



# LUMBOSAKRAL TRANSİZYONEL VERTEBRA: FREQUENCY IN PLAIN RADIOGRAPHY SERIES

## LUMBOSAKRAL TRANSİZYONEL VERTEBRA: DÜZ RADYOGRAFİK SERİLERDE GÖRÜLME SIKLIĞI

Şafak EKİNCİ<sup>1</sup>,  
Ali Osman YILDIRIM<sup>2</sup>,  
Celalettin YÜKSEL<sup>3</sup>,  
Ömer ERŞEN<sup>4</sup>,  
Mustafa SUNGUR<sup>5</sup>,  
M. Fethi CEYLAN<sup>6</sup>

<sup>1</sup>Orthopaedic Surgeon, Ağrı Military Hospital, Ağrı  
<sup>2</sup>Emergency Medicine Specialist, GATA Haydarpaşa Education Hospital, Department of Emergency Medicine, İstanbul  
<sup>3</sup>Radiologist, Gümüşsuyu Military Hospital, İstanbul.  
<sup>4</sup>Çakmak Military Hospital, Erzurum  
<sup>5</sup>Ortopedi ve Travmatoloji Uzmanı, Gümüşsuyu Asker Hastanesi, İstanbul  
<sup>6</sup>Asst. Prof. of Orthopaedic Surgery, 100. Yıl University Department of Orthopaedic Surgery, Van.

**Address:** Ömer Erşen,  
Mareşal Çakmak Asker Hastanesi  
Erzurum,  
**Tel.:** 0533 5275181  
**E-mail:** merschenn@yahoo.com  
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### SUMMARY:

**Objectives:** A narrow disc space below a transitional vertebra is more likely to be related to the anomaly than to be a degenerative phenomenon. For most signs of disc degeneration, the prevalence was lower in the disc below an anomalous vertebra than in the one above, and the disc at the level above the fused segment has been found to be at an increased risk of degeneration. For this reason the presence of transitional vertebrae should be noted while investigating the lumbosacral region. The purpose of this study was to assess the percentage of patients with a transitional vertebra in the general population.

**Patients and Method:** In this study, 500 consecutive lumbar plain X-rays performed between June 2010 and September 2011 on adult patients (those older than 18 years) were retrospectively reviewed. Visual assessment was done by two orthopedic surgeons and one radiologist, and the presence or absence of a lumbar transitional vertebra was documented according to Castellvi's classification system.

**Results:** Of the 500 lumbar plain X-ray studies assessed, 412 (82.4%) patients had normal lumbosacral segmentation and 88 (17.6%) had transitional lumbosacral junctions.

**Conclusions:** The prevalence of transitional vertebrae was 17.6% in this study. Knowledge of the type of transitional vertebra will assist both orthopedic surgeons and radiologists in the early determination and prevention of lower back pain.

**Key Words:** Lumbosacral vertebra, transitional vertebra, abnormalities of the lumbosacral junction, lower back pain

**Level of Evidence:** Retrospective clinical study, Level III

### ÖZET:

**Amaç:** Lumbosakral transizyonel vertebranın üst seviyesindeki diskte erken dejenerasyon gelişme riskinin arttığı, alt seviyesindeki diskte ise azaldığı saptanmıştır. Bu etkilerinden dolayı lumbosakral bölge incelenirken transizyonel vertebranın varlığı bildirilmelidir. Bu çalışmanın amacı ağrısı olan ya da olmayan hastaların düz bel grafilerinde lumbosakral transizyonel vertebra görülme sıklığının belirlenmesi.

**Hastalar ve Metot:** Haziran 2010 ile Eylül 2011 tarihleri arasında rastgele seçilen beş yüz erişkin hastanın lumbosakral düz grafisi değerlendirilerek lumbosakral transizyonel vertebra bulunup bulunmadığı belirlendi. Değerlendirme iki ortopedi uzmanı ve bir radyoloji uzmanı tarafından yapıldı ve Castellvi sınıflandırmasına göre lomber transizyonel omurga varlığı kaydedildi.

**Sonuçlar:** Değerlendirmeye alınan beş yüz hastanın 412'sinde (% 82.4) normal lumbosakral görünüm, 88'inde (% 17.6) ise transizyonel lumbosakral vertebra oluşumu gözlemlendi.

**Tartışma:** Bu çalışmada transizyonel vertebra prevalansı % 17.6 gibi yüksek bir oranda bulunmuştur. Hem ortopedistler, hem de radyologlar için transizyonel vertebranın tiplerini ve görülme sıklığını bilmek önemlidir. Bu sayede gelişebilecek şiddetli bel ağrısı önceden tahmin edilerek, alınacak önlemlerle engellenebilir.

**Anahtar kelimeler:** Lumbosakral vertebra, transizyonel omurga, lumbosakral bileşkenin bozuklukları, bel ağrısı.

**Kanıt Düzeyi:** Retrospektif klinik çalışma, Düzey III

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## INTRODUCTION:

A transitional lumbosacral vertebra is a common congenital anomaly first observed by Bertolotti in 1917<sup>1</sup>. Transitional vertebrae may have varying formations, the common feature being an atypical lumbosacral articulation between the transverse process(es) of the most inferior lumbar vertebra and the sacrum<sup>4</sup>. The term 'lumbosacral transitional vertebra' (LSTV) is used, to avoid having to decide whether such a vertebra is a "sacralized L5" or a "lumbarized S1"<sup>7</sup>. LSTV are common in the general population, with a reported prevalence of 4–21%<sup>2,13</sup>. They are commonly classified based on the type of articulation between the transverse processes and the sacrum. Some authors have concluded that the incidence of transitional vertebrae is equal in those with and without back pain, rendering it only an incidental finding on imaging<sup>4</sup>. The presence of a lumbosacral transitional vertebra can create confusion regarding which level corresponds to which exiting nerve root during injection or surgery. For these reasons, the presence of a transitional vertebra has clinical significance.

The purpose of this study is to assess the percentage of patients with a transitional vertebra in the general population.

## PATIENTS AND METHODS:

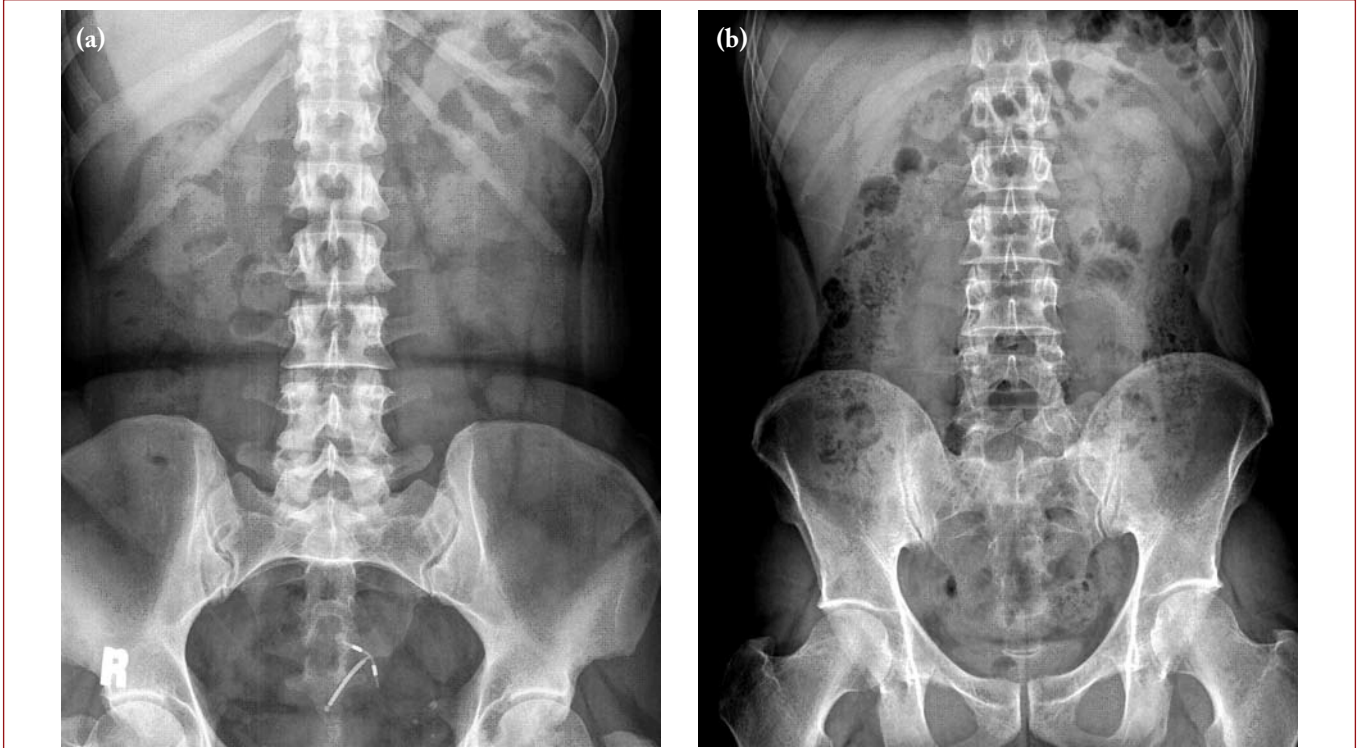
In this study, 500 consecutive lumbar plain X-rays performed between June 2010 and September 2011 on adult patients (those older than 18 years) was retrospectively reviewed. The visual assessment was done by two orthopedic surgeons and one radiologist, and documented the presence or absence of a lumbar transitional vertebra according to Castellvi's classification system.

The incomplete group (Castellvi Type I and II) included those X-rays in which the most inferior lumbar vertebra had a distinct transverse process(es) large enough that no space was visible between the transverse process(es) and the sacrum. Sometimes this was difficult to accurately determine, due to the two-dimensional nature of plain X-rays. In these cases, if T12 had no ribs or short ribs and L4 had the normal shape of L5, the most inferior lumbar vertebra was counted as transitional.

Also included in the incomplete group were those transitional vertebrae in which the transverse processes formed a diarthrodial joint with the sacrum. Complete transitional vertebrae (Castellvi Type III and IV) were considered to be those vertebrae with a clear bony union between one or both of the transverse processes and the sacrum.

We classified lumbarization in the LSTV cases when the shape of the S1 was similar to the L5. Conversely, we classified sacralization of the L5 in the LSTV cases when the shape of the L5 was difficult to distinguish from the S1.

We also divided lumbarization into the following three types of classification (Figure-1): (a) Complete lumbarization, in which both transverse processes of the S1 do not form a joint with the transverse process of the S2 and appear to be separated; (b) Incomplete lumbarization, in which both transverse processes of the S1 form a pseudoarthrosis with the transverse process of the S2, or only one side formed a pseudoarthrosis and the other side showed normal fusion; and (c) Mixed lumbarization,



**Figure-1.a.** Bilateral complete lumbarization, **b.** mixed lumbarization

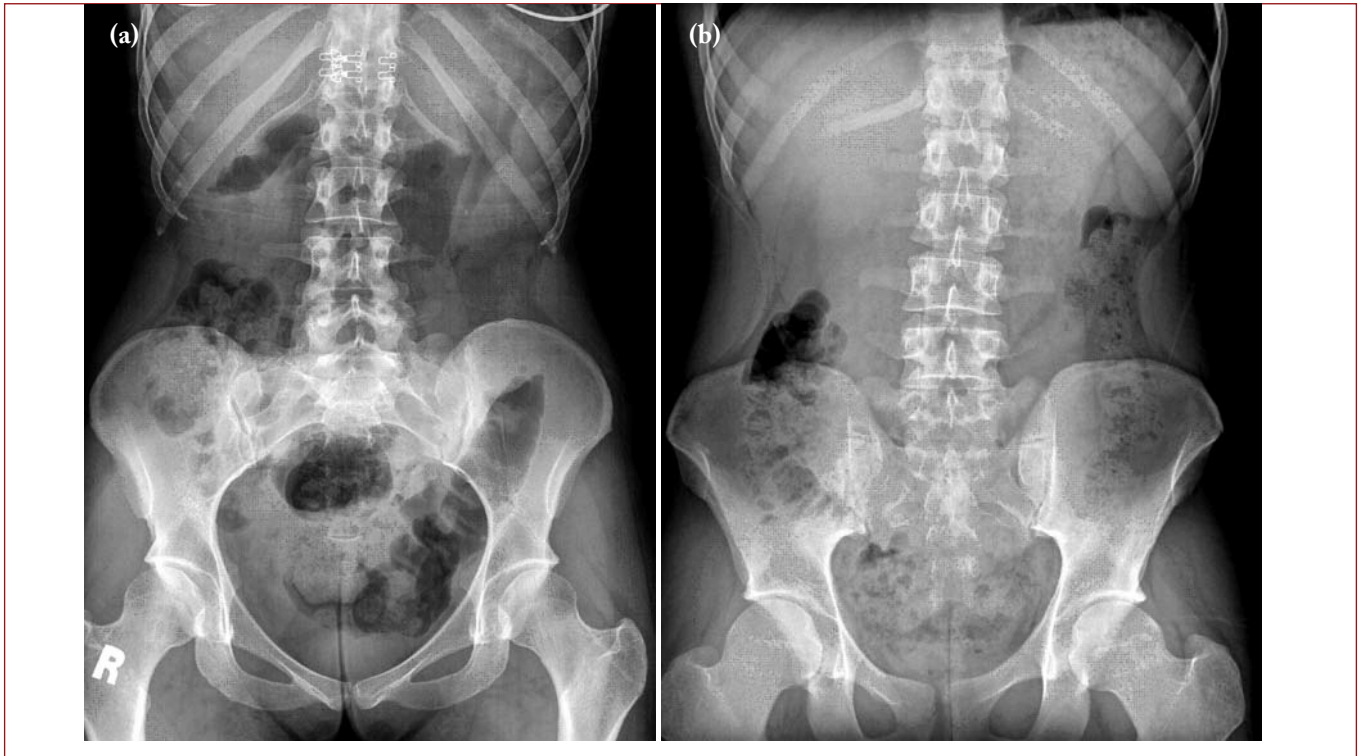
in which one side was a complete type and the other was incomplete or normal. Additionally, we classified three types of sacralization (Figure-2): (a) Complete sacralization, in which both transverse processes of the L5 are completely fused with the transverse process of the S1; (b) Incomplete sacralization, in which both transverse processes of the L5 form a pseudoarthrosis with the transverse process of the S1, or one side forms a pseudoarthrosis and the other side shows normal separation; and (c) Mixed sacralization, in which one side is a complete type and the other is incomplete or normal.

We examined the incidence of each type of lumbarization and sacralization according to the earlier classifications. We included dysplastic transverse processes, which are a particular frequently-seen type of LSTV, as the control group.

## RESULTS:

The 500 patients in the study group consisted of 342 females and 158 males, with a mean age of 38.6 years (range: 18–68 years). Of the 500 lumbar plain X-rays assessed, 412 (82.4%) patients had normal lumbosacral segmentation and 88 (17.6%) had transitional lumbosacral junctions.

Among the 88 cases in the LSTV group, we observed lumbarization and sacralization in 34 (6.8%) and 54 (10.8%) of the cases, respectively. Among the 34 cases showing S1 lumbarization, we observed 15 complete (44.1%), 9 incomplete (26.4%), and 10 mixed (29.5%) cases. Among the 54 cases that had L5 sacralization, we observed complete, incomplete, and mixed types in 22 (40.7%), 28 (51.8%), and 4 (7.5%) of the cases, respectively.



**Figure-2.a.** Complete sacralization, **b.** incomplete sacralization

## DISCUSSION:

The LSTV is a frequently-encountered anomaly, and the most common site for an LSTV to occur is at the lumbosacral junction<sup>9</sup>. The last lumbar vertebra may have some or all of the anatomical characteristics of the first sacral segment (sacralization). Conversely, the first sacral segment may have the radiographic appearance of a lumbar vertebra (lumbarization)<sup>2</sup>.

The presence of an LSTV is best identified on a true 30° angled anteroposterior radiograph of the lumbosacral junction (Ferguson view), together with an anteroposterior view including the thoracolumbar junction to enable assessment of the vertebral level<sup>7</sup>. A classification system for LSTV was proposed by Castellvi et al. in 1984 based on the conventional radiographic

appearances. According to Castellvi's system, Type I is defined as a large transverse process measuring at least 19 mm in width, Type II is an actual diarthrodial joint between the last transverse process and the sacrum, Type III is a bony union between the last transverse process and the sacrum, and Type IV is mixed<sup>2</sup>.

The disc height below the transitional lumbosacral vertebra has been found to be significantly lower than at the upper disc levels<sup>6</sup>. A narrow disc space below a transitional vertebra is more likely to be a part of the anomaly than a degenerative phenomenon. For most signs of disc degeneration, the prevalence was lower in the disc below an anomalous vertebra than in the one above, and the disc at the level above the fused segment has been found to be at increased risk of degeneration<sup>11</sup>.

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The joint between the transverse process of the transitional vertebra and the sacrum has been assumed to restrict rotational and bending movements<sup>12</sup>. This would result in greater forces being imparted to the segment above, and potentially more translation and rotation occurring with movement at this superior level. In 1917, Bertolotti first described the association between lower back pain and lumbosacral transitional vertebrae; hence this condition is sometimes referred to as Bertolotti's syndrome<sup>5</sup>. Early internal disc disruption of the level above, spondylosis concentrated at the level above, contralateral facet pain, and pain from the articulation with the transverse process, have all been shown to be commonly associated with transitional vertebrae<sup>4</sup>. Castellvi found that only those with Type II transitional vertebrae had increased herniations directly above the transition<sup>2</sup>. However, there is poor correlation between the presence of lower back pain and imaging study findings in the general population<sup>8,10</sup>. Tini et al. demonstrated no relationship between lower back pain and the presence of an LSTV in a study including 4,000 patients<sup>15</sup>. Tini et al. also found a familial tendency for transitional vertebrae and concluded that there may be a genetic factor, which may explain some of the variability in the different populations studied<sup>2,4-13</sup>.

Otani et al.<sup>13</sup> studied a group of patients to determine if a transitional vertebra contributes to an increased rate of nerve root symptoms from disc herniation and spondylosis. There was no difference in the incidence of transitional vertebrae<sup>14</sup>. Connolly et al. performed skeletal scintigraphy on 48 patients with lower back pain and a transitional vertebra. 81% of the 48 patients showed increased uptake in the bone at the articulation between the transverse

process and the sacrum (unilateral in all but one patient)<sup>3</sup>. These findings suggest that unilateral incomplete articulation frequently results in increased local stress, potentially resulting in pain at this joint.

When only lumbar radiographs or MRI are used, wrong numbering may occur in cases involving a supernumerary rib, hypoplastic rib, or cervical rib. Correlation of plain X-rays with MRI will help to prevent any confusion from occurring regarding the appropriate level to be treated with diagnostic or therapeutic fluoroscopic spine procedures.

In this study, the frequency of transitional vertebrae in patients who had plain X-rays due to lower back pain or routine check-ups was found to be 17.6%. An awareness of the incidence and types of transitional vertebrae is important for both orthopedic surgeons and radiologists; in this way, the development of severe lower back pain disorders can be predicted and prevented through necessary recommendations.

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