CASE REPORT

Stress fracture of the thoracic spine in an elite rhythmic gymnast : A case report

Subash C Jha[1], Toshinori Sakai[1], Mika Hangai[2], Akiko Toyota[1], Shoji Fukuta[1], Akihiro Nagamachi[1], and Koichi Sairyo[1]

[1]*Department of Orthopedics, Institute of Biomedical Sciences, Tokushima University Graduate School, Tokushima, Japan,* [2]*Department of Orthopedics, Medical Center Japan Institute for Sports Sciences, Tokyo, Japan*

Abstract : Spondylolysis, a defect or stress fracture of the vertebral pars interarticularis, occurs most frequently in the lower lumbar spine and occasionally in the cervical spine, but is extremely rare in the thoracic spine. We report the case of a 17 year-old girl, an elite rhythmic gymnast, who reported with early-stage thoracic spondylolysis at T10 and T11 levels. Physicians should be aware that performance of unusual athletic movements, such as those by gymnasts, may lead to spondylolysis in rare locations. J. Med. Invest. 63 : 119-121, February, 2016

Keywords **:** *Stress fracture, Thoracic spine, Spondylolysis, Athletes*

INTRODUCTION

Low back pain (LBP) is common in young competitive athletes and is a frequent reason for lost training and playing time. Chronic severe LBP in adolescent athletes may be caused by spondylolysis (1, 2), a defect or stress fracture of the vertebral pars interarticularis most commonly occurring in the lumbar spine, particularly at L5 (3). Spondylolysis is also found, although less often, in the cervical spine (4, 5) but rarely if ever in the thoracic spine, as we are aware of no published reports of thoracic spondylolysis. Here, we report a case with stress fracture (early-stage thoracic spondylolysis) at T10 and T11 levels in an elite rhythmic gymnast, underscoring the possibility of rare spondylolysis locations resulting from certain sports.

CASE REPORT

History

A 17-year-old girl, an elite rhythmic gymnast, was referred to our sports clinic for severe back pain. There was no definitive traumatic episode ; however, she had taken a 1-month sick leave from practice due to a knee sprain. When practice resumed, she experienced severe back pain, which was exacerbated on back extension. After 1 week of symptoms, she consulted a local doctor and was referred to our outpatient clinic.

Examination

On examination, there were no neurological findings. Physical examination revealed normal gait and alignment of spine and pelvis. There was no difficulty on flexion but she felt discomfort on hyperextension of the spine. Tenderness could be elicited on the spinous processes and right paravertebral muscle area of the lower thoracic region.

Radiological Findings

Plain radiographs of the thoracolumbar spine showed no obvious abnormality except mild scoliosis with slight left rotational deformity at T10 (Fig. 1). Parasagittal short tau inversion recovery (STIR) images showed high signal changes indicative of bone marrow lesion around the articular processes of T10 and T11 vertebrae (Fig. 2). On axial STIR images, bone marrow edema was more evident on the right side of T10 and T11 laminae (Fig. 3). Computed tomography (CT) scans showed a fracture line at the right inferior articular process of the T10 vertebrae (Fig. 4). The final diagnosis was stress fracture of the right inferior process (early-stage spondylolysis) of the T10 vertebrae and stress reaction of the pars interarticularis (very early-stage spondylolysis) of the T11 vertebrae.

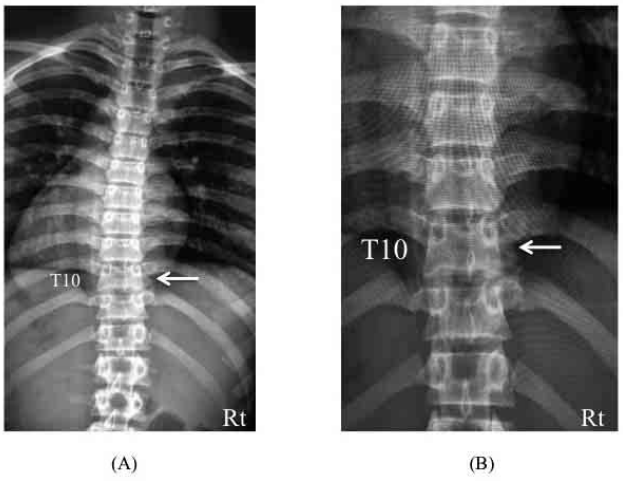

Figure 1.
Plain radiographs of the thoracolumbar spine showing no obvious abnormality except mild scoliosis with slight left rotational deformity at T10 (arrow).

Treatment

Since she was a member of the national rhythmic gymnastics team, she could not have a long sick leave. Also, a brace may cause rigid spine, impeding performance. Hence, the decision was made to continue rhythmic gymnastics but with further stretching of the hip joint and other levels of the thoracic/lumbar spine.

Received for publication June 5, 2015 ; accepted June 8, 2015.

Address correspondence and reprint requests to Toshinori Sakai, MD, PhD, Associate Professor, Department of Orthopaedic Surgery, Tokushima University 3-18-15 Kuramoto-cho, Tokushima 770-8503, Japan and Fax : +81-88-633-0178.

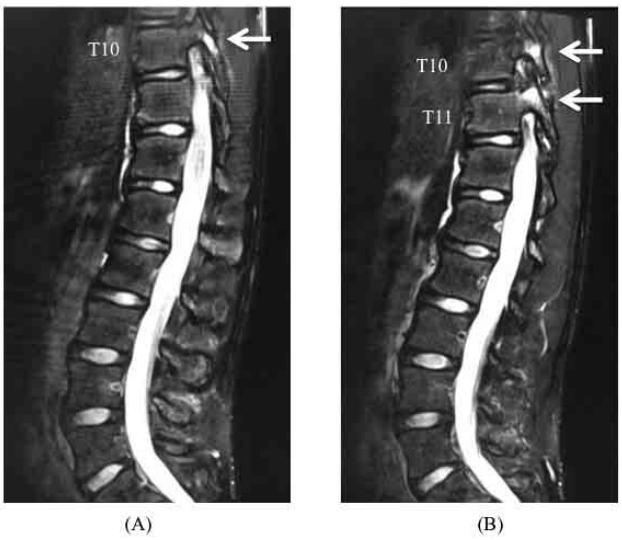

Figure 2.
Para-sagittal STIR-MRI showing high signal changes (arrows) indicating bone marrow lesion around the articular processes of T10 and T11 vertebrae.

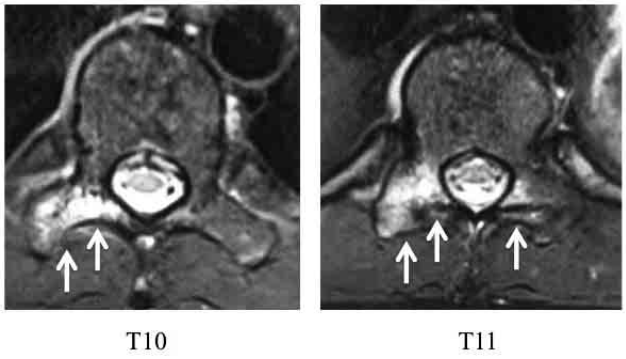

Figure 3.
Axial STIR image showing more severe bone marrow edema on the right side of T10 and T11 laminae.

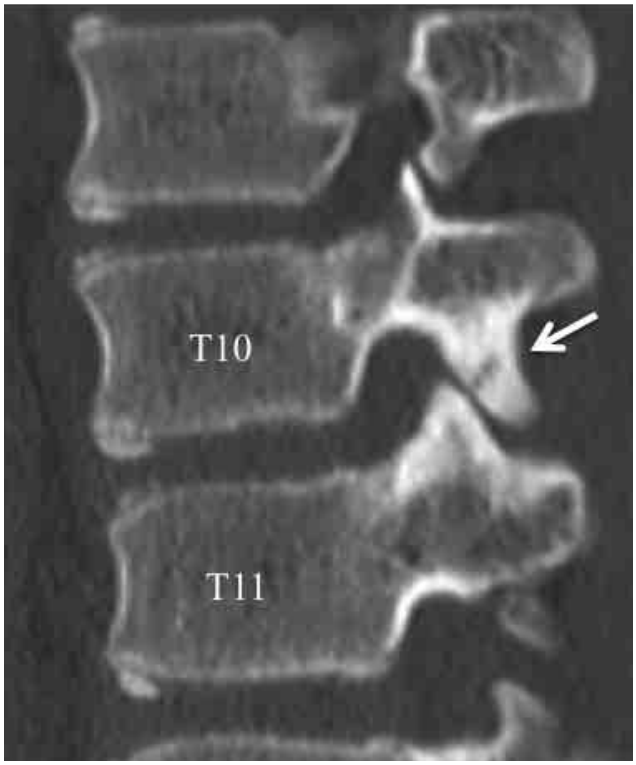

Figure 4.
Right parasagittal multi-planar reconstruction CT images showing a fracture line at the right inferior articular process of the T10 vertebrae.

DISCUSSION

We present a rare case with stress fracture of a thoracic vertebrae. Spondylolysis is thought to result from repeated stress on the vertebra, and most cases are found in the lumbar spine. More than 90% are found at the most caudal level (L5) as a pars interarticularis defect (3), with fewer cases in the cervical spine (4, 5). As far as we know, this is the first report describing thoracic spondylolysis including stress fracture.

Since Wiltse *et al.* first suggested that spondylolysis begins as a fatigue fracture of the pars interarticularis (6), many studies have described an association between specific sporting activities and spondylolysis, supporting the stress fracture theory. Sairyo *et al.* analyzed the highest stress lines of the pars interarticularis using a 3-D finite element model of a lumbar motion segment (L3 to S1) in various modes (7) and concluded that extension and rotation may be the most important lumbar motions contributing to stress fracture. Furthermore, the stress increased when the motion included both extension and rotation (8).

The pathogenesis of the present case is still unclear. A kinematic study of a contortionist in an open-configuration magnetic resonance scanner (9) found no evidence for abnormal segmental motion, physiologic limits, segmental motion, or subluxation, even in extreme body contortions. Accordingly, we speculate that her slight left rotational deformity at T10 combined with specific trunk movements required for rhythmic gymnastics may have led to the defect (Fig. 5). Extreme back extension with left rotation may cause maximum compressive stress at the contralateral facet joint. This repetitive motion may have caused the stress reaction at the right lower thoracic spine.

Due to the rarity of this disorder, it may be difficult to diagnose. In this case, MRI findings, particularly STIR, revealed deficits similar to those observed in early lumbar spondylolysis (10). In addition, CT findings were similar to those of lumbar spondylolysis. The fracture line originated in the ventral aspect of the inferior articular process (par interarticularis) as reported by Terai *et al.* (11).

There have been no reports describing thoracic spondylolysis including stress fracture. Athletes may present with unusual spinal injuries, such as thoracic spondylolysis, that reflect stressors specific to their sport.

CONFLICT OF INTEREST

All authors confirm that there are no conflicts of interest with people or organizations that could bias the nature of this report.

Figure 5.
Pictures showing a specific movement required for rhythmic gymnastics. The patient's trunk is hyperextended (A) and rotated to the left side toward the pelvis (B).

REFERENCES

1. Soler T, Calderón C : The prevalence of spondylolysis in the Spanish elite athlete : Am J Sports Med 28 : 57-62, 2000
2. Rossi F : Spondylolysis, spondylolisthesis and sports. J Sports Med Phys Fitness 18 : 317-340, 1978
3. Sakai T, Sairyo K, Takao S, Nishitani H, Yasui N : Incidence of lumbar spondylolysis in the general population in Japan based on multidetector computed tomography scans from two thousand subjects. Spine (Phila Pa 1976) 34 : 2346-2350, 2009
4. Alton TB, Patel AM, Lee MJ, Chapman JR : Pediatric cervical spondylolysis and American football. Spine J 14(6) : e1-e5, 2014
5. Sasa T, Yoshizumi Y, Imada K, Aoki M, Terai T, Koizumi T, Goel VK, Faizan A, Biyani A, Sakai T, Sairyo K : Cervical spondylolysis in a judo player : a case report and biomechanical analysis. Arch Orthop Trauma Surg 129 : 559-567, 2009
6. Wiltse LL, Widell EH Jr, Jackson DW : Fatigue fracture : the basic lesion in isthmic spondylolisthesis. J Bone Joint Surg Am 57 : 17-22, 1975
7. Sairyo K, Katoh S, Komatsubara S, Terai T, Yasui N, Goel V, Vadpallo S, Biyani A, Ebraheim N : Spondylolysis fracture angle in children and adolescents on CT indicates the fracture producing force vector : A biomechanical rationale. Internat J Spine Surg 1 : Number 2. 2005
8. Sakai T, Yamada H, Nakamura T, Nanamori K, Kawasaki Y, Hanaoka N, Nakamura E, Uchida K, Goel VK, Vishnubhotla L, Sairyo K : Lumbar spinal disorders in patients with athetoid cerebral palsy : a clinical and biomechanical study. Spine (Phila Pa 1976) 31 : E66-70, 2006
9. Hahn F, Kissling R, Weishaupt D, Boos N : The extremes of spinal motion : a kinematic study of a contortionist in an open-configuration magnetic resonance scanner : case report. Spine (Phila Pa 1976) 31 : E565-E567, 2006
10. Sairyo K, Katoh S, Takata Y, Terai T, Yasui N, Goel VK, Masuda A, Vadapalli S, Biyani A, Ebraheim N : MRI signal changes of the pedicle as an indicator for early diagnosis of spondylolysis in children and adolescents : a clinical and biomechanical study. Spine (Phila Pa 1976) 31 : 206-211, 2006
11. Terai T, Sairyo K, Goel VK, Ebraheim N, Biyani A, Faizan A, Sakai T, Yasui N : Spondylolysis originates in the ventral aspect of the pars interarticularis : a clinical and biomechanical study. J Bone Joint Surg Br 92 : 1123-1127, 2010