

Original research article

Epidemiological study correlating Lumbosacral Transitional Vertebra (LSTV) with low back pain in a Tertiary Care Hospital in Central Indian

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Abstract

Background: Lumbosacral transitional vertebrae (LSTV), is a structural anomaly, of the lumbo-sacral spine in which an elongated transverse process of the last lumbar vertebra fuses with varying degree to the “first” sacral segment which has been variably associated with, low back pain (LBP) and its presence can also result in a level being wrongly identified pre-operatively.

Objectives: To assess the prevalence and pattern of Lumbosacral Transitional vertebrae in patients presenting with Low Back pain. To assess the patient clinically and radiologically, to see if a co-relation exists between back pain in patients with LSTV.

Methods: We conducted a Prospective observational study from the period of August 2019 to July 2021 in the Department of Orthopaedic Shyam Shah Medical College and Associated SGMH Hospital Rewa M.P. India, with a sample size of 500 patients. Study design: Prospective observational study Patients of both sexes in the age group of 20-45 years presenting low back pain of any duration were included in the study.

Results: In our study, the incidence rate of LSTV was 28.8% against the reported 4.0%-35.9% with a mean of 12.3%. mean age of patients was calculated to be 35.5 years¹⁵, in our study of patients with LSTV, Male: Female ratio was 2.1:1. in our study, Sacralisation has been reported to be more common than lumbarisation. Sacralisation: Lumbarisation ratio in our study was 1.8:1. In our study, Type II and Type IV LSTV patients were most symptomatic in our study patients with Type I LSTV had lesser severity of low back pain as compared to patients without LSTV.

Conclusion: The study shows that presence of Lumbosacral transitional vertebrae (Type II and Type IV) in patients with low back pain have a strong and positive correlation with the severity of pain and it also has an adverse effect on a patient’s daily activities. Due to the absence of consensus and controversial association of LSTV with low back pain, the incidence observed in our study assumes great significance. Our findings illustrate the importance of including Lumbosacral Transitional vertebrae in the list of differential diagnosis when investigating young and middle-aged patients with low back pain.

Keywords: Lumbosacral transitional vertebrae, low back pain, sacralization

Introduction

Low back pain is a very common condition, affecting two-thirds of all adults at some point in their lives, and second only to upper respiratory problems as a reason to see a physician^[1]. Various Factors that have been found to positively correlate with back pain are obesity, age, gender and socioeconomic conditions as well as disc degeneration, slippage, herniation, and muscle sprain and strain^[2]. This wide range of both physiological and psychosocial factors emphasize the elusive nature of identifying the cause of Low back pain and for many patients the specific cause of pain may never be discovered.

Lumbosacral transitional vertebrae (LSTV) are congenital spinal anomalies, in which an elongated transverse process of the last lumbar vertebra fuses with varying degree to the “first” sacral segment^[3].LSTV, as a morphological variation, spans a spectrum from partial/complete L5 sacralization to partial/complete S1 lumbarization^[4, 5].

When the L5 vertebra fuses completely to the sacrum, 4 lumbar vertebrae exist, whereas when S1 separates entirely from the sacrum, 6 lumbar vertebrae exist and the sagittal contour of the spine becomes more lordotic^[6].Many intermediate incomplete transitions have also been recognized and classified as LSTV^[7].

The resulting combination due to developmental defects occurring at the lumbosacral border, produces a variety of morphological configurations collectively referred to as lumbosacral transitional vertebrae (LSTV)^[8].Depending on the direction of the shift, an individual may end up with either an extra lumbar segment or one fewer segment, which can have significant biomechanical and clinical implications.

In 1984, Castellvi *et al.*^[5, 9]classified LSTV into 4 types.

The estimated prevalence of LSTV in the general population varies widely throughout the literature due to differences in definition and diagnostic modalities, ranging from 4.0%-35.9% with a mean of 12.3%^[5,7,10,11]. The presence of LSTV is thought by many researchers to be associated with low back pain (LBP). Suspected causes of low back pain include disc degeneration, disc prolapse, spinal stenosis, spondylolisthesis, muscle strain or sprain, sacroiliac joint pain, chemical irritation and nerve impingement and the presence of a LSTV could potentially cause any of these.

The association between LSTV and low back pain has been debated since it was first described by Bertolotti almost a century ago in 1917^[12].According to Quinlan *et al.*, the prevalence of Bertolotti Syndrome is 4.6% in the general population and 11.4% in patients under the age of 30^[13].

Conversely, other authors believe that lumbosacral transitional segments are quite common in the general population and may not be seen with higher prevalence in patients reporting low back pain^[10]. A third opinion suggests that low back pain complaints might be worse, but not more frequent in the presence of an LSTV^[14,15].

A diagnosis of Bertolotti Syndrome should be cautiously considered with appropriate patient history, imaging studies, and diagnostic injections^[16].As with other causes of low back pain, the initial treatment of symptomatic LSTV is clinical, including a combination of NSAIDS and rehabilitative physical therapy^[17].

There is a lack of consensus, however, regarding the treatment of Bertolotti Syndrome and the number of studies and case reports in the literature reporting on the diagnosis and outcomes of patients with symptomatic LSTV is sparse^[16,18].

Hence, the clinical significance of Lumbosacral transitional vertebrae with low back pain needs further research and correlation. This study is being undertaken to evaluate the prevalence and pattern of LSTV in patients with low back pain and to determine a correlation between LSTV and Low Back Pain.

Material and Methods

We conducted a Prospective observational study from the period of August 2019 to July 2011 in the Department of Orthopaedic Shyam Shah Medical College and Associated SGMH Hospital Rewa M.P. India, with a sample size of 500 patients.

Study design:Prospective observational study.

Patients of both sexes in the age group of 20-45 years presenting low back pain of any duration were included in the study.

Those patients presenting with low back pain associated with radicular pain, traumatic, previous spinal surgery, history of infections in the spine, having myelopathy features, known primary or secondary osteoporosis were excluded from the study.

The patients were evaluated by a detailed history, examination, Modified Oswestry Low Back Pain Disability Index Questionnaire and the diagnosis of LSTV was confirmed by X-ray Lumbosacral standard Spine AP and lateral views and a 30-degree angled cranially directed AP Plain radiograph (Ferguson View). Patients were then be classified into different groups according to Castellvi classification^[9].

Statistical analysis

A sample of 500 patients fulfilling the inclusion criteria were considered for the study. Descriptive statistics such as mean, median, standard deviation and range etc. were used for continuous data.Percentage and proportions were applied to represent the categorical data as a descriptive statistic e.g. Sex, Side involved etc.Sample-size calculation was done.

For continuous data, the Kolmogrov-Smirnov tests was performed to assess normality and where appropriated data was analysed with required statistical tests and descriptive statistics. Parametric data was analysed with student's t-test. Non-parametric data was analysed with the Mann-Whitney U-test. Categorical data was compared using X2 and Fishers exact tests and use Microsoft excel 2007 for

analysis.

Result

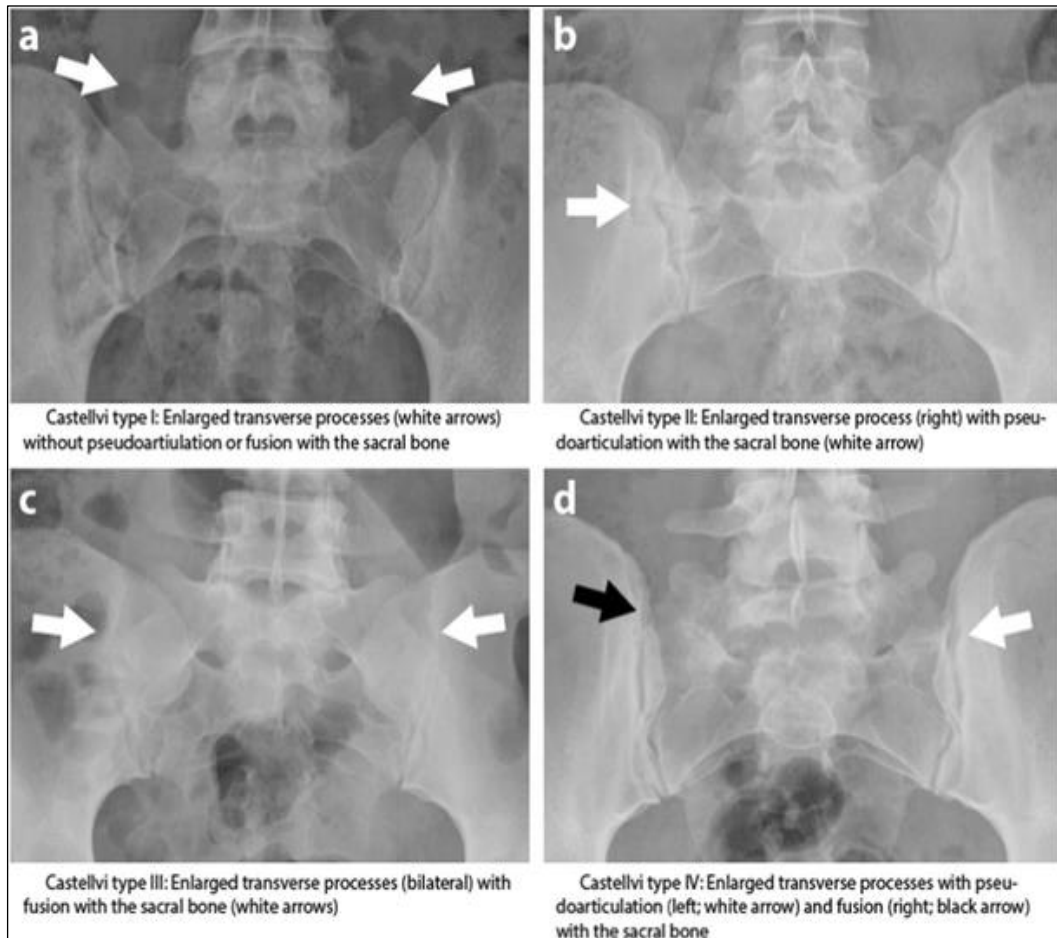


Fig1: Representative Radiographs of different types of LSTV

Table 1: Age Group Distribution

| Age (Years) | No. of cases | Percentage |
|-------------|--------------|------------|
| 20-25 | 32 | 6.4 |
| 26-30 | 74 | 14.8 |
| 31-35 | 120 | 24 |
| 36-40 | 156 | 31.2 |
| 41-45 | 118 | 23.6 |
| Total | 500 | 100 |

Incidence of LSTV

Patients who were diagnosed to have LSTV were 144 out of 500.

Table 2:LSTV grading

| Grade | Age Group (Years) | | | | | Total |
|-------|-------------------|-------|-------|-------|-------|-------|
| | 20-25 | 26-30 | 31-35 | 36-40 | 41-45 | |
| IA | 1 | 2 | 6 | 5 | 2 | 16 |
| IB | 3 | 2 | 4 | 5 | 2 | 16 |
| IIA | 4 | 4 | 4 | 3 | 5 | 19 |
| IIB | 2 | 6 | 6 | 12 | 9 | 35 |
| IIIA | 1 | 2 | 5 | 7 | 5 | 20 |
| IIIB | 4 | 3 | 8 | 6 | 4 | 25 |
| IV | 2 | 4 | 3 | 3 | 1 | 13 |
| Total | 16 | 23 | 36 | 41 | 28 | 144 |

Table 3: Pattern of LSTV

| LSTV (= 185) | | No. of Cases | Total |
|--------------|---|--------------|-------|
| Type1 | a | 16 | 32 |
| | b | 16 | |
| Type2 | a | 19 | 54 |
| | b | 35 | |
| Type3 | a | 20 | 45 |
| | b | 25 | |
| Type4 | | 13 | 13 |

Lumbarisation/Sacralisation

In patients with LSTV, 93 patients had Sacralisation while 51 patients had Lumbarisation.

Table 4: Modified Oswestry Low Back Pain Disability Index

| Modified Oswestry Low Back Pain Disability Index | Average Score |
|--|---------------|
| Pain Intensity | 2.36 |
| Personal Care | 1.37 |
| Lifting | 1.92 |
| Sitting | 2.00 |
| Walking | 1.52 |
| Standing | 1.59 |
| Sleeping | 1.24 |
| Social Life | 1.66 |
| Travelling | 1.81 |
| Employment | 1.78 |

Table 5: Type of LSTV correlation with modified Oswestry Low Back Pain Disability Index

| LSTV(Avg. Score) | No LSTV | Type I | Type II | Type III | Type IV |
|------------------|---------|--------|---------|----------|---------|
| Pain Intensity | 2.36 | 1.34 | 3.16 | 2.40 | 3.53 |
| Personal Care | 1.37 | 0.84 | 2.06 | 1.71 | 2.30 |
| Lifting | 1.92 | 1.37 | 3.06 | 2.20 | 3.23 |
| Sitting | 2.00 | 1.12 | 3.02 | 2.17 | 3.23 |
| Walking | 1.52 | 0.90 | 2.51 | 1.84 | 3.00 |
| Standing | 1.59 | 0.84 | 2.31 | 1.82 | 3.00 |
| Sleeping | 1.24 | 0.59 | 1.72 | 1.35 | 2.23 |
| Social Life | 1.66 | 0.812 | 2.57 | 1.95 | 3.15 |
| Travelling | 1.81 | 0.84 | 2.81 | 2.15 | 3.61 |
| Employment | 1.78 | 0.84 | 2.92 | 2.15 | 3.61 |

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Table 6: Prevalence of lumbarisation/sacralisation in various studies

| Author | LSTV | Lumbarisation | Sacralisation |
|---------------|------|---------------|---------------|
| Hughes | 67 | 21 (31.3%) | 46 (68.7%) |
| Steinberg | 85 | 20 (23.5%) | 65 (76.5%) |
| Kim | 41 | 29 (70.7%) | 12 (29.3%) |
| Chithriki | 37 | 15 (40.5%) | 22 (59.5%) |
| Santiago | 26 | 10 (38.5%) | 16 (61.5%) |
| Peh | 17 | 9 (52.9%) | 8 (47.1%) |
| Hald | 792 | 341 (43.05%) | 451 (56.95%) |
| Hahn | 24 | 9 (37.4%) | 15 (62.6%) |
| Leboeuf | 61 | 32 (52.5%) | 29 (47.5%) |
| TOTAL | 2206 | 486 (22.03%) | 664 (77.97%) |
| Present Study | 144 | 51(35.5%) | 93 (64.5%) |



Fig 4: X-ray showing LSTV grade IIB in a 33-year male with Modified Oswestry Low Back Pain Disability Score of 58%

Discussion

In our study the incidence rate of LSTV was 28.8% against the reported 4.0%-35.9% with a mean of 12.3%^[5,7,10,11] in various studies. Lowest incidence of LSTV was reported by Hsieh *et al.*, (4%) who in his study of 1668 patients which mainly consisted of Chinese population excluded Type I patients^[19]. Erken *et al.*, in his study of 729 Turkish population included all the subtypes of LSTV and reported the highest incidence of LSTV (35.9%)^[20]. Results of our study were consistent with studies published by Luoma *et al.*, with prevalence of 30%^[21], Dai *et al.*, reported a prevalence of 27%^[22] and Delpont *et al.*, in his study of 300 patients where prevalence of LSTV was 30%^[23].

As per Quinlan *et al.*, the mean age of patients was calculated to be 32.7 years^[15], which was comparable to that in our study i.e. 35.5 years.

In our study of patients with LSTV, Male: Female ratio was 2.1:1 which was in accordance with Lynch *et al.*, where Male: Female ratio was 2.5:1^[24].

Type (classification) of LSTV in our study correlated well with the study published by Hussain M *et al.*, where majority of the patients with LSTV belonged to Type II and type III^[25,26]. However, the results of our study differ from Demet *et al.*, who in his retrospective study population of 6200 reported Type I to be most common^[27]. This variation could be attributed to the fact that the study conducted by Demet *et al.*, was on an asymptomatic population and not in patients with low back pain. Also the study was conducted using abdominal radiographs instead of Lumbosacral radiographs. Like in our study, Sacralisation has been reported to be more common than lumbarisation in various other studies as well (approximately in the ratio of 2:1 to 3:1), except in the series of Kim *et al.*,^[23] where lumbarisation was common. In our study Sacralisation: Lumbarisation ratio in our study was 1.8:1 which was comparable with the reported literature^[27]. One reason for this could be heavier male axial skeleton with more load that necessitated entire fusion of L5 to sacral mass to optimise load transit from sacrum toward SI joint^[28]. Studies also point out that Lumbarisation of S1 is more common in females^[28].

In our study, Type II and Type IV LSTV patients were most symptomatic which was comparable with the study by Taskaynatan *et al.*, (881 patients)^[29]. In our view, this association is clinically relevant because patients with severe pain are more likely to seek health care, including physician visits, medication, and surgical treatment.

The results of our study differ from Tini *et al.*, who in his study did not observe an association between LSTV and Low back pain when using a subtype-specific analysis^[30].

In our study patients with Type I LSTV had lesser severity of low back pain as compared to patients without LSTV. This observation was consistent with findings of study by Nardo *et al.*, where 53.9% of the patients without LSTV presented with low back pain as compared to 46% of patients with a Type I^[24]. The lesser severity of pain in Type I patients could be due to alteration of spine movements where a large transverse process may prevent bending^[24]. In a systematic review of comparable observational studies, it was observed that the results obtained in our study regarding the correlation and severity of pain in patients with different types of LSTV were consistent and in accordance with most of the studies reported in the literature^[29]. It is a well-established fact that differentiating low back pain caused by LSTV from other sources of back pain in patients with LSTV is a challenging task^[18]. However, investigations and researches done to determine the association of LSTV and low back pain have shown Type II and Type IV LSTV were most consistently associated with low back pain^[24,29].

Bertolotti Syndrome is probably one of the most challenging clinical condition when it comes to managing low back pain in young adults. The treatment of Bertolotti syndrome does not usually require interventional pain treatment but an individualized approach based on thorough clinical and radiological correlation^[31]. The incidents of Bartolotti syndrome and its correlation with refractory lower back pain requires further detailed studies, especially in cases of partial fusion (sacralization/lumberization) which can be diagnosed better on SPECT/CT (as a cause of pain generator). Also, facet joint as a cause of pain generator should be evaluated vis-a-vis Bertolotti Syndrome, as facet joints sprains can mimic a similar picture. We also feel that facet hypermobility secondary to non-bony articulation or hemi-sacralization (transverse process to sacrum) as a secondary pain generator needs more attention in understanding the bertolotti syndrome physiology.

We believe that Bertolotti Syndrome treatment still lacks a definite management plan and there is no consensus regarding the pain generator or treatment guidelines. Also undiagnosed cases of Bertolotti Syndrome carry a huge economic and social impact on the life of young people in absence of proper treatment. Many of them even move to psychiatry for psychological counselling in absence of proper diagnosis and treatment^[32,33].

Conclusion

The study shows that presence of Lumbosacral transitional vertebrae (Type II and Type IV) in patients with low back pain have a strong and positive correlation with the severity of pain and it also has an adverse effect on a patient's daily activities. Due to the absence of consensus and controversial association of LSTV with low back pain, the incidence observed in our study assumes great significance. Our findings illustrate the importance of including Lumbosacral Transitional vertebrae in the list of differential diagnosis when investigating young and middle-aged patients with low back pain.

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