Determination of lumbosacral transitional vertebrae in kidney urinary bladder x-ray films in the Saudi population

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ABSTRACT

الأهداف: التغيرات التشريحية في الفقرات الانتقالية القطنية والعجزية هي الاكثر شيوعا على مستوى العمود الفقري في العالم .ووجود التباين الكبير في وتيرة حدوثها بين الأفراد استدعى القيام بهذه الدراسة

الأهداف: للتعرف على معدل حدوث التغيرات التشريحية في الفقرات الانتقالية القطنية والعجزية بين سكان المملكة العربية السعودية من خلال تشخيصها باستخدام الأشعة السينية المطلوبة لتشخيص أمراض الكلى والمثانة .

الطريقة: خلال الفترة من 1يناير 2012م إلى 31 يناير 2015م تم مراجعة جميع الأشعة المطلوبة لتشخيص امراض الكلى و المثانة بغية تحديد نسبة حدوث التغييرات الانتقالية بين الفقرات بنوعيها الناقص و الكامل .تم استبعاد جميع أشعات مرضى عمليات الظهر الجراحية لصعوبة التشخيص، وقد تم التعرف على 158حالة تغيرات انتقالية من بين 2078تصويراشعاعي .

النتائج: شخصت حالات التغييرات العجزية في (96.8%) 153 حالة بينما تواجدت التغييرات القطنية في 5حالات(3.2%) وكان 136حالة من العجزية غير مكتملة و17حالة مكتملة بينما كانت 3حالات من القطنية غير مكتملة و حالتين مكتملتين. يعد النوع 1ـ ب الأكثر شيوعا بين الفقرات العجزية لدى الذكور (28.5%)، يليه النوع 2ـ ب في الفقرات القطنية (0.6%)، بينما يعد النوع 1ـ أ الأكثر شيوعا لدى الأناث في الفقرات العجزية (11.3%)، و النوع 2ـ ب بين الفقرات القطنية .(2.8%)

الخاتمة: نسبة حدوث التغييرات الانتقالية بين الفقرات القطنية العجزية لدى المرضى السعوديين هو 7.6%و هناك حاجة للقيام بدراسات مستقبلية تشمل أعداد أكبر من المرضى لتحديد الأهمية السريرية لهذه التغييرات .

Objectives: To investigated the rate of occurrence of lumbosacral transitional vertebrae (LSTV), spinal variant, in kidney urinary bladder (KUB) plain radiographs in a Saudi population.

Methods: Between January 2012 to January 2015, KUB plain films obtained from patients at King Abdulaziz University Hospital, Jeddah, Saudi Arabia, were reviewed, and the presence or absence of LSTV was documented and classified as incomplete or complete. Patients who had evidence of spinal surgery that would obscure the view were excluded.

Results: A total of 2078 patients underwent KUB examinations during the study period; LSTV anomalies were detected in 158 of these. Sacralization was present in 153 (96.8%) of this cohort, while lumbarization was present in 5 (3.2%). A total of 136 (86.1%) of the sacralized segments were of the incomplete type, whereas 17 (10.7%) were complete. Of the lumbarized vertebrae, 3 (1.8%) were incomplete, and 2 (1.2%) were complete. The most frequent type in men was type Ib (28.5%) for sacralized segments, and type IIb for lumbarized segments (0.6%). In women, type Ia was the most common form of sacralized segments (11.3%) and type IIb was the most common form of lumbarized segments (2.8%).

Conclusion: The prevalence of LSTV in Saudi patients is 7.6%, with a higher incidence of sacralization than lumbarization. Further studies with larger sample sizes and longer follow-up time are needed to demonstrate the clinical significance thereof.

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Normal anatomical variants occur at the L5-S1 vertebral level, commonly termed lumbosacral transitional vertebrae (LSTV); LSTV include both lumbarization of the highest sacral segment and sacralization of the inferior lumbar segment.[1] Lumbarization of the S1 vertebrae presents as an anomalous articulation, with well-formed lumbar type facet joints, and a well-defined, full-sized disk; while sacralization of the L5 vertebra is characterized by broadened, elongated transverse processes that are fused to the sacrum.[1]

Lumbosacral transitional vertebrae were first observed by Bertolotti,[2] who classified spinal anomalies depending on the type of articulation between the transverse processes and the sacrum. In 1984, Castellvi et al[3] classified the radiographic appearance of LSTV into 4 types, depending on the morphological characteristics. Type I includes unilateral (Ia) or bilateral (Ib) dysplastic transverse processes, with a measured width of at least 19 mm (craniocaudal dimension). Type II includes incomplete unilateral (IIa) or bilateral (IIb) lumbarization/sacralization with an enlarged transverse process, which has a diarthrodial joint between itself and the sacrum. Type III involves unilateral (IIIa) or bilateral (IIIb) lumbarization/sacralization with complete osseous fusion of the transverse process(es) to the sacrum. Type IV includes a unilateral type II transition, with a type III on the opposite side.[3] The prevalence of LSTV in the general population varies greatly. It ranges from 4% to 35.9%, depending on the definition, diagnostic modalities, observer error, sample size, and the population studied.[4-19]

Lumbosacral transitional vertebrae variants are best identified on Ferguson radiographs (antero-posterior radiographs, angled cranially at 30°).[4,20,21] Other radiographic or CT examinations are more reliable in detecting LSTV than MRI.[4,20,21]

The association of LSTV with low back pain is controversial.[2] Some studies[8,22,23] have reported a strong association between LSTV and the incidence of low back pain,while others[7,15,18,24-26] considered that LSTV abnormalities are a common finding in the general population and have no relationship to the higher incidence of low back pain. Spine surgeons must be aware of LSTV anomalies, particularly when they operate at L5–S1 vertebral levels, in order to avoid any surgical or procedural errors in terms of vertebral numbering, which might affect the surgical outcome.[4,7,21,27,28] The occurrence rate of LSTV in Saudi Arabia is unknown. Therefore, we conducted a retrospective study to estimate the prevalence of LSTV among a sample of Saudi patients.

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Methods. *Search strategy.* PubMed and Google Scholar were searched using the following keywords: lumbosacral transitional vertebrae; LSTV; sacralization; lumbarization; kidney urinary bladder x-ray films; KUB; Saudi Arabia; and KSA in different combinations was performed to identify previously published studies. The papers identified were reviewed by the authors and the design of the current study was developed to estimate the prevalence of LSTV among Saudi Population.

Data extraction. The study followed the principles of the Helsinki Declaration, institutional approval was obtained from the Research and Ethics Committee of King Abdulaziz University, Jeddah, Saudi Arabia. The need for patient consent was waived, and a retrospective, cross-sectional study was conducted between January 2012 and January 2015, at King Abdulaziz University Hospital, Jeddah, Saudi Arabia. All KUB x-ray films taken during that period were included in the study and a thorough assessment of the films was made by expert radiologists in order to identify abnormal LSTV variants. Patients who demonstrated evidence of spine surgery that would obscure the identification of LSTV were excluded from the study. Demographic data were collected. Identification of LSTV anomalies was dependent upon Castellvi's classification. Complete and incomplete forms of LSTV were identified as follows: unilateral and bilateral types I and II were labeled as incomplete, whereas unilateral and bilateral type III and IV were labeled as complete.

Statistical analysis. Statistical analysis was performed using the IBM SPSS Statistics for Windows, Version 21.0 (Armonk, NY: IBM Corp). Frequency tables were developed and categorical data were analyzed using Chi-square testing with a $p<0.05$ considered statistically significant.

Results. The review of KUB films obtained from 2078 patients revealed LSTV anomalies in 158 patients. Of these, 113 (71.6%) were men, and 45 (28.4%) were women. The age ranged from 2 to 80 years, with a mean ± SD of 46.8 ±14.6 years. The prevalence of LSTV in this sample size was 7.6%. Sacralization was present in 153 (96.8%) patients, while lumbarization was present in 5 (3.2%). Among the sacralized segments, 136 (86.3%) were of the incomplete type, whereas 17 (10.7%) were complete. Of the lumbarized vertebrae, 3

(1.8%) were incomplete, and 2 (1.2%) were complete. **Table 1** showed the various types of transitional vertebrae, including sacralized and lumbarized vertebrae.

Stratifying frequencies for both genders revealed that, in men, the most frequent types were Ib (28.5%) for sacralized segments, and IIb for lumbarized segments (0.6%). Sacralization was present in 81% of men and lumbarization in 0.2%. Complete forms comprised 5%, and incomplete forms 64.2%. All lumbarizations were incomplete in men. In women, 18% of LSTV were sacralized, and 0.8% lumbarized. Type Ia was the most frequent form of sacralized segments (11.3%) and type IIb of lumbarized segments (2.8%). Complete transitional sacralized vertebrae accounted for 11.3%, while incomplete forms accounted for 29.6%. An equal percentage of complete and incomplete lumbarized segments (2.8%) were seen.

Based on the Chi-square test, age was not statistically significantly different between transitional vertebrae groups (p=0.319). However, a statistically significant association was found between gender and sacralization, which was more common in men than in women (p<0.001), while the association with lumbarization was insignificant (p=0.23).

Table 1 - Frequency of various type of sacralization and lumbarization.

Vertebral variant types	Sacralization n (%)	Lumbarization n (%)
Type Ia	40 (25.3)	0 (0.0)
Type Ib	56 (35.4)	0 (0.0)
Type IIa	18 (11.4)	0 (0.0)
Type IIb	22 (13.9)	3 (1.9)
Type IIIa	7 (4.4)	0 (0.0)
Type IIIb	7 (4.4)	1 (0.6)
Type IV	3 (1.9)	1 (0.6)
Total	153 (96.8)	5 (3.2)

Discussion. The prevalence of LSTV in this study falls in the range of previously published studies (4% to 35.9%).[4-19] The wide variability in the prevalence and incidence of LSTV cited in the literatures is mainly related to many contributing factors: differences in populations, sample size and selection criteria (symptomatic or asymptomatic), vertebral numbering technique, observer error, and imaging modality.[4-19]

When we compared the transitional states of LSTV, we found that sacralization of the fifth lumbar vertebrae is more common than lumbarization of the first sacral segment. Previously published studies[10,13,19,29-34] have reported a prevalence of sacralized L5 of 1.7% to 14%, and that of lumbarized S1 of 3% to 7%, which is similar to our findings, although the prevalence of sacralization was lower in our study. The vertebral numbering technique and other factors might contribute to this finding. The use of KUB films to identify LSTV anomalies might have contributed to a higher prevalence among men, as renal stones are historically 2-4 times more common among men than among women.[35,36] Other unknown factors may have contributed to this finding and further studies are needed to clarify such associations. Many studies have reported a higher prevalence of lumbarization than of sacralization,[19,30,34] but the cause of this difference has not been reported. Further studies are required to clarify the present situation. When we classified LSTV into complete and incomplete groups, only 7.6% of our sample films were considered to be the complete type, and this is similar to the findings documented in previously published studies in Asian and Australian populations.[1,6] Types I and II were the most prevalent types in our study, which is similar to the findings in the study by Castellvi et al[3] and Apazidis groups,[7] although they considered them to be of no clinical significance.

In terms of the relationship between gender and LSTV anomalies, Nardo et al, as well as other investigators,[6,34,37,38] reported a similar finding, where the prevalence of sacralization was more common in men than in women, while lumbarization of S1 was more common in women than in men.

Study limitation. On of the limitation of this study is the retrospective nature of the study. A second limitation is the use of more than one observer to identify LSTV, which might lead to observer error. Further prospective studies, where a single observer assesses the imaging, and the use of other image techniques, are needed in future.

Despite the available reports, there are debates about the clinical significance of LSTV and its association with low back pain, as well as the contribution to surgical error in the identification of vertebral level,[7] and future studies should concentrate on finding answers to such questions.

In conclusion, our study adds to the literature about the prevalence of LSTV in the Saudi population, and emphasizes a higher prevalence of sacralization among men than among women.

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