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Guest Editorial

Incidental Findings Following Radiography of the Thoracic Spine and Chest in our Orthopaedic Practice

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Editorial

The purpose of this editorial is to review the literature on incidental radiographic findings of the thoracic spine and chest detected in the common orthopaedic practice, to present congenital, idiopathic, or acquired incidental abnormalities detected at our service in children, adolescents, and adults, and to consider their potential or apparent clinical significance and differential diagnosis. This work excluded patients with fractures, osteomyelitis or discitis, tumors, and systemic disorders.

Congenital radiographic findings

During the 6th week of gestation, two chondrification centers form in each half of the vertebral body (called the centrum), which eventually fuse into a solid block of cartilage. The vertebral arch, the transverse processes, and the spinous process also form from chondrification centers, completing the cartilage anlage of each vertebra. Three primary ossification centers develop within the cartilaginous template of the vertebra: one in the centrum and one for each half of the neural arch. The C3-L5 primary ossification centers appear at nine weeks in utero and ossify by one year of life. The C3-L5 secondary ossification centers at each annular vertebral epiphysis at the upper and lower surfaces of the vertebral body, at the tip of the spinous process, and the tip of each transverse process develop after puberty, and fuse about the middle of the third decade [1-3].

Congenital anomalies of the thoracic spine may be diagnosed during gestation, soon after birth, and later on incidentally on radiographs performed for an unrelated reason or when they become symptomatic [4,5].

The thoracic vertebral body may fail to form, leading to a wedged vertebra or hemivertebra. Lateral hemivertebrae develop when one of the two chondrification centers of the centrum fails to grow, leading to congenital scoliosis (Fig. 1, 2). It may be due to a lack of vascularization on the defective side [6]. Dorsal and ventral hemivertebrae are much less frequent than lateral ones [7]. Patients diagnosed with a hemivertebra should undergo a careful assessment to identify coexistent anomalies, usually skeletal, cardiac, genitourinary, and gastrointestinal [8].

Congenital block vertebrae or synostosis occurs when segmentation fails; leading to unilateral or bilateral fusion of the vertebral bodies (bony bars). The intervening disc space is small, incomplete, and dysmorphic. The anomaly is typically detected in the cervical spine and rarely in the thoracic and lumbar regions (Fig. 3). It should not be confused with the appearance of inflammatory spondylodiscitis [9], with Forestier and Rotes-Querol disease (diffuse idiopathic skeletal hyperostosis, progressive or ankylosing spinal hyperostosis) [10,11], and with progressive noninfectious anterior vertebral fusion (Copenhagen syndrome) [12,13].

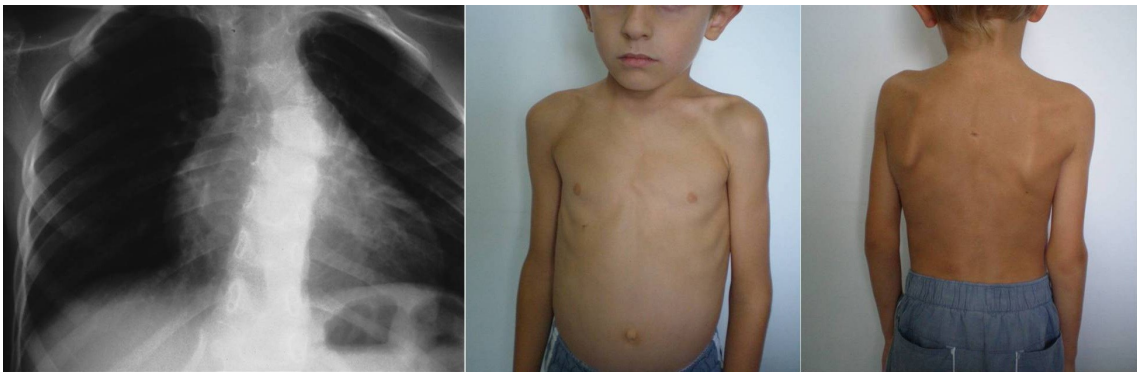

Figure 1: *A 6.5-year-old boy presented with a high fever in the pediatric emergency department. Chest radiography showed two adjacent lateral hemivertebrae on opposite sides of the upper thoracic spine. The mild trunk asymmetry had remained unnoticed.*

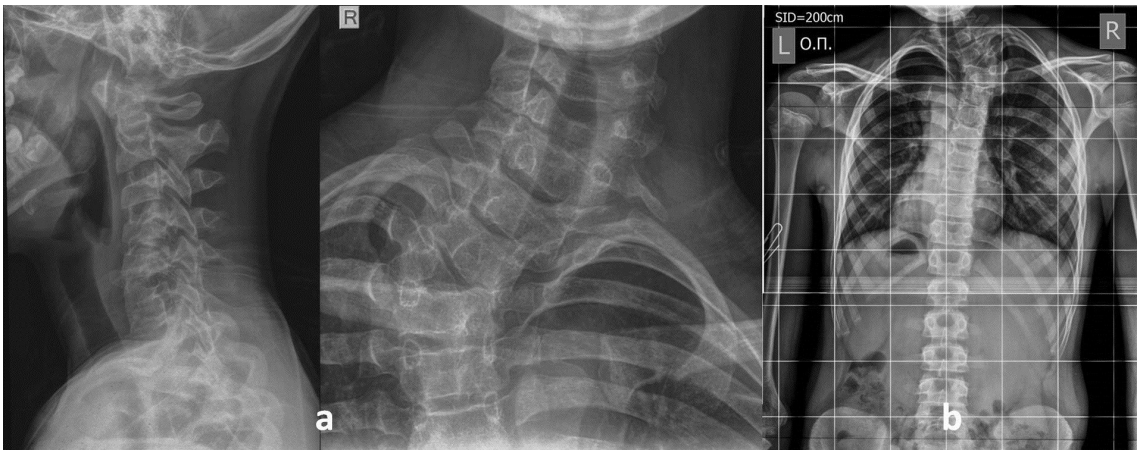

Figure 2: *A 15-year-old boy presented with acute torticollis after a sports injury. The lateral radiograph showed loss of the normal lordosis, and the anteroposterior radiograph lateral hemivertebra at the T3 level on the right side, associated with upper thoracic scoliosis (a). His parents reported no previous neck insult or diagnosed disorder. Two weeks later, he had an uneventful recovery while a standing radiograph revealed no additional spinal abnormalities (b). The potential susceptibility of the cervical spine to posttraumatic torticollis in patients with upper thoracic scoliosis remains obscure.*

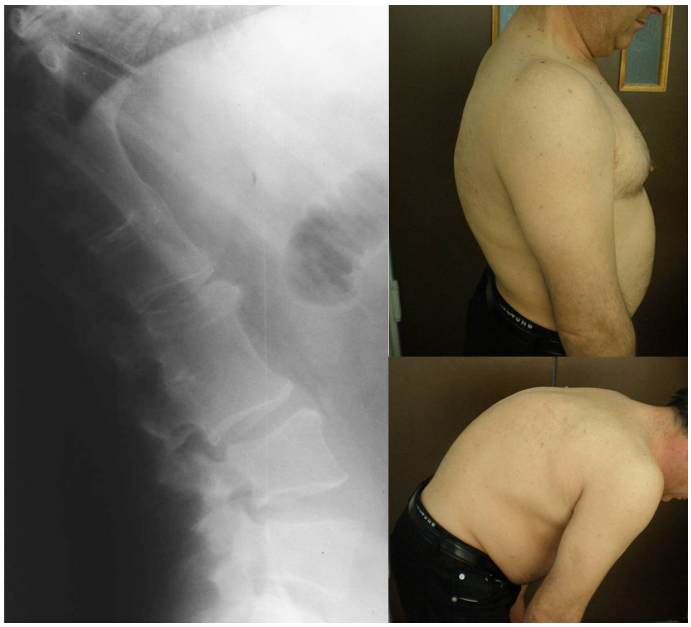

Figure 3: *A 41-year-old male presented with acute back pain. The lateral radiograph showed vertebral fusion of T10-T12 and L2-L3 vertebrae. No other anomalies were evident in the spine. The differential diagnosis included congenital synostosis, Forestier disease, and progressive non-infectious anterior vertebral fusion. The radiographic appearance of the involved vertebrae and intervertebral discs suggested a developmental disorder due to failure of vertebral segmentation.*

The butterfly vertebra (sagittal cleft vertebra) is due to failure of fusion of the two halves of the vertebral body. It also appears under the name of anterior rachischisis or somatoschisis. It is usually clinically insignificant and may be mistaken for a wedge fracture unless the anteroposterior radiographic view is correctly assessed [14]. The two vertebral halves appear as hemivertebrae, usually ankylosed to the adjacent superior and inferior thoracic vertebral bodies [15]. Multiple butterfly vertebrae are typically associated with syndromic diseases [16].

Disruption of the secondary ossification center of a transverse or spinous thoracic vertebral process may result in aplasia or hypoplasia [17], while its radiographic appearance could be confused with a fracture. The spinous process may be absent, which is not to be confused with a bifid spinous process; spina bifida occulta may be evident at any level of the thoracic spinal column [9,18].

The pedicles may exhibit significant variability in their shape and orientation, not only from region to region within the thoracic spine but also within the same region and even within the same pedicle. They may not be fused anteriorly or posteriorly and may be absent [19]. Pedicle deficiencies, including hypoplasia and aplasia, are usually unilateral, asymptomatic, and incidental observations on thoracic spine imaging involving single and rarely multiple levels [20].

Unilateral lumbar-type facet articular projections of the thoracic spine are more common than bilateral ones, resulting in articular asymmetry. These variations are significant in transpedicular screw internal fixation and fusion techniques [21,22].

Idiopathic radiographic findings

The early diagnosis of adolescent idiopathic scoliosis is essential for intervention. However, the poor correlation between clinical deformity and radiographic abnormality is a challenge in adolescent scoliosis screening programs, which all rely on clinical examination and the Adams forward-bending test [23]. The latter is not a safe diagnostic criterion for the early detection of scoliosis, especially when it is the only screening tool, because it results in an unacceptable number of false-negative findings (Fig. 4) [24]. Rib cage asymmetry due to length differences of each rib pair, associated with idiopathic scoliosis, is most likely secondary to the spinal deformity rather than a causative factor [25]. In addition, physical examination may reveal breast volume and level asymmetry as well as costal protrusion in female adolescent idiopathic scoliosis patients [26].

On the other hand, diffuse idiopathic skeletal hyperostosis usually affects patients during the 6th or 7th decade. The radiographic findings to differentiate the disease from ankylosing spondylitis include the continuous linear calcifications along the anterior longitudinal ligament of at least four contiguous vertebral bodies (Fig. 5) [27], while in ankylosing spondylitis, there is annulus fibrosus ossification, anterior and lateral, adjacent vertebral body bridging referred to as bamboo spine, and fused sacroiliac joints (Fig. 6) [28]

Figure 4: *A 13-year-old girl presented to the outpatient clinic complaining of the asymmetric unilateral projection of the anterolateral left costal edge (margin or arch). Her standing radiograph showed a double primary curve (S-shaped) idiopathic scoliosis, which had skipped diagnosis in the school screening.*

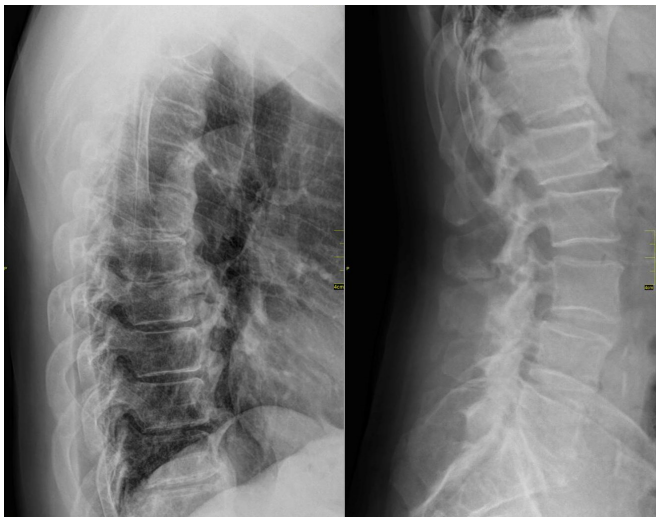

Figure 5: *A 61-year-old male was involved in a traffic road accident while riding a motorcycle. The radiographs showed two independent continuous linear calcifications along the anterior longitudinal ligament complicated with partial fusion of adjacent vertebrae of the lower cervical and the thoracic spine and severe hyperostosis around the hip joints. There was no involvement of disc spaces, facets, and sacroiliac joints. He was diagnosed with Forestier disease.*

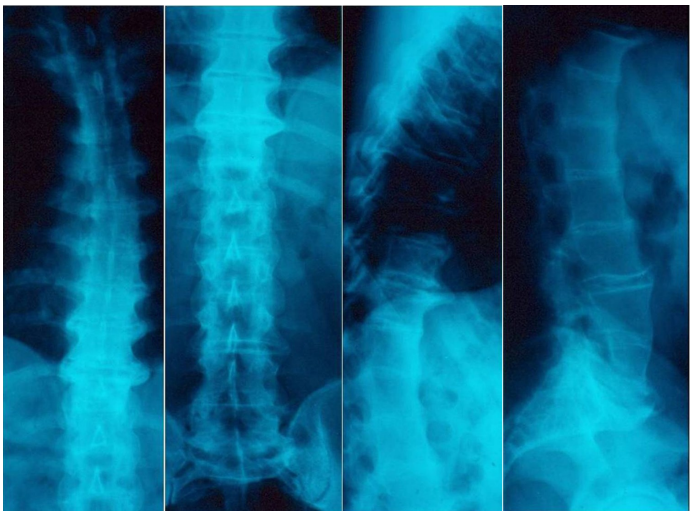

Figure 6: *A 50-year-old male with the characteristic radiographic findings of ankylosing spondylitis.*

Acquired radiographic findings

A limbus annulare or vertebra in the immature skeleton may commonly be mistaken for a fracture, infection, or tumor of the endplate. The anterosuperior corner of a mid-lumbar (Fig. 7) and occasionally of a lower thoracic vertebral body is usually affected. It results as a sequel of a remote injury, forcing a fragment of the nucleus pulposus to herniate through the cartilaginous ring (ring apophysis or annular epiphysis) before fusion occurs [29].

Asymptomatic cement pulmonary emboli may be evident on chest radiography in elderly patients treated with vertebroplasty (Fig. 8). The latter is a minimally invasive procedure in which bone cement is injected into the vertebral body under fluoroscopic control for the treatment of compression fractures due to osteoporosis or malignancy [30].

Figure 7: *An anterior limbus vertebra was evident on the lateral radiograph of the lumbar spine of this 16-year-old boy, referred after a lumbar school injury. The lesion involved the superior corner of the fourth lumbar vertebra, appeared too small to fit into the adjacent vertebral body defect, was triangular in shape, and had a sclerotic appearance as well as the adjacent vertebral margin.*

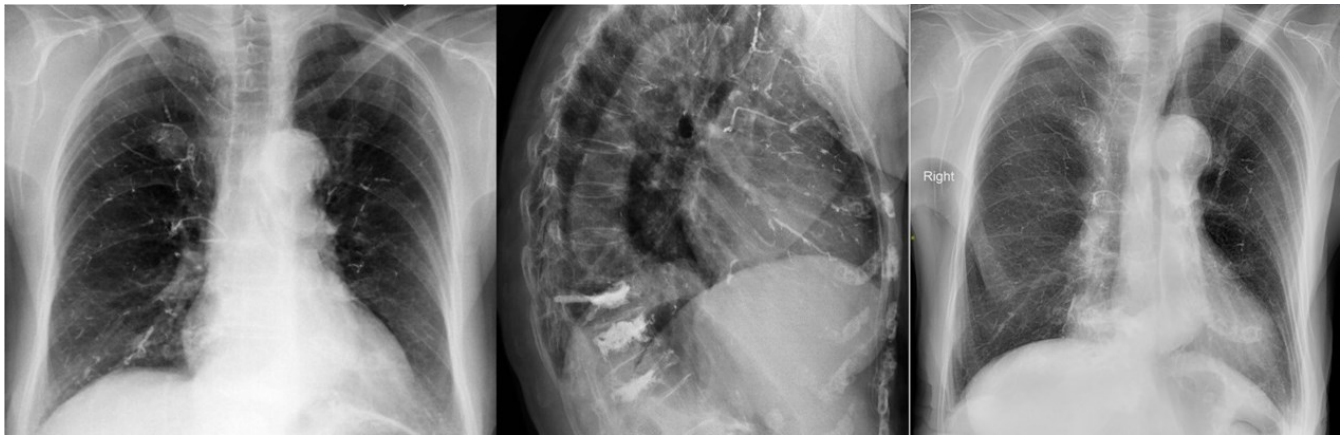

Figure 8: *A 76-year-old woman had percutaneous vertebroplasty for osteoporotic compression fractures of T10-T12. During her follow-up, chest radiography showed cement pulmonary emboli. No clinical findings were evident. Two years later, most of the cement emboli had resolved.*

Conclusions

We diagnosed a variety of congenital, idiopathic, and acquired incidental abnormalities at our orthopaedic practice in children, adolescents, and adults during radiography of the thoracic spine and chest. Although all these findings were of potential or apparent clinical significance, they presented as asymptomatic lesions or with mild clinical features, and their diagnosis was made incidental to the primary purpose of the ordered conventional radiographic examination.

The occasional presentation of major malformations of the thoracic spine with minimal or mild findings on the physical examination is usually associated with a missed opportunity for an early diagnosis. Therefore, the careful inspection of the body for signs of asymmetry of the thoracic spine, rib cage, and chest and the value of plain radiographic assessment of the thoracic spine and chest, at least in the anteroposterior and lateral planes, should never be underestimated.

Conflict of Interest

The author has no conflicts of interest to declare.

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