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Radiographic prevalence of lumbosacral transitional vertebrae

MD. TOWHIDUR RAHMAN[1], MOFAZZAL SHARIF[2], ABU SALEH MOHIUDDIN[3].

Abstract:

Objective: *This cross sectional observational study was undertaken to determine the prevalence of lumbosacral transitional vertebra among the Bangladeshi population.* ***Method:*** *Plain radiographs (anteroposterior and lateral views of lumbosacral spine) of 301 patients done from July 2018 to June 2019 meeting inclusion criteria were retrospectively analyzed for the presence of lumbosacral transitional vertebra.* ***Result****: Prevalence of lumbosacral transitional vertebra was 15.3% in lumbosacral radiographs. Prevalence of sacralization was higher than lumbarization (13.1% vs. 2.2%). Lumbosacral transitional vertebra was more common in females than in males.* ***Conclusion:*** *With this study, the overall prevalence of lumbosacral transitional vertebra in the studied Bangladeshi population was 15.3% with lumbosacral radiographs.*

Keywords: *Lumbosacral transitional vertebra; Plain radiographs; Sacralization; Lumbarization.*

Introduction:

Lumbosacral transitional vertebra (LSTV), with a wide range of prevalence from 4% to 35.9% and a mean prevalence of 12.3% as reported in different studies, is a common congenital anomaly of lumbosacral vertebral junction that presents either as sacralization of fifth lumbar (L5) vertebra (elongated and broadened L5 transverse processes to its fusion with sacrum) or lumbarization of first sacral (S1) vertebra (separation of S1 vertebra from remaining sacral vertebrae).[1,2] Identification of LSTV is important as its presence may lead to number of clinical consequences like performing spinal surgery at wrong level, errors in other lumbosacral procedures and poor correlation of patients symptoms because of failure to correctly number the problematic vertebra.[3] Association between presence of LSTV and low back pain (also known as Bertolotti syndrome) was first described by Bertolotti in 1917,[4,5] which is still controversial and debatable as the results of various studies are conflicting with some studies showing positive correlation, while no association was found in others.[6] However higher occurrence of disc herniation or degenerative changes immediately above the level of LSTV has been reported.[7-9]

Even though detection of LSTV can be made in various imaging modalities including plain radiographs, computed tomography (CT) and magnetic resonance imaging (MRI), there is no well-established standard technique to identify and number LSTV. Ferguson radiograph which is an antero-posterior radiograph with 30 degrees cranial angulation has been regarded as best for identifying LSTV, but currently role of CT and MRI in this regard have been evaluated. Due to risk of exposure to radiation CT scans are not routinely recommended for sole purpose of evaluation of LSTV. Also determination of LSTV with MRI alone may be challenging when plain radiographs are not available. On MRI different studies have suggested various techniques to number the lumbar vertebrae, of which use of iliolumbar ligament as a landmark is considered to be more accurate.[10,11]

As different studies done at different part of the world have shown wide range of prevalence of LSTV, knowledge of local prevalence is important so as to avoid any untoward consequences during patient management due to failure to accurately assign the vertebral number. Hence this hospital based study was undertaken to determine the prevalence of LSTV in the Bangladeshi population.[12]

Material and methods:

Three hundred one consecutive subjects with no evidence of previous lumbar spine surgery were included in this study. This cross sectional observational study which spanned from 1st July, 2018 to 30th June, 2019 was conducted at the

1. Associate Professor, Department of Radiology & Imaging, Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM), Dhaka, 2. Associate Professor, Department of Radiology & Imaging, Khwaja Younus Ali Medical College Hospital, Sirajgonj, 3.Professor and Ex-Head, Department of Radiology & Imaging, BIRDEM.

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Radiology and Imaging department of BIRDEM. Plain radiographs of lumbosacral spine (AP & Lateral) of 301 patients were studied. Patients of both sexes and all age groups were included in the study. Radiographs of poor image quality hampering adequate evaluation of all lumbosacral vertebrae (mainly transverse processes); not including last thoracic vertebra with rib attached to it and with presence of vertebral fracture, signs of spinal surgery and/or vertebral destruction due to tumor or infection were excluded from the study. First of all twelfth thoracic (T12) vertebra was identified, which was defined as the vertebra to which the lowest rib is attached and then numbering of lumbar vertebrae was done craniocaudally with the vertebra immediately below T12 vertebra numbered as first lumbar (L1) vertebra thus noting presence or absence of LSTV. When present, LSTV were further classified according to the Castellvi radiographic classification[13,14] into four types as follows:

Type I: Enlarged and dysplastic transverse process (es), measuring ≥19 mm in width (cranio-caudal dimension). Ia–Unilateral, Ib–Bilateral.

Type II: Incomplete lumbarization / sacralization with an enlarged transverse process (es) and pseudo-articulation of the transverse process (es) and the sacrum. IIa–Unilateral, IIb–Bilateral.

Type III: Lumbarization / sacralization with complete bony fusion of the transverse process (es) to the sacrum. IIIa–Unilateral, IIIb-Bilateral.

Type IV: Mixed type. A unilateral type II transition with a type III on the contralateral side.

All of these four types of LSTV were included in this study. Record was made of patient's age, gender and findings of lumbosacral vertebrae including number of lumbar vertebrae, craniocaudal measurement of transverse process of L5 vertebra and pseudoarthrosis and/or bony fusion of L5 vertebral transverse process (es) with the sacrum.

For statistical analysis acquired data were entered on Microsoft Excel worksheet and then using IBM SPSS statistics 20 software further analysis was done. Frequency, percentage and mean with standard deviation were calculated for various categorical and numerical variables. Chi-square test was applied to examine association between two categorical variables with p-value <0.05 considered to be significant.

Measurements

AP & Lateral X ray Lumbar spine radiographs of the patients were taken in a standing position by Hitachi machine. The images obtained were analyzed to measure the following radiographic parameters of sacralization, lumbarization.

Fig.-1: *Plain AP X ray of lumbar spine with sacralization.*

Result:

The study included 301 patients with mean age of the patients at the time of imaging was 45.9 ± 15.5 years (range 14-90 years). Plain radiographs of 301 patient's lumbosacral spine were studied. Of these, 141 (47%) were male and 160 (53%) female with male to female ratio of 1:1.13.

Out of the total 301 patients, LSTV was seen in 46 (15.3%). LSTV was found to be more common in females with its distribution of 22 (48%) in males and 24 (52%) in females and a prevalence of 14.1% and 15.1% in males and females respectively. This difference in prevalence of LSTV between males and females was statistically insignificant (p value = 0.666).

According to Castellvi classification of LSTV, type I was seen in 20 (43.9%), type II in 14 (30%), type III in 8 (18.1%) and type IV in 4 (7.2%) of patients.

Of the 46 patients with LSTV, 37 (81.3%) had sacralization whereas lumbarization was seen in

Table-I

Distribution of sacralization and lumbarization according to gender

LSTV	Male (n = 22) (%)	Female (n = 24) (%)	Total (n = 46) (%)	P value*
Sacralization	31 (84.9)	28 (76.3)	59 (81.2)	0.820
Lumbarization	01 (15.1)	02 (23.7)	03 (18.7)	0.184
Total	32 (100)	30 (100)	62 (100)	0.676

*Chi square test

9 (18.7%) patients with overall prevalence of sacralization and lumbarization being 13.1% and 2.2% respectively. Sacralization was commonly seen in males than in females (31 (84.9%) vs. 28 (76.3%)), while lumbarization was common in females (2 (23.7%) vs. 1 (15.1%)). However this gender difference in sacralization and lumbarization was statistically insignificant (p value = 0.820 and 0.184 respectively). (Table 1)

Discussion

LSTV has a wide range of prevalence from 4% to 35.9% in different study population as reported in literature.[1] This variation in prevalence has been attributed to differences in the number of factors taken into consideration while conducting a study, like definition, criteria and classification of transitional vertebra; type of study population, whether with low back pain (LBP) or not; imaging technique used; error of observer and other study population related confounding factors.[15] Erken et al,[3] Nardo et al[8] and Elster[14] included Castellvi type I LSTV in their study, while Hsieh et al,[2] Otani[15] did not include it, as they considered Castellvi type I to be a normal anatomical variation lacking clinical significance. In this study all four types of LSTV according to Castellvi radiographic classification were included.

In this study, the overall prevalence of LSTV in the studied Bangladeshi population was 15.3% with higher prevalence in females in comparison to males. However this gender variation in prevalence of LSTV was statistically insignificant. In another MRI based study from Nepal by Quinlan[9] LSTV was seen in 3.8% of patient, which was much lower than that noted in this study. Similarly LSTV prevalence of 10% was reported in north Indian population by Paajanen[12] from evaluation of lumbosacral, KUB and abdomen radiographs. The most common type of LSTV observed in this study was Castellvi type I with type IV being least common, which was similar as seen in study of Elster[14] but in different proportions.

According to literature, the overall prevalence of sacralization is higher than that of lumbarization,[1] which also holds true for this study with the prevalence of 13.1% and 2.2% for Sacralization and lumbarization respectively. Sacralization was common than lumbarization in the study of Steinberg et al.[10]

Wide range in prevalence of sacralization and lumbarization has been noted in analysis of different studies. The prevalence of sacralization and lumbarization was 14% and 4.3%,11% and 2%, 9.2% and 4.2%, 3.8% and 5.3%, 17.2% and 1.7%, 21.2% and 2.4%, 11.6% and 7.2%, 5.5% and 6% & 6.2% and 7% in the studies of Steinberg et al,[10] Sekharappa et al,[16] Hughes et al,[17] French et al,[18] respectively with the range of 3.8% - 21.2% for sacralization and 1.7% - 7.2% for lumbarization. Hence the prevalence of sacralization (13.1%) and lumbarization (2.2%) as seen in this study falls within the above mentioned range. Gender difference in occurrence of sacralization and lumbarization was noted with sacralization common in males than in females (84.9% vs. 76.3%) and lumbarization common in females than in males (23.7% vs. 15.1%), but was statistically insignificant.

Conclusion

As LSTV is a common congenital anomaly of lumbosacral vertebral junction, its identification and thus accurate assignment of vertebral number

is important to avoid any untoward consequences during patient management.

Limitation

The main limitation of this study was the small case series.

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