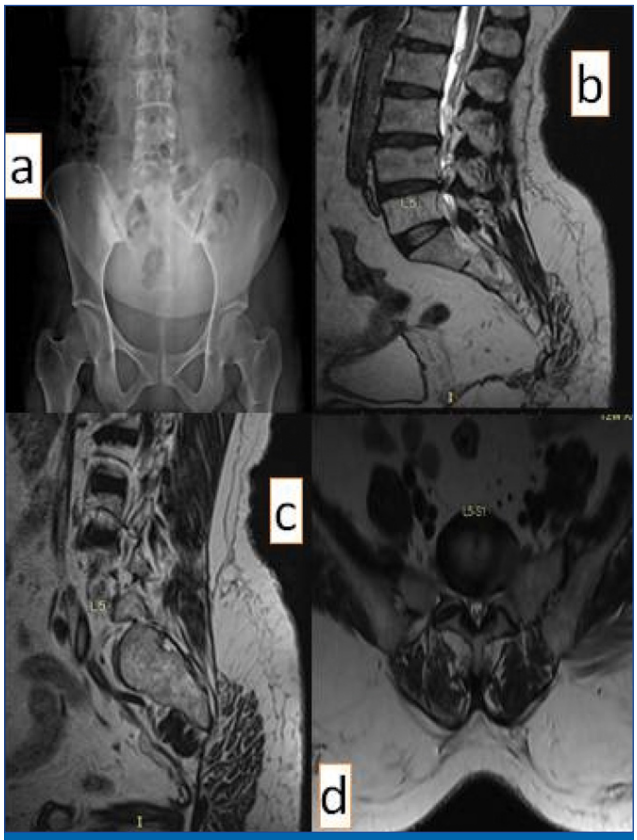
| | | Category | N | Observed Prop. | Test Prop. | Asymp. Sig. (2-tailed) |
|---|---|---|---|---|---|---|
| Disc Degeneration | Group 1 | Grades | 35 | 0.70 | 0.50 | 0.007<0.01 |
| | Group 2 | No | 15 | 0.30 | | Highly Significant |
| | Total | | 50 | 1.00 | | |

**[Table/Fig-10]:** Binomial test for disc degeneration proportions.

The degree of anterior slippage of L4 on L5 assessed on lateral radiographs of the lumbosacral spine and expressed as a percentage of the sagittal diameter of the slipped vertebral body: A'/A×100 (%) [Table/Fig-1].

## DISCUSSION

Lumbosacral Transitional Vertebrae (LSTV) are congenital anomalies of the lumbosacral region, including sacralisation of the fifth lumbar vertebra and lumbarization of first sacral vertebra. This condition occurs due to a defect in the segmentation of the lumbosacral spine during development. There are several types of articulations which link the L5 vertebra to the sacrum. This results in the formation of a relatively stable lumbosacral junction. Sacralisation at this level results in increased concentration of stress, which causes further degenerative changes involving the facet joint, disc and anterior slippage of the vertebra. Some previous studies have shown an association between sacralisation of L5 and the development of disc degeneration in the lumbar spine.




**[Table/Fig-11]:** a) Anteroposterior radiograph of the lumbosacral spine and the MR images; b) Sagittal; c) Parasagittal; and d) Axial sections, showing sacralisation of L5 vertebra of a 38 years old female patient presenting with lower backache.

Sacralisation of L5 is considered to be a predisposing factor for degenerative spondylolisthesis at L4-L5 [13].

In sacralisation of the fifth lumbar vertebra, the transverse process of L5 vertebra enlarges on one side or both sides, and fuses to the sacrum, or ilium or both. This anomaly is observed in about 3.6% to 18% of cases and is usually bilateral. The patient is usually asymptomatic or may be symptomatic that includes spinal or radicular pain, disc degeneration, L4/L5 disc prolapse, lumbar scoliosis and lumbar extradural defects [14].

Castellvi AE et al., [6], described on the basis of morphologic characteristics, a radiographic classification system to identify four types [2] of LSTVs.

Type I - Unilateral (Ia) or bilateral (Ib) dysplastic transverse processes, measuring at least 19 mm in width (craniocaudad dimension) [2].

Type II - Incomplete unilateral (IIa) or bilateral (IIb) lumbarisation/ sacralisation with an enlarged transverse process that has a diarthrodial joint between itself and the sacrum [2].

Type III LSTV - Unilateral (IIIa) or bilateral (IIIb) lumbarisation/ sacralisation with complete osseous fusion of the transverse process (es) to the sacrum [2].

Type IV - Unilateral Type II transition with a Type III on the contralateral side. Although, useful for characterising the relationship between the transitional segment and the level above or below, this classification system does not provide information relevant to accurate enumeration of the involved segment [2].

In our present study, we found that the association of sacralisation with degenerative changes in the lumbosacral spine to be significant, which is consistent with previous studies. Statistical significance was also seen between sacralisation and anterior slippage of L4 vertebra. No statistical significance was seen with facetal osteo arthropathy.

## LIMITATION

Present study is an observational study, which found an association with sacralisation and degenerative changes in lumbar vertebra whereas, further analytical study is required to establish the relation between them.

## CONCLUSION

The present study showed that sacralisation is a predisposing factor of lumbar degenerative changes in significant number of young patients with chronic LBP by using radiographic parameters such as anterior slippage of L4 on L5, facet osteoarthritis of L4-L5 by Fujiwara's criteria and disc degeneration of L4-L5. Further, detail study is required with large population to establish the role of sacralisation in degenerative changes.

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