Imaging Features of Non-Isthmic Spondylolysis: A Case Report

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Lumbar spondylolysis is the leading cause of low back pain in children and adolescents and is a relatively common disease that affects approximately 6% of adults in the general population[1], including asymptomatic cases. Its main cause is considered to be fatigue fracture[2], which is found in 47% of young athletes with low back pain[3]. Although the condition is typically detected as a defect in the pars interarticularis, several variations in the fracture line have been reported[4-6]. Here, we report an as-yet unreported new fracture type.

A 24-year-old, left-handed, male baseball player was referred to our hospital with a complaint of low back pain during hitting without any other neurological symptoms. His symptoms started 6 months earlier and had worsened despite conservative treatment with medication and rehabilitation. No obvious fracture line was seen on plain radiography, but a right non-isthmic spondylolysis was noted at L5 on computed tomography (Fig. 1). Bone modeling provided further clarification: the fracture lines were seen in the coronal direction along the dorsal side of the right transverse process from the caudal side of the pars interarticularis to the superior intervertebral foramen (Fig. 2). STIR magnetic resonance imaging showed an area of high signal intensity in the superior articular process and the pedicle around the fracture line (Fig. 3). Based on these findings, we made a diagnosis of non-isthmic spondylolysis. As he hoped for an early return, we did not aim for bone union and provided pain-relieving treatment including temporarily wearing soft brace for non-pain spondylolysis while continuing to play. As a result, although bone union was unknown, his pain improved.

Six types of atypical imaging presentations have been previously reported as non-isthmic spondylolysis (Fig. 4)[4,5]. These are classified into two main types: pediculolysis, in which a fracture line is seen in the pedicle anterior to the pars interarticularis, and laminolysis, which is seen in the lamina posterior to the pars interarticularis. However, the fracture type seen in the present case does not fall under these main types or any of the reported atypical presentations, and to our knowledge, it has not been reported in the literature. Some cases of laminolysis are considered to be congenital malformations[5], and pediculolysis has been reported to occur after unilateral spondylolysis[7]; however, the detailed mechanism of non-isthmic spondylolysis remains unclear.

Intriguingly, the fracture in this case presented with a relatively rare unilateral spinal separation on the side contralateral to the hitting side. Sairyo et al. demonstrated that maximum load is exerted on the pars interarticularis during lumbar extension with rotation and that extension loading causes a more coronally oriented fracture line as seen on finite element modeling[8]. Because the fracture type in this case has a more coronally oriented fracture line compared with typical spondylolysis, it is probably closely related to the stretching action in hitting motion. Furthermore, baseball batting transmits rotational force from the lower limbs to the upper limbs; thus it is likely that high load from repeatedly rotating in the same direction caused unilateral fracture on the contralateral side. Some reports state that a large load is applied to the side of the trunk contralateral to the direction of lumbar spine rotation in baseball players[9,10]; this is consistent with the notion that this fracture was a result of hitting motion. Our patient received conservative treatment including relative rest, abstinence from sports, and wearing an orthosis. From a biomechanics perspective, reducing extension loading should be an effective measure in treating this

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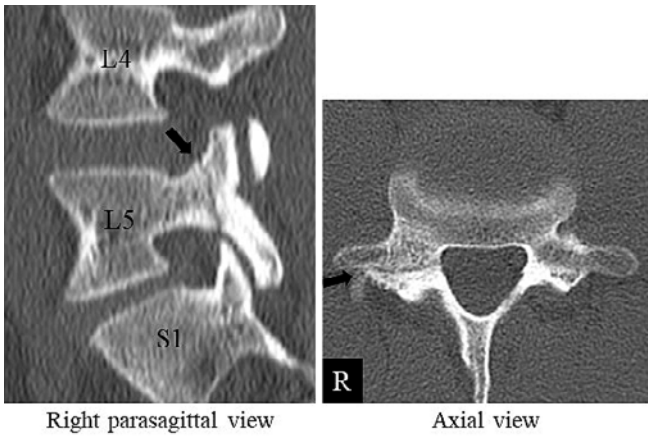

Figure 1. The fracture line (arrow) from the caudal side of the pars interarticularis to the superior intervertebral foramen.

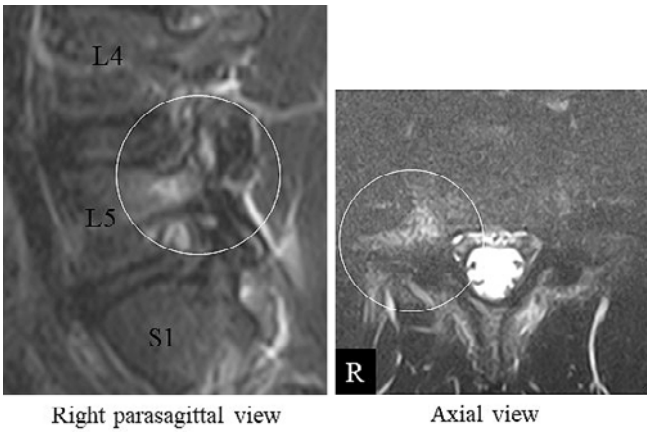

Figure 3. High signal intensity (circle) in the superior articular process and the pedicle around the fracture line.

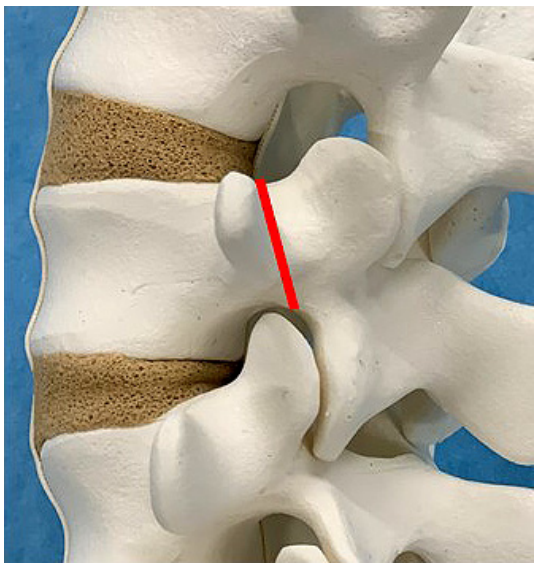

Figure 2. A model showing the atypical fracture line in the coronal plane along the dorsal side of the right transverse process from the caudal side of the pars interarticularis to the superior intervertebral foramen seen in this case.

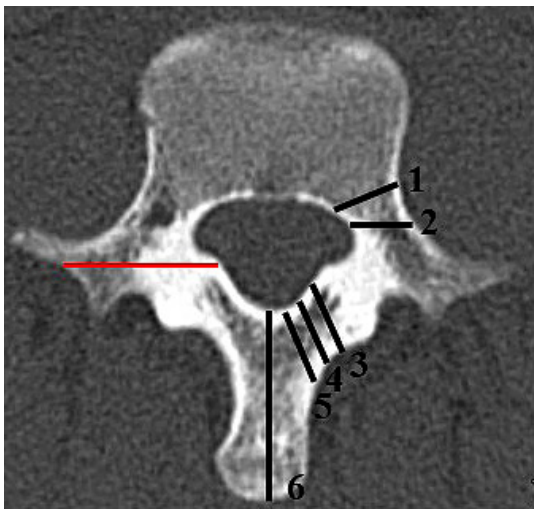

Figure 4. Illustration showing the six previously reported atypical fracture lines depicted by black lines. Red line indicates the new fracture line type reported in this case.

condition.

A comprehensive understanding of all variations of non-isthmic spondylolysis will not only help to prevent misdiagnosis and overlooks but will also facilitate appropriate treatment.

Conflicts of Interest: The authors declare that there are no relevant conflicts of interest.

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Informed Consent: Informed consent was obtained by all participants in this study.

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