

Study of Sacralization of Fifth Lumbar Vertebra

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Abstract: Vertebral column have very important role in weight transmission and to maintain posture of our body. Stress and strain of vertebral column are increasing from above downward. Lumbosacral region have more stress and strain and low back pain is very common in this region. Low back pain is also associated with sacralization of fifth lumbar vertebra (2).

Sacralization is congenital condition in which the fifth lumbar vertebra fuses completely or partially with sacrum on either or both sides. Sacralization may be at times associated with problems in biomechanics and affect the way of movement and posture control. Person with sacralization may present with low back pain, radicular pain and related signs (4). Sacralization leads to narrowing of disc space between L5 and S1, so there is higher chance of disc herniation and disc degeneration (9). Sacralization can lead to narrowing of intervertebral foramina causing compression of spinal nerve which can cause spinal or radicular pain (8). In present study we found sacralization in four specimens.

Keywords: Sacralization, Low back pain, Radicular pain, Disc prolapse.

I. Introduction

Sacrum is a large triangular bone formed by fusion of five sacral vertebrae. It lies obliquely at the upper and posterior part of pelvic cavity between two hips bone. Because of its oblique position it forms an angle with rest of vertebral column known as sacrovertebral or Lumbosacral angle (1).

Lumbosacral transitional vertebra (LSTV) is a common congenital anomaly of lumbosacral region, which includes sacralization and lumbarisation and it is frequently encountered. Sacralization is a congenital condition in which usually the fifth lumbar vertebra fuses completely or partially with sacrum unilaterally or bilaterally. In lumbar sacralization usually L5 and rarely L4 along with L5 fuses with sacrum. In coccygeal sacralization coccyx fuses completely or partially with sacrum. Lumbarisation of first sacral vertebra is a condition in which the first sacral vertebra is not completely attached to its fused sacral components but instead this first sacral vertebra appears like the other lumbar vertebrae. It occurs due to non-fusion of first and second sacral segments.

Sacralisation of L5 is a congenital anomaly in which the lumbar vertebra mainly its transverse process gets fused or semi fused with sacrum or the ilium or to both. This can be on one or both sides of the body. Sometimes it is observed that the lumbar vertebral body is not fused but only transverse process is fused with sacrum, completely on one side and incompletely on other side. When fusion occurs with body of sacrum it is central sacralization and when fusion of transverse process occurs it is transverse sacralization which may be unilateral or bilateral. After sacralization L4 becomes last lumbar vertebra and L4 vertebra lack the ability to perform function like L5 and cause problems. It is difficult for L4 to cope with increased demand causing overuse and undue strain to the disc between L4 and L5. This usually leads to pain and discomfort in region of low back. Sacralization can lead to narrowing of intervertebral foramina causing compression of spinal nerve which can cause spinal or radicular pain (8). Sacralization can lead to narrowing of intervertebral disc which can cause disc prolapse or disc degeneration (9).

Material and methods: The study was conducted in the department of anatomy AIIMS, Patna. We have studied forty sacral bones of both sexes male and female. All the sacra were observed for sacralization, lumbarisation, number of ventral and dorsal sacral foramina, number of vertebral bodies, sacral hiatus and sacral cornua. All the observations were noted and tabulated.

Observation: In the present study out of forty sacral bones there were 31 male sacral bones and 9 female sacral bones. We found sacralization of fifth lumbar vertebrae in four male sacral bones. So sacralization was found in 10% cases. In all the cases sacralization was bilateral. Out of four sacralised bones in two specimens body was completely fused and in other two specimen's body was not completely fused.



Fig. 1- Ventral and Dorsal view of 1st sacralized specimen. There was complete fusion of body as well as transverse process of L5 with sacrum. Lamina, spinous process and inferior articular facet was also completely fused. There are 5 sacral foramina on dorsal and ventral aspect of sacrum.



Fig. 2- Ventral and Dorsal view of 2nd sacralized specimen. There was incomplete fusion of L5 with sacrum. Transverse process of L5 was completely fused with sacrum but body and spinous process was not completely fused. There were 5 sacral foramina on dorsal and ventral aspect of sacral bone.



Fig.3- Ventral and Dorsal view of 3rd sacralized specimen. There was incomplete fusion of L5 with sacrum. Transverse process of L5 was completely fused with sacrum but body, spinous process and lamina was not completely fused. There were 5 sacral foramina on dorsal and ventral aspect of sacral bone.



Fig.4- Ventral and Dorsal view of 4th sacralized specimen. There was complete fusion of L5 with sacrum. Lamina of left side was fused and lamina of right side was not fused. There were 5 sacral foramina on dorsal and ventral aspect of sacral bone.

II. Discussion

In our present study we found sacralization in four (10%) cases. All the sacralised bones were male sacrum which shows that the incidence of sacralization is more common in males. Eyo et al. (2001), in his study he found that the incidence ratio of sacralization to lumbarisation was 2:1 and this condition was more common in males (7).

Magora and Schwartz (1978) found sacralization in 20.8% of cases (3). Castellvi et al (1983) reported incidence of sacralization may be 1.7 % to 14%, he also gave radiological classification system for sacralization (4). Peter et al (1999) reported 6.2% sacralization (6).

Chet Savage (2005) reported 7% sacralization (10). Sharma et al (2011) reported sacralization in 14.1% of cases in central India (12). Our study was close to Dharati K et al who found sacralization in 11.1% of cases (13). J.L Brow in a systematic review on the subject analysed all the relevant studies from 1986 till 2006 and documented that the mean prevalence of sacralization to be 12.3%.

Sacralization is basically related to embryological development of vertebra and sacrum. During 3rd week of intrauterine life segmentation of paraxial mesoderm starts to form somites on either side of notochord along the cranio caudal axis. These somites differentiate further into dermomyotome and sclerotome. Each sclerotome consists of loosely packed cells cranially and densely packed cells caudally. Some densely packed cells move cranially opposite the centre of myotome where they form intervertebral disc.

The remaining densely packed cells fuses with the loosely arranged cells of immediately caudal sclerotome to form mesenchymal centrum (body of vertebra). The mesenchymal cells of sclerotome surrounding the neural tube form neural arch. Ossification of vertebra begins in 8th week and end by 25th year of life. There are 3 primary centres for each sacral vertebra, 1 for body and 2 for each arch which appears between 10th to 20th weeks. 6 primary centres for costal elements of upper 3 sacral vertebrae appears in pairs one on each side. There are 5 secondary centres present in each vertebra, one for spinous process, one for tip of each transverse process and 2 for annular epiphysis. Thus sacrum has 21 primary centre and 14 secondary centres and completes ossification occurs at 25 years of age. Ossification from 3 primary centres and 7 secondary centres occurs in lumbar vertebrae that fuses between 17 to 25 years of age. Any defect in these ossification centres leads to variant morphology of the vertebrae (Sharma et al, 2011)

The primary cause of Lumbosacral transitional vertebra (LSVT) is cranial shift that means sacralization of last lumbar vertebra and partial shift means unilateral fusion of transverse process. Caudal shift results in lumbarisation of first sacral vertebra, cranial shift is dominant over caudal shift. So sacralization is more common than lumbarisation (Sharma et al, 2011). The improper formation and union of somites can cause vertebral abnormalities including block vertebrae, cleft vertebra or hemivertebrae.

The development of vertebra and sacrum is regulated by homeobox and paired box genes pax1 and pax9 which control cell proliferation during sclerotome development (6). As revealed in mice that deficiency of pax1 and mutation of pax9 leads to vertebrae malformation in lumbar region. There are genetic determinants leading to sacralization. This hypothesis was supported by a previous study of Tini (1977) as increased incidence of Lumbosacral transitional vertebra were observed occurring within families (5).

Bertolotti (1917) described the relationship between low back pain and sacralization of L5 which is known as Bertolotti syndrome (2). In young patient with low back pain the possibility of bertolotti syndrome should always be taken in account. Back pain in sacralization is due to pressure on nerve or nerve trunk or

ligamentous strain around the sacralization. Aihara et al in an anatomical study of 70 cadavers claimed that the iliolumbar ligament at the level immediately above the transitional vertebra is much thinner and weaker than in cadavers without a lumbosacral transitional vertebra(9).

Lumbosacral transitional vertebra is associated with disc herniation, sciatic pain and scoliosis in some individuals. Failure to recognize the transitional vertebra during spinal surgery may cause serious complications. In sacralization pelvis may fails to expand during labour leading to difficulty in delivery of baby.

III. Conclusion

Knowledge of sacralization or lumbarization is very important for orthopaedic and neurosurgeons operating in this region to avoid surgery at incorrect level, and also for anaesthetists during administration of epidural, subdural and caudal anaesthesia.

It is also very important for radiologists while reporting x-ray, CT and MRI for correct clinical and radiological assessment and for physicians to rule out secondary spinal disorders like disc herniation, disc degeneration, facet arthritis and radicular pains.

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