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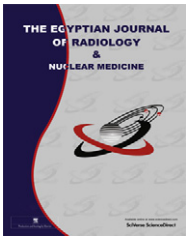

ORIGINAL ARTICLE

Diagnosis of spondylolysis on MRI: Importance of recognition of hypoplastic L5 on MRI

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KEYWORDS

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Abstract *Objective:* To perform a combined (retrospective and prospective) study to further characterize hypoplastic L5, its correlation with spondylolysis and other associated abnormalities on routine Computed tomography and magnetic resonance imaging.
Methods: We studied the Computed tomography and magnetic resonance imaging images of 29 patients with hypoplasia and posterior wedging of L5 with bilateral spondylolysis at L5. These cases were followed up retrospectively and prospectively. The anteroposterior diameter of L4, L5 and S1 was calculated and compared. The percentage of posterior wedging of L5 was calculated. Anterolisthesis, hypoplastic pedicle, facet joints, L4–5 and L5–S1 intervertebral discs, nerve roots and fragmentation of pars interarticularis were also studied.
Results: The mean difference of anteroposterior diameter between L4 and L5 was 2.75 mm and of L5 and S1 was 3.78 mm. The mean percentage of posterior wedging was 31%. Grade I anterolisthesis was present in 13 patients and grade II in 2 patients. Facet joint arthropathy was seen in 20 patients. In 24 patients, there was hypoplastic pedicle. Pars fragmentation was seen in 7 patients. L5–S1 disc disease was seen in 21 patients out of whom 8 had exiting nerve root compression. L4–L5 disc disease was seen in 10 patients of whom 5 had exiting nerve root compression.
Conclusions: Hypoplastic L5 is a strong predictor of bilateral spondylolysis even in the absence of true anterior slippage. True anterior slippage and disproportionate adjacent disc disease result in varying degrees of exiting nerve root compression.

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Advances in knowledge: L5 hypoplasia can simulate anterolisthesis and can predict the bilateral spondylolysis. L5 hypoplasia can lead to early disc disease.

1. Introduction

Hypoplastic L5 is a newly rediscovered entity by Wilms et al. in 2008 [1]. It was initially described by Frank and Miller in 1979 who introduced the term pseudospondylolisthesis due to shortening of anterior–posterior (AP) diameter on plain radiograph [2]. The appearance of hypoplastic L5 is quite characteristic on plain radiograph, Computed tomography (CT) and Magnetic resonance imaging (MRI) where it is associated with bilateral spondylolysis. It has always been difficult to diagnose spondylolysis on routine MR imaging. The finding of L5 hypoplasia draws attention toward the pars interarticularis to look for possible defects and is helping to avoid overlooking L5 spondylolysis.

The aim of this work is to perform a combined retrospective and prospective study to further characterize hypoplastic L5 and its correlation with spondylolysis and other associated abnormalities on routine CT and MR imaging.

2. Materials and methods

Twenty-nine patients who had been referred for routine CT and MRI imaging were followed retrospectively and prospectively over a period of 2 years. The age range was between 17 and 68 years (mean age 37 year) and there were 15 males and 14 females. Routine MR imaging was performed mostly for clinical query of backache, radiculopathy, and spinal canal stenosis. A total of twenty-one MRI of lumbosacral spines having L5 hypoplasia were included, with CT correlation in 12 patients. Eight patients were detected on routine CT imaging as incidental finding, which had been done for an unrelated clinical indication. Patients with transitional vertebra, segmental anomalies, chronic degenerative changes, posttrauma and marrow infiltrative disorders were excluded.

The MR imaging studies were performed on a 1.5T (Magnetom Avanto; Siemens, Germany) machine. We obtained T1 and T2 weighted images in sagittal plane of the lumbar spine and axial plane along all the lumbar levels. Routine MR parameters for T1 weighted sequence were TR, 500–600 ms; TE, 10–12 ms; and section thickness of 3–4 mm. Parameters for T2 weighted sequence were TR, 4000–5000 ms; TE, 80–110 ms; and section thickness of 3–4 mm. Images were examined carefully for the presence or absence of bilateral spondylolysis.

We employed a method described by Wilms et al. to measure the anteroposterior diameter of L4, L5 and S1. Anteroposterior diameter was measured at midsagittal and midvertebral levels at the site of the basivertebral vein in L4 and L5 and along the superior endplate of S1 (Fig. 1A). Mean difference was calculated between L4 and L5, and L5 and S1.

Percentage of posterior wedging of L5 was calculated by the formula given by Frank and Miller:

Anterior height of the vertebral body minus posterior height divided by anterior height (Fig. 1B).

Other findings that were also taken into account included anterior slippage, hypoplastic pedicle, facets, L4–L5 and L5–S1 disc desiccation with or without height loss, neural foramina narrowing, exiting nerve root compression, fragmentation of lysed pars interarticularis, gap between the lysed segments and osteophytes from L5.

All measurements were performed independently by 2 observers using electronic calipers on the Siemens workstation. We did not include the control population as we relied completely on Wilms et al. for the measurement process. CT images provided a more accurate measurement as cortical margins are well appreciated while measuring the anteroposterior diameter, anterior and posterior height (Fig. 2).

3. Results

The mean difference of anteroposterior diameter between L4 and L5 was 2.75 mm (range from 2 to 5.1 mm) and between L5–S1 was 3.78 mm (range from 2.7 to 6 mm). The mean percentage of posterior wedging was 31% in our series with a range from 26 to 38%.

Among the additional findings, 13 patients presented with Grade I anterior slippage and two patients with Grade II anterior slippage. Facet joint arthropathy was noted in 20 patients. Hypoplastic pedicle was noted in 24 patients and fragmentation of pars interarticularis in seven patients. L5–S1 disc disease was present in 21 patients with a significant height loss and L5 exiting nerve root compression in eight patients. L4–L5 disc disease was noted in 10 patients with L4 exiting nerve root compression in five patients. Facet joint arthropathy was always a contributory factor in nerve root compression.

4. Discussion

Although Frank and Miller [2] coined the term L5 hypoplasia and pseudospondylolisthesis in 1979, it was not until 2008 that Wilms et al. [1] rediscovered it with retrospective analysis and established the measuring parameter on MR imaging and its clinical correlation. Interestingly L5 hypoplasia was noted on routine MR and CT imaging in both symptomatic and asymptomatic patients. Indeed, the appearance of L5 hypoplasia is a very useful predictor of bilateral spondylolysis as otherwise it frequently is underdiagnosed on routine MR imaging. There is 100% correlation between L5 hypoplasia and spondylolysis in our series. We also performed a retrospective analysis of our available data bank and found our underdiagnosed cases of spondylolysis by observing the appearance of L5 hypoplasia even without true anterolisthesis.

In our series the mean difference in AP diameter between L4–L5 and L5–S1 is slightly lower than in Wilms et al. However, the finding of posterior wedging is 31% in our series which is quite significant compared to 24.7% by Wilms et al. This may be explained as we also included the routine CT imaging as well as MR imaging in measurement. CT provides a more accurate