CASE REPORT

Vertebral Synostosis of Three Thoracic Vertebrae

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Abstract

This case report presents a unique finding of fused thoracic vertebrae in the Anatomy osteology collection at the Faculty of Medicine, Wayamba University of Sri Lanka. The specimen exhibits a rare condition wherein three adjacent thoracic vertebrae have fused together. This report describes the anatomical features and implications of this fused thoracic vertebra in the context of clinical significance and research.

Key words: Anatomical variations; Thoracic Vertebrae; Vertebral Synostosis

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Introduction

The study of anatomical variations and anomalies in the human vertebrae is important for understanding the normal and abnormal development of the vertebral column (1). Numerous anatomically significant vertebral anomalies, such as occipitalization (fusion of atlas vertebra to occipital bone), sacralization (fusion of fifth lumbar vertebra to the sacrum), absence of posterior vertebral arch elements, and vertebral synostosis, have been documented (2).

The terms "block vertebrae," "spinal fusion," and "vertebral synostosis" refer to the fusion of adjacent vertebrae at one or more levels. It can happen in the cervical, lumbar, and thoracic regions. The least common of the three forms of vertebral fusions is the thoracic vertebral fusion (3). This fusion can be either congenital due to failure of sclerotome segmentation during organogenesis or acquired spinal malformations following trauma, juvenile rheumatoid arthritis, tuberculosis, diffuse idiopathic skeletal hyperostosis, or ossification of the posterior longitudinal ligament (4,5). Vertebral synostosis can lead to structural changes, altered biomechanics, and potential clinical implications (5).

Fusion of thoracic vertebrae may exhibit early clinical symptoms such as congenital scoliosis and trunk shortening and/or lordosis (6). The block vertebrae could also cause limited mobility and early degeneration alterations and related neurological deficiencies. Symptoms can change according to the severity and level of spinal unit fusion (7). The incidence of such fusions in the thoracic region, was determined to be 4.16% in a study using 48 adult dry vertebral columns in an Indian population (8). In a Lithuanian population, the prevalence of vertebral synostosis was reported as 2.6% for the cervical region, 1.6% for the thoracic region, and 0.5% for the lumbar region (9).

Case Presentation

The thoracic vertebral specimen under investigation was obtained from the osteology collection at the Department of Anatomy, Faculty of Medicine, Wayamba University of Sri Lanka. Upon examination, a distinct anatomical variation was observed.

Three adjacent thoracic vertebrae were found to be fused together, completely at the anterior aspect of their vertebral bodies (Figure 1A: Fusion of the upper two spinous processes) and partially at the posterior aspect of the vertebral bodies (Figure 1C.), and the superior two were fused at their thoracic spines (Figure 1D.). There was a small interverbal gap (possibly where the intervertebral disc was) between the middle and inferior vertebral bodies only in the posterior aspect (Figure 1E). The superior and inferior articular processes of the upper two vertebra were also completely fused (Figure 1C. Fusion of the anterior aspect of the vertebral bodies). The laminae and pedicels of all three vertebrae remained unfused.

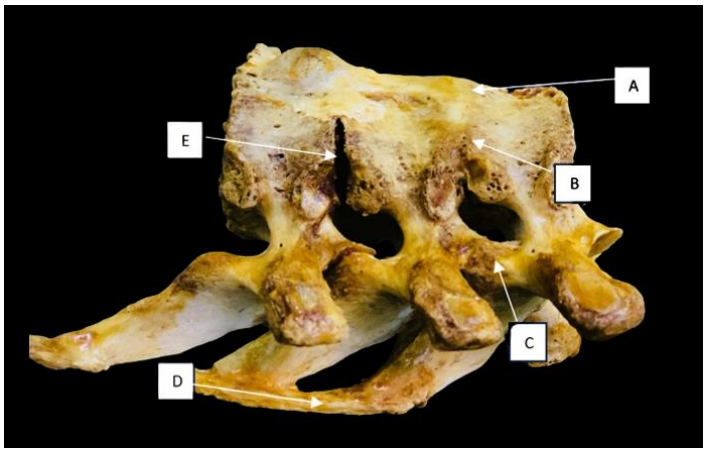

Figure 1: left lateral view

Figure 2: right lateral view

Fused Thoracic vertebrae

A. Fusion of the upper two spinous processes
B. Fusion of the anterior aspect of the vertebral bodies
C. Fusion of the posterior aspect of the vertebral bodies
D. Fusion of the superior and inferior articular facets
E. Interverbal gap between the middle and inferior vertebral bodies

Table 1: Morphometry of the fused thorasic vertebrae

Anthropometric measurement	Right side	Left side
Height of the superior vertebral body	17.60mm	20.21mm
Height of the middle vertebral body	19.30mm	19.31mm
Height of the inferior vertebral body	20.93mm	19.08mm
Interverbal gap between middle and inferior vertebral bodies	1.62mm	1.05mm
Longitudinal diameter of superior intervertebral foramen	10.24mm	12.44mm
Longitudinal diameter of inferior intervertebral foramen	12.06mm	12.82mm

The type of vertebra was confirmed as thoracic vertebra with the presence of a heart-shaped vertebral body, demi-facets on the sides of each vertebral body to articulate with the heads of the ribs, long and inferiorly slanting spinous processes, and the presence of costal facets on the transverse processes to articulate with the tubercles of the ribs. Since all three fused vertebrae had both superior and inferior demi facets, it was determined that these were possible to be typical thoracic vertebra (T2–T9).

The morphological and morphometric features of the fused thoracic vertebrae were analyzed

from the anterior, posterior, right lateral (Figure 2), left lateral, and superior aspects. All the anthropometric measurements were measured by a single investigator using a digital vernier caliper. The height of each fused vertebral body (right and left), the total height of the whole fused vertebra, and the diameter of each intervertebral foramina were measured three times, and the mean value was taken as the final anthropometric measurement (Table 01).

Discussion

The fused thoracic vertebra observed in this case is a rarity with limited documentation in the literature. Though identifying fused vertebrae is simple, it might be challenging to figure out if they are congenital or acquired (10). The entire height of the fused segment in congenital fused vertebrae is equal to the total of the relevant vertebral bodies plus the intervertebral discs between them. In contrast, its height is smaller in acquired fusion than in congenital fusion (11). As observed in this case, fusion of posterior elements is also commonly seen in congenital block vertebrae (12). Further, anteroposterior diameter of the vertebra and individual heights of the two vertebral bodies being equal to the fused vertebral height and the intervertebral disc was also observed in this case (12,13). This fused vertebra showed fusion in both anterior and posterior aspects of the vertebral bodies and no signs of degenerative changes, suggesting that the fusion most likely occurred during early development or as a congenital anomaly. The fusion sites also displayed smooth articulation surfaces, indicating that the fusion was likely established during the embryonic stage of skeletal development (12).

Fused vertebrae can have significant clinical implications, primarily affecting spinal stability, biomechanics, and neurological function. In this case, the fusion involves three thoracic vertebrae, which may result in altered spinal curvature, shortening of the trunk, restricted range of motion, and potential muscular imbalances. These factors can contribute to conditions such as scoliosis, kyphosis, or an increased risk of spinal injury (06). Once the vertebral column gets shorter when the intervertebral discs are absent, the thoracic length may be reduced, resulting in respiratory distress and asphyxiating thoracic dystrophy (14).

Conclusion

The finding of a fused thoracic vertebra in the Anatomy and Osteology Collection at Wayamba University of Sri Lanka represents a rare anatomical variation. Thoracic vertebral fusion usually occurs either due to congenital or acquired causes. This case provides information on the morphology of vertebral synostosis of thoracic vertebrae.

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Conflicts of interests

The authors have no conflicts of interests.

Author contributions

EAAMW involved in case identification, conceptualization, and writing the original draft; KMWWP involved in proofreading and editing; DASS Kumara involved in proofreading and formatting; KMC involved in supervision, review, and editing.

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