Lumbosacral Transitional Vertebrae and Their Relationship With Lumbar Extradural Defects

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The relationship between herniated lumbar disc and abnormalities of the transverse process of the lumbosacral junction was investigated. Two hundred consecutive patients with positive myelographic findings of herniated lumbar disc were reviewed. Sixty patients presented abnormalities of the transverse process to satisfy the criteria for lumbosacral transitional vertebra. A new classification of lumbosacral transitional vertebra is presented based upon the morphologic and clinical characteristics with respect to herniated nucleus pulposus. Type I represents a "forme fruste" of lumbosacral transitional vertebra and shows no difference in the incidence of the location of herniations. In Types III and IV, there are no herniations at the level of the lumbosacral transitional vertebra and no increase in the incidence of herniations just proximal to the lumbosacral transitional vertebra. The Type II lumbosacral transitional vertebra presents herniated lumbar disc at the level of transition. It also presents a greater than normal incidence of herniations at the level just above the lumbosacral transitional vertebra. [Key words: anomalous lumbosacral junction, transverse process abnormalities, transitional vertebra, herniated lumbar disc]

THE PRESENCE OF an enlarged transverse process on one or both sides of the last lumbar vertebra is a common anomaly. For nearly a century, the clinical significance of the lumbosacral transitional vertebra has been debated. In 1917, Bertolotti[1] described assimilation of the fifth lumbar vertebra into the sacrum associated with low-back pain. Stinchfield[10] stated that roentgenographic interpretation of the amount of motion present at the lumbosacral transitional vertebra is deceptive and found at surgery a great deal of motion was possible. He also made the only reference in the literature as to herniations at the level of the transitional vertebra. In his review, he commented only on unilateral or bilateral transitional changes with no reference to the presence of a diarthrodial joint. He found only one case in 31 patients with herniated nucleus pulposus. All the other herniations were at the level above that of the lumbosacral transitional vertebra. DePalma and Rothman[2] claimed that the disc between the transitional vertebra and the body of the sacrum is vestigial and devoid of nuclear material, and if a lumbar lesion develops, the affected disc is proximal to the rudimentary disc. Nachemson,[8] in 1974, stated that lumbosacral transitional vertebra is an incidental radiographic finding that has no relevant significance to low-back pain. Keim,[4] in 1980, described low-back pain with or without sciatica due to a lumbosacral transitional vertebra with unilateral or bilateral contact to the sacrum. He stated that lumbosacral transitional vertebra with diarthrodial joints between transverse process and ala produced abnormal torque moments at the vertebral segments above the transition, which subsequently can lead to disc degeneration. Wigh,[13] in 1981, found no incidence of herniation at the level of the lumbosacral transitional vertebra in the review of 200 positive myelograms. In view of the controversy of the lumbosacral transitional vertebra and its relationship to pain syndromes of the low back, we have attempted solely to determine the relationship between herniated nucleus pulposus and lumbosacral transitional vertebra through a study of 200 positive myelograms.

MATERIALS AND METHODS

This study is a retrospective radiographic analysis of 200 consecutive cases in 1979 with myelographic evidence of herniated nucleus pulposus. A small percentage had, in addition to myelography, lumbar venography, and/or augmented computerized axial tomography. The chest posterior/anterior and anterior/posterior of the lumbar spine, a spot L5–S1 lateral and a true AP of the lumbosacral joint were reviewed. Chest roentgenograms were used to determine the number of lumbar vertebrae in the AP lumbar spine. A spot lateral view of the lumbosacral joint was used to determine the presence of spondylolisthesis. A true 30 degree AP view of the lumbosacral joint was taken on all patients. We think that this is the best view to determine the relationship of a lumbosacral transitional vertebra since the standard AP may produce false positive information due to overlap of the transverse process of L5 in the area of the sacrum.

All myelograms were read by the neuroradiology staff and reread independently by one of the authors. An extradural lesion is diagnosed when the contrast medium-filled subarachnoid space is depressed and/or deviated laterally on the AP film and/or posteriorly on a cross table lateral. Amputation or asymmetry of the nerve roots and displaced or swollen adjacent roots were considered to be positive for herniation of the disc. All patients with questionable studies were discarded, and only strongly positive myelograms were accepted for inclusion in the study.

We classified the different types of lumbosacral transitional vertebrae into four groups according to the morphologic characteristics and clinical relevance with respect to lumbar disc herniation.

Type I. *Dysplastic transverse process:* a, unilateral; b, bilateral. This type presents a large transverse process triangular in shape, measuring at least 19 mm in width, as described by Southworth and Bersack[11] in 1950.

Type II. *Incomplete lumbarization/sacralization:* a, unilateral; b, bilateral. This type has a large transverse process, which appears

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disease. We have also documented, contrary to popular anecdotal belief, an incidence of 17% of herniation at the level of the transitional vertebra.

As expected in Types III and IV, there are no herniations at the level of transitional vertebra, with a similar distribution of herniations as occurs in the normal population. There is not an increased incidence of herniation at the level just above the lumbosacral transitional vertebra.

CONCLUSION

A classification of lumbosacral transitional vertebrae is presented based on the morphologic characteristics and correlated with myelographic findings of herniated nucleus pulposus.

Type I represents a "forme fruste" of lumbosacral transitional vertebrae and shows no difference in incidence of the location of herniation.

In Types III and IV, there were no herniations at the level of the lumbosacral transitional vertebrae and no increase in the incidence of herniations just proximal to the lumbosacral transitional vertebrae.

Of greatest significance, is the Type II anomaly, which not only presented a greater incidence of disc herniation just above the lumbosacral transitional vertebra, but it also presented herniated nucleus pulposus at the level of the transition.

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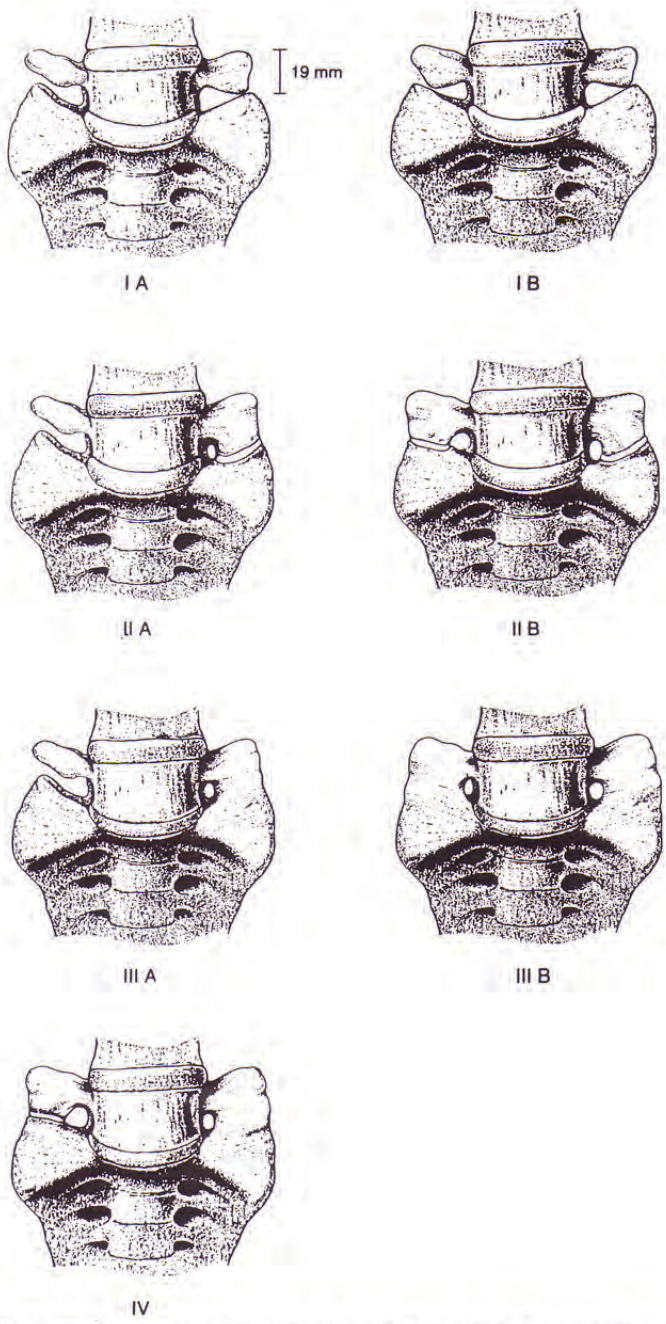

Fig 1. Classification of lumbosacral transitional vertebrae according to radiomorphological and clinical relevance with respect to lumbar disc herniation.

to follow the contour of the sacral ala. They are considered incomplete because there appears to be a diarthrodial joint between the transverse process and the sacrum.

Type III. *Complete lumbarization/sacralization:* a, unilateral; b, bilateral. This is similar to Type II except that instead of diarthrodial joint between the transverse process and the sacrum, there is a true bony union.

Type IV. *Mixed:* The patients that fall in this category exhibit Type II on one side and Type III on the other.

We have used the terms "lumbarization and sacralization" because we were not able actually to determine the total number of vertebrae in the patients' spines.

RESULTS

This review of 200 patients with positive myelograms contained 60.5% men and 39.5% women. The distribution of herniated discs showed 127 discs at L4–5 (63.5%), 68 at L5–S1 (34%), 23 at L3–4 (11.5%), and four at L2–3 (2%). Twenty-two patients had multiple level herniations for an incidence of 11%. We found 60 patients with lumbosacral anomalies for an incidence of 30%. The sex distribution of lumbosacral anomaly showed a greater incidence in men (71.5%) than in women (28.5%). Twenty-nine out of 60 patients had dysplastic transverse process or six lumbar vertebrae. Only 31 out of 200 (15.5%) present true transitional characteristics.

Two percent (4/2000) presented with full lumbarization of the first sacral segment. These four patients showed 12 thoracic vertebrae and six lumbar vertebrae without any changes of the transverse process at L6. In these four patients, the distribution of disc herniation is no different from that seen in the normal population with three (75%) occurring at L4–5 and one (25%) at L3–4.

Type I anomalies, were seen in 25 patients. Nine were unilateral and 16 bilateral. Type Ia, unilateral, presents an 11.1% incidence of herniated nucleus pulposus at L3–4 (1/9), a 55.5% incidence (5/9) at L4–5, and a 33% incidence (3/9) at L5–S1. Type Ib presents 12.5% (2/16) at L3–4, 37.5% (6/16) at L4–5, and 50% (8/16) at L5–S1. The incidence of right and left dysplasia with comparison to the site of the herniation was studied and no significant differences were found.

Type IIa anomalies appeared in 38.3% (23/60). Twenty percent are Type IIa (12/60), and 18.3% (11/60) are Type IIb. In Type IIa, 75% (9/12) presented with herniated nucleus pulposus at L4–5 in 90.9% (.0/11) and L5–S1 in 9% (1/11).

Type III anomalies occurred in 8.3% (5/60) with 1.6% being Type IIIa and 6/6% (4/60) being Type IIIb. There are no herniations at the level of the transitional vertebra in this group, regardless of whether the deformity is unilateral or bilateral. In Type IIIa, the herniation was a central disc at L4–5. In Type IIIb, 50% (2/4) occurred at L3–4, 25% (1/4) occurred at L4–5, and 25% (1/4) at L5–6 at the level just above the transitional vertebra.

Type IV anomalies occurred in 5% (3/60). This group does not present herniations at the level of the transitional vertebra with 33% (1/3) occurring at L4–5 and 66% (2/3) at L5–6.

Spondylolisthesis did not occur in any of our patients with a lumbosacral transitional vertebra. There was only one in the total series. Spina bifida presented in six of the 200 patients. Only one patient presented a lumbosacral transitional vertebra (of the Type Ib) associated with spina bifida occulta.

DISCUSSION

There are multiple and varying classifications of transitional vertebrae[4,12,13] in the literature, most of which deal with the radiomorphology but none take into consideration the relationship between radiologic findings and their clinical significance.

In Type I anomalies, the location of herniated nucleus pulposus is no different from that seen in the normal population. This type of malformation with dysplastic transverse process that measured 19 mm or greater is described in our classification as well as the classification described by Tini[12] and Keim.[4] We think that even though there are no clinical differences, between these patients and the normal population, embryologically these represent a "forme fruste" of lumbosacral transitional vertebrae. This is confirmed by Tini's findings of increased incidence in families with a high manner of lumbosacral transitional vertebrae.[12]

In Type II transitional vertebrae, the incidence of herniation at the level just above the transition was 83.4% (20/25). This may possibly indicate, as previously stated by Keim,[4] that there are abnormal torque moments at the level just above the lumbosacral transitional vertebrae with increased incidence of degenerative disc