

Research Article

Incidence of lumbarization and sacralization in normal and low backache patients – A roentgenogram study

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Abstract

Background: In lumbosacral transitional zone number of vertebrae is variable and unreliability of anatomical landmark for identification of last lumbar vertebrae make the region interesting for research purpose. On the other hand its correlation with low backache makes it more clinically relevant than anatomically.

Objective: To study the prevalence of lumbarization and sacralization of vertebrae in lumbosacral transitional zone in study population and in patients with low backache.

Material and method: Radiographs of the entire spine of 100 patients were examined. 50 radiographs out of these were of patients with low backache and 50 radiographs of age and sex matched normal subjects, having problems other than low backache.

Result: In the present study, it was observed that incidence of sacralization and lumbarization was 5% and of 10% respectively in the study population but this incidence was increased in low backache patients to 8% sacralization and 18% lumbarization. It was also perceived that around 22.2% female had lumbarization in comparisons to males 25% in 31-40 years of age group of low backache patients. Incidence of sacralization was also higher in male 25% in comparison to female 11.7%

Conclusion: From these observations in the present study, it may be concluded that increase in incidence of lumbarization and sacralization may lead to increased chances of low backache and also higher incidence of lumbarization and sacralization in males perhaps make them more vulnerable to low backache.

Keywords: Lumbosacral transition vertebrae (LSTV), Lumbarization, Sacralization, low backache.

1. Introduction

The number of lumbar vertebrae is quite variable in different populations with reported prevalence of variations being 4-30% which may lead to low backache¹⁻³. These variations include lumbarization of upper segments of sacral vertebrae which show similarity with lumbar vertebrae and sacralization of last lumbar vertebra resulting in either 6 or 4 lumbar vertebrae. Incomplete fusion of lumbar vertebra to sacrum or compression of lumbar nerve root by hypertrophic transverse process may be the cause of pain. Pain can also arise due to lumbar nerve root syndrome which is diagnosed by comparing the anatomical level of the disc herniation to the compressed nerve root. It is also assessed by the pattern of the peripheral sensory and motor deficit. Identification and numbering of these lumbosacral transition vertebrae (LSTV) has great importance for eliminating surgical and procedural errors because these variations make the landmarks (i.e. the twelfth rib and the first sacral vertebra) unreliable clues to define the nerve roots. To avoid such type of blunders which may lead to great complications, a good communication between a radiologist and a surgeon must be established which is the main purpose of the present study. Therefore, the radiographs of entire spine was chosen, not only to count from C2 but also to segregate hypoplastic rib from lumbar transverse processes, thereby empowering the correct identification of the L1 vertebral body. The prevalence of lumbarization and sacralization in normal and patient of low backache will be seen to make a protocol for preoperative evaluation of a patient of Prolapse of Intervertebral Disc (PIVD) in this prospective study.

2. Material and Methods

The present study was conducted in All India Institute of Medical Sciences, Jodhpur and its associated Hospital. Radiographs of 100 patients were examined, out of which 50 radiographs of low backache patients and 50 radiographs of age & sex matched normal subjects, having problems other than low backache. Written informed consent were taken and detailed history regarding age, sex, duration and severity of symptoms (he/she was suffering from) were obtained. Necessary permission was obtained from the Institutional Human Ethical Committee. Ideally we have to take radiographs of the entire spine from occiput to sacrum but due to unavailability of extra-large digital cassette we took skiagrams of whole spine in segments by putting radiographic markers. All the vertebrae were counted from C2 to the last sacral vertebrae. Moreover, differentiation of hypoplastic ribs from lumbar transverse processes and other anomalies like unusual segmentation of the vertebrae in case of more or less than 33 vertebrae were also included. Considering above factors, number of thoracic vertebrae were counted and identification of L1 vertebral body was done. All the lumbar vertebrae were assigned numbers and identification of lumbo-sacral transition vertebrae was established.

2.1 Exclusion Criteria

1. Children below 16 years of age.
2. Pregnant women
3. Any history of injury or surgery in spinal region

2.2 Ethical considerations

Informed consent was taken from the patients prior to operation and for the inclusion to the study. The study was performed according to the Declaration of Helsinki, and the Institutional Ethical Board approved it.

3. Result

In present study we examined 100 patients’ roentgenogram (50 patients control and 50 cases). Female patients were more in number (39 in case group and 38 in control group) than male patients (11 in case and 12 in control group). Most of the cases were in 21- 40 years (86%) age groups (Table 1).

Table 1: Age distribution in both groups

Age groups (in Years)	Case group		Control group	
	Male	Female	Male	Female
21- 30	5	26	5	22
31- 40	4	9	4	11
41- 50	2	4	3	5
Total	11	39	12	38

It was observed that out of 100 patients 15 (two in control group and thirteen in case group) had either lumbarization or sacralization in their radiographs.

In control group one female patient of 31- 40 years of age group was noted having sacralization in which there was unilateral fusion of transverse process of L₅ vertebrae to S₁. Incomplete lumbarization was observed in one male patient of 21- 30 years of age group.

In low backache patients, this figure was 13 in which 10 were female patients. Out of the 10 female patients with low backache, Five female patients of 21- 30 years of age group were observed having incomplete to complete lumbarization of S₁. There were separate transverse process of S₁ vertebrae from ala of sacrum (fig 1).

But incomplete intervertebral disc (IVD) between S₁ and S₂ was observed in incomplete lumbarization. However in complete lumbarization there were fully developed IVD observed between S₁ and S₂. Out of five female two were have complete lumbarization and three were have incomplete.

Fig 1: Skigram of 25 years female patient showed complete lumbarization of S₁. There were separate transverse process of S₁ vertebrae from ala of sacrum.



Three female patient of same age group had sacralization in which unilateral fusion of transverse process of L₅ was with S₁ vertebrae. Two female patients from 31- 40 years age group had incomplete lumbarization in their radiographs (table 2). No lumbarization or sacralisation was observed in any patient of 41- 50 years of age group.

Table 2: Age wise distribution of patients of lumbarization and sacralisation in cases

Age (years)	Lumbarization		Sacralisation	
	Male	Female	Male	Female
21- 30	1	5	-	3
31-40	1	2	1	-
Total	2	7	1	3

One male patient from 21- 30 years and one from 31- 40 years of age group showed complete lumbarization while one male from 31-40 years age group had sacralization in which there was bilateral fusion of transverse process of L₅ with S₁ vertebrae (Fig 2).

Fig 2: Skigram of male of 33 years age showed sacralization in which there was bilateral fusion of transverse process of L₅ with S₁ vertebrae



In the present study, it was also observed that two females of 27 and 32 years had prolonged transverse process of L₁ on the right side (may be gorilla rib?) while opposite side had normal length transverse process. In two male patients, hypoplasia of 12th rib was also observed.

Incidence of sacralization was found to be 5% and of lumbarization was 10% in the study population comprising of both control and case group. However this incidence was increased in low backache patients to 8% sacralization and 18% lumbarization. It was also observed that incidence of lumbarization and sacralization in male was 18.18% and 8.33% respectively higher in comparison to female i.e. 17.94% and 8.10% respectively. On further analysis of data it was seen that around 22.2% female had lumbarization in comparisons to males 25% in 31- 40 years of age group of low backache patients. Incidence of sacralization was also higher in male 25% in comparison to female 11.7% in the present study. These observations conclude that increase in incidence of lumbarization and sacralization may lead to increased chances of low backache. It is also being concluded that higher incidence of lumbarization and sacralization in males perhaps make them more vulnerable to low backache.

4. Discussion

The prevalence of the lumbarization of first sacral vertebra varies from 4.2% to 30% in different populations by origin¹⁻³. The presence of a sixth lumbar vertebra is one of most common anomaly. Lumbarization generates a slightly more flexible and unstable spine. The person may remain asymptomatic or may present with clinical symptoms like spinal or radicular pain, disc degeneration, L4/L5 disc prolapse and lumbar extradural defects²⁻⁶.

In present study 5% incidence of sacralization and 10% incidence of lumbarization was observed which correlated with the observations of Chet Savage⁷ 7%, 2005. Magora & Schwartz⁸ found 20.8% sacralization in his study; Kubavat dharati *et al*⁹ and Peter *et al*¹⁰ found this incidence to be 11.1% and 6.2% respectively.

The occurrence of LSTV may be linked to its embryological development and osteological defects. Sacralization and lumbarization are caused by the border shifts, cranial shift and caudal shift of the segments which give rise to that part of vertebrae¹¹. Apart from that, shapes of the different vertebrae are regulated by HOX genes. The changes in the axial pattern, such as lumbosacral transitional vertebra, results from mutations in the HOX- 10 and HOX - 11 paralogous genes¹².

LSTV alter the anatomy of the lumbosacral junction that affects load bearing at the region. Lumbarization or sacralization is not a contraindication to any activity, sports participation or employment, but it may predispose to the possibility of having more back pain.

Lumbo-sacral transitional vertebrae (LSTV) are common congenital anomalies which include lumbarization and sacralization and were observed for the first time by Bertolotti⁶. The association of lumbosacral transitional vertebra and low back pain is known as Bertolotti's syndrome. For a long time, the clinical significance of this condition has been debated, and it has usually been associated with neurological deficit & low back pain, however there have been studies reporting no relationship between lumbarization and sacralization and back pain. Complications of sacralization of 5th lumbar vertebra which causes pain include actual pressure on nerves or nerve trunks, ligamentous strain around the sacralization, compression of soft tissues between bony joints, by an actual arthritis if a joint is present, by bursitis if a bursa is present. Lumbar spine experiences more abuse from normal functions than any other part of human skeleton¹³. According to M.U. Eyo *et al*¹⁴, to be able to give support to and bear the weight of the body, the integrity of all the vertebrae in the spine, particularly in the lower back must be maintained.

In present study incidence of sacralization and lumbarization were found to be 5% and 10% respectively. In addition, increase incidences were also observed in low backache patients. This reveal increased incidence of lumbarization and sacralization may be associated with low backache patients especially in 31- 40 years of age group. It is expected that jeopardy of this integrity by any pathology, either congenital or acquired, especially in females in reproductive age group where lack of nutrition and other factors come in picture, will affect the stability of the spine and therefore its biomechanics. On this basis that the presence of LSTV is believed to be associated with an increased liability for a patient to develop low back pain.

The relation between incidence of LSTV and its relation with low backache patients is debatable but still the present study may help clinicians like orthopedic surgeons, neurosurgeons, physiotherapists, spinal surgeon to know correlation between LSTV & low back pain and this knowledge will also be vital for clinical anatomists and forensic experts.

Conflict of interest statement

No financial grants have been received for the study. No other people or organization is associated with the study to influence the work.

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