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Lumbar radiological pseudo-bulging patterns

Abdullah Tacyildiz[a,b]

[a] *Turgut Özal University, Faculty of Medicine, Department of Neurosurgery, Malatya, Türkiye*
[b] *Karabuk University, Faculty of Medicine, Department of Neurosurgery, Karabuk, Türkiye*

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Abstract

Aim: The most interesting humanoid fracture is probably the pars interarticularis defect. The main aim of our study is to describe the pseudo-bulging patterns in sagittal images in magnetic resonance imaging (MRI). Thus, it aims to increase pars interarticularis fractures recognizability with MRI. Radiation exposure in tomography may be eliminated.

Materials and Methods: Our study is single-center, non-randomized, retrospective and observational. Level of pars interarticularis defect, complete-incomplete formation, presence of pedicular involvement and unilateral or bilateral pars interarticularis defect were observed and noted in lumbar tomography. Pseudobulging patterns were observed on lumbar magnetic resonance imaging. Adobe Photoshop® 2023 was used to filter the pseudo-bulging images. The shape and form of the pseudo-bulging patterns were observed and noted. Descriptive statistics were used in our study.

Results: Various pars interarticularis defects were detected in 24 patients on computed tomography images. 14 were female and 10 were male. In our study, pseudo-bulging patterns revealed a distinctive appearance in 21 of 24 cases. We defined 4 different pseudo-bulging shapes and forms.

Conclusion: We revealed four different pseudo-bulging patterns in sagittal MRI images of patients with confirmed pars interarticularis defect by tomography. Learning the pseudo-bulging patterns and shapes will facilitate the identification of the pars interarticularis defect on the MRI.

Introduction

There is no more interesting and unique humanoid fracture than spondylosis, which is probably the result of bipedalism and changing lifestyles [1]. The term fracture should be understood as a discontinuity of cortical and cancellous bone tissue [2]. The incidence of spondylosis is 3-6% and approximately 20% of cases are symptomatic [3, 4]. A lateral lumbar spine radiograph is the most commonly used technique to diagnose patients [5]. However, lateral radiographs may not always show pars interarticularis defects due to imaging quality [5]. Lumbar vertebrae computed tomography remains the gold standard for identifying pars interarticularis defects [5, 6]. The biggest disadvantage of computed tomography is radiation exposure [2].

For the diagnosis of lumbar spondylolisthesis; meta-analysis studies demonstrated high sensitivity and specificity of magnetic resonance imaging in children and adolescents [2]. It may reduce radiation exposure [2]. Also lumbar MRI; may also provide grading of pars defects [7].

The study aims to increase the recognition of pars interarticularis defects by presenting the pseudo-bulging form in cases with pars defects. Our other aim is to increase the guidance service of MRI to surgeons. We believe that neurosurgeons have a high level of knowledge in interpreting radiological images.

Materials and Methods

Study design and patient population

Our study is a single-center, non-randomized, retrospective, and observational study. This retrospective study was approved by the 26th decision of the Malatya Turgut Özal University Faculty of Medicine Clinical Research Ethics Committee (date: 01.11.2022, decision no: 2022/46). Our study was carried out Malatya Training and Research Hospital between 01.06.2021 and 01.08.2022. It was carried out among patients who applied to the neurosurgery outpatient clinic. Patients with low back pain (M54.5) ICD code were screened retrospectively. In this patient group, patients with pars interarticularis defect on lumbar computed tomography were recorded.

The patient profile and demographic information of the

*Corresponding author:
Email address: abdullahemretacyildiz@gmail.com
(Abdullah Tacyildiz)

patients with pars interarticularis defect on computed tomography were examined and recorded from the hospital records. Level of pars interarticularis defect, complete-incomplete formation, presence of pedicular involvement, and unilateral or bilateral pars interarticularis defect were observed and noted in lumbar tomography. Lumbar magnetic resonance images of the patients were examined. Spondylosis and pseudo-bulging were observed on lumbar magnetic resonance imaging. The shape of the pseudo bulging was observed and noted. Observations were carried out by a neurosurgeon of four years. Pseudo-bulging shapes were presented by applying various filters on the computer. Adobe Photoshop® 2023 was used to filter the pseudo-bulging images.

Tomography and magnetic resonance imaging

Computed tomography examinations were performed as standard using GE brand, 128 slices, and 2 mm spacing. Axial, sagittal, and coronal images are included in the electronic database. Lumbar magnetic resonance imaging was performed with a Siemens brand device.

Inclusion and exclusion criteria

Patients with pars interarticularis defect on lumbar tomography and lumbar MRI were included in the study. Individuals under the age of 18 were not included in the study. Traumatic cases and traumatic pars interarticularis defect cases were not included in the study. Operative cases were not included in the study.

Statistical analysis

The variables of the study were presented with descriptive values such as mean ± standard deviation, highest and lowest. Because of the lack of groups in the study population, comparison tests were not performed. Qualitative changes will be interpreted anatomically and radiologically.

The sample of this study was determined by power analysis. According to the calculation made using the G*power 3.1 program; The sample size was determined to be at least 24 with an effect size of 0.85, a margin of error of 0.05, a confidence level of 0.95, and a population representation of 0.95 [8].

Results

24 cases were identified in the study. 14 were female, and 10 were male. The mean age of the patients included in the study (the lowest age: 19 and the highest age: 59) was calculated as 40.08 ± 12.35. Various pars interarticularis defects were detected in 24 patients on computed tomography images (Table 1). Two patients had pedicular involvement.

In our study, pseudo-bulging revealed a distinctive appearance in 21 of 24 cases (Figure 1 and Figure 2). We often describe the first of these images as a hill that slightly raises and compresses the upper root (1A, 1B 1D-F, 2A, 2B, 2D, 2F, 2K, 3A). In the other hand, the pseudo bulging image progresses posterior or inferior without heightening. It then creates an appearance that progresses towards the posterior corpus of the inferior vertebra (1C, 2C, 2E, 2G,

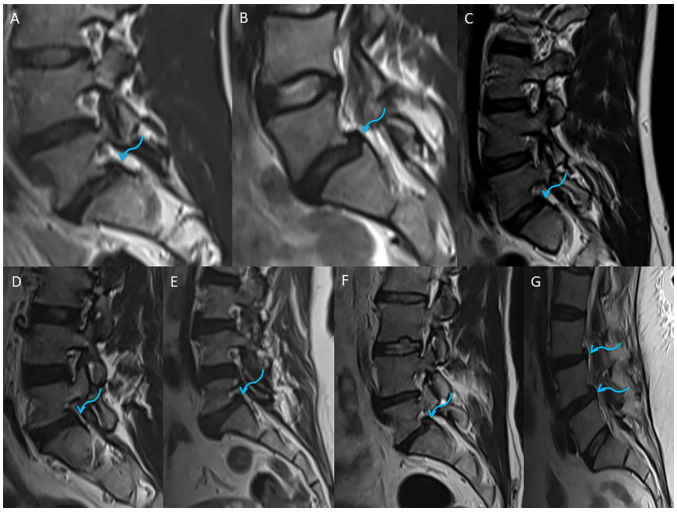


Figure 1. Pseudo bulging patterns (blue arrow) are observed in different patients.

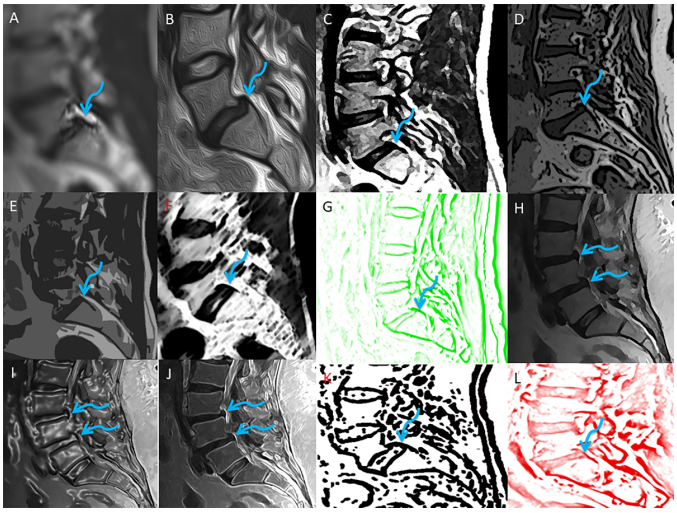


Figure 2. Pseudo bulging images and shapes of the patients (blue arrow) are shown with various filters for clearer understanding.

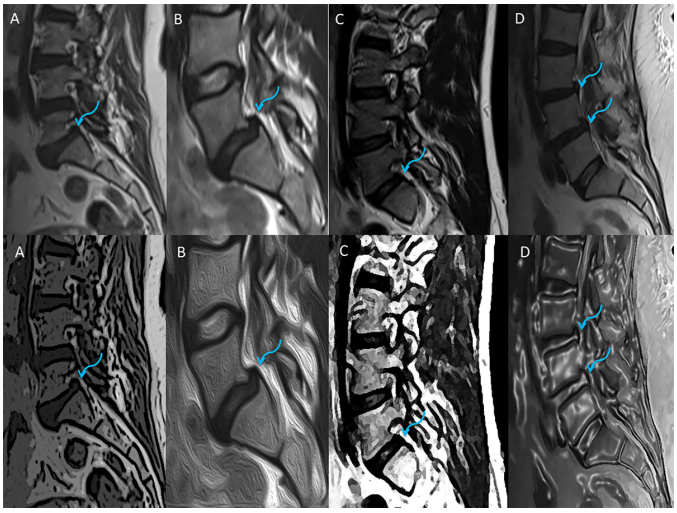
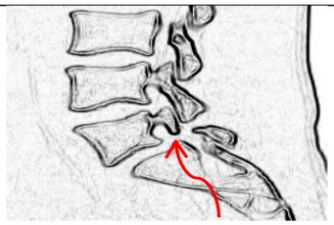
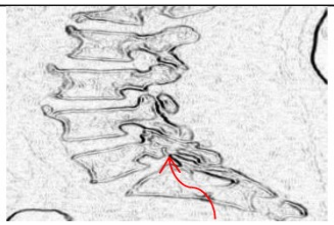
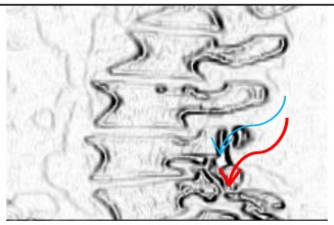
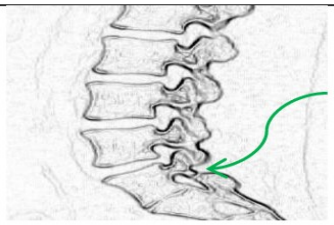
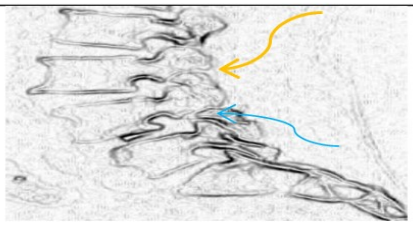


Figure 3. There are 4 different pseudo-bulging patterns that we have identified. The sagittal images below were revealed by filtering real MRI images.

Table 1. Types and locations of pars interarticularis defects according to computed tomography images of our patients are shown. It is graphed to facilitate CT scans. (Red arrow: L5, blue arrow: L4, green arrow; S1, yellow arrow: L3, thin arrows incomplete, thick arrows complete fractures).

Number of Cases	Type of pars interarticularis defect	Graphic image
20	L5 bilateral, complete	
1	L5 bilateral, incomplete	
1	L5 bilateral complate, L4 unilateral incomplete	
1	Left S1 complete	
1	L3 complete bilateral and L4 complete bilateral	

2L, 3B, 3C). Pseudo-bulging images formed at L3 and L4 distances looked different due to a more vertical corpus alignment (1G, 2H, 2I, 2J, 3D). Thus, we have defined 4 different types of pseudo-bulging (Figure 3).

Discussion

Our study focused on the pseudo-bulging of patients with pars interarticularis defect. To the best of our knowledge, it is the first detailed study of the appearance and shape of pseudo-bulging. We defined 4 different pseudo-bulging shapes and forms.

Teplick et al. liken the pseudo-bulging shape to a quadrant on sagittal images[9]. Our findings, on the contrary, revealed that pseudobulging has a more specific form (Figure 1-3).

Semaan et al. state that in some pseudo-bulging images, the disc cannot be considered a true herniation because it does not pass through the lower vertebral corpus [10]. This is an understatement. Our study showed that pseudo bulging compresses the upper root with its unique shape (Figure 1D-F, 2A, 2D).

As Yusufoğlu et al. stated, magnetic resonance imaging has high accuracy in detecting pars interarticularis defects [11]. Our study revealed the shape of pseudo-bulging with magnetic resonance images. The results of our study will may increase the accuracy of the MRI in detecting pars interarticularis defects. It will potentially guide neurosurgeons.

Spengler et al. classified lumbar disc herniation as protrusion, extrusion and sequestration [12]. Williams et al. classified lumbar disc herniation as degeneration, bulge, protrusion, extrusion (including subligamentous, transligamentous and sequestered types) [13]. Zhou et al., on the other hand, classified lumbar disc herniation as protruded, ruptured sequestered [14]. We defined 4 different pseudo-bulging shapes and forms (Figure 1-3).

In previous studies, cerebral hemorrhage was measured digitally using Photoshop® [15]. Photoshop®-based image analysis has been shown to provide superior results [16]. Photoshop®-based findings of our study also make the pseudobulging patterns understandable (Figure 1-3).

There are some limitations of our study. Pseudobulging patterns were presented only in sagittal images. Our study is retrospective. Our study did not focus on the clinical consequences of spondylosis and pseudo-bulging. The number of patients is not enough for a descriptive clinical study.

Conclusion

Pars interarticularis defects can be recognized by computed tomography, but radiation exposure is a potential risk. Magnetic resonance imaging has a high accuracy rate as computed tomography in detecting pars interarticularis defects. We have specified four different pseudo-bulging images and shapes. Knowing the pseudo-bulging images and patterns will facilitate the identification of the pars interarticularis defect on the MRI. Our study guides neurosurgeons by presenting pseudo-bulging images.

Ethical approval

This retrospective study was approved by the Ethics Committee of Clinical Research of Malatya Turgut Ozal University, Faculty of Medicine with the (date: 01.11.2022, decision no: 2022/46).

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