



## A STUDY OF THORACIC VERTEBRAL SYNOSTOSIS

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**ABSTRACT** Anomalies in the vertebrae are rare. Fusion of vertebra can be congenital or acquired. It can occur at various levels. (i.e., Cervical, thoracic and lumbar vertebral levels). Vertebral column develops from sclerotome compartments of somites. A definitive vertebra is formed by condensation of caudal half of one sclerotome and fusion with cranial half of the subjacent sclerotome. Among 200 dry specimens of all human vertebrae, three anomalous sets of thoracic vertebrae were found in this study. Knowledge of this anomaly is very much essential for Ortho-surgeons and Neurologists for diagnosing the patients with such anomalies.

**KEYWORDS :** Fused Vertebrae, Cervical, Thoracic, Lumbar, Anomalies, Synostosis, Lordosis

**INTRODUCTION**

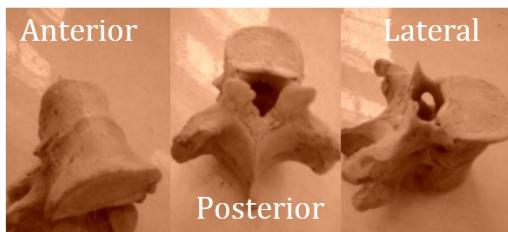
Vertebral column is derived from the sclerotomes of somites [1, 2]. Patterning of shapes of the different vertebra is deregulated by HOX genes [2]. Each vertebra is formed by the combination of much of the caudal half of one bilateral pair of sclerotome with much of cranial half of next caudal pair of sclerotomes. The type of vertebra is specified very early in the development [4]. Fusion of thoracic vertebra can present in clinical science like congenital scoliosis in early life and shortening of trunk with *scoliosis* or *lordosis* in older children [3].

The fusion can occur at various levels of vertebral column viz., cervical, thoracic and lumbar levels. Two or more vertebrae that are normally separate may fuse with each other and may occur in the cervical region which is called Klippel-Feil's syndrome. The atlas may be fused to the occipital bone is known as Occipitalization of the atlas. The fifth lumbar may be partially or completely fuse to the sacrum is called as Sacralisation of fifth lumbar vertebrae in the thoracic region. The parts of the vertebral column that are normally fused to each other may be separate. The first sacral vertebra may be separate from the sacrum is known as Lumbarization of first sacral vertebra [5].

The fusion of thoracic vertebrae is the rarest among the three types-cervical, lumbar and thoracic. The fusion of two vertebrae can be congenital or acquired. The surgical fusion of two vertebrae is known as Spondylodesis or Spondylosyndesis. Acquired fusion can be due to diseases like tuberculosis, juvenile rheumatoid arthritis and trauma [6].

**METHOD AND MEASUREMENTS**

A study on 200 dry specimens of vertebrae is conducted out of which broken vertebrae are excluded. Three sets of fused thoracic vertebra were observed out of 200 specimens of unknown sex and age. Measurements of fused thoracic vertebra were taken by digital Vernier calipers and tabulated below in mm.

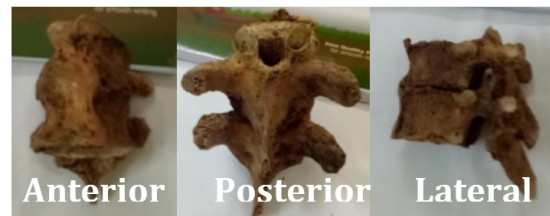
**Set-1: Fused thoracic vertebra**

**Fig.1:** Fused thoracic vertebra – Anterior, Posterior & Lateral views of set-1.

**TABLE – 1 Set 1: Measurements in mm**

Parts of Vertebra	View	Upper Vertebra	Lower Vertebra
Body	AP	21.94	22.58
	Transverse	24.07	30.48
Spinal Canal	AP	11.88	11.48
	Transverse	14.8	14.58

Vertebral foramen	Right	3.8
	Left	5.8
Fused lamina		35.84

**Set-2: Fused thoracic vertebra**

**Fig.2:** Fused thoracic vertebra – Anterior, Posterior & Lateral views of set-2.

**TABLE – 2 Set 2: Measurements in mm**

Parts of Vertebra	View	Upper Vertebra	Lower Vertebra
Body	AP	21.94	22.58
	Transverse	24.07	30.48
Spinal Canal	AP	11.88	11.48
	Transverse	14.8	14.58
Vertebral foramen	Right	3.8	
	Left	5.8	
Fused lamina		35.84	

**Set-3: Fused thoracic vertebra**

**Fig.3:** Fused thoracic vertebra – Anterior, Posterior & Lateral views of set-3.

**TABLE – 3 Set 3: Measurements in mm**

Parts of Vertebra	View	Upper Vertebra	Lower Vertebra
Body	AP	16.62	18.70
	Transverse	23.96	27.97
Spinal Canal	AP	13.60	9.07
	Transverse	13.56	13.8
Vertebral foramen	Right	2.30	
	Left	2.52	
Fused lamina		25.01	

**OBSERVATIONS**

The first specimen shows complete fusion of both vertebral bodies and both laminae and spinous processes with linear crust which

demarcates the fusion. Fusion is symmetrical. Due to fusion, there is absence of superior articular facet of lower vertebra and inferior articular facet of upper vertebra. Inter-vertebral foramen is persistent.

In second and third sets, bodies of both vertebra are fused anteriorly and there is linear groove on the lateral aspects of both sides of vertebra. Fusion of both lamellae are seen. Here also it is seen that due to fusion, there is absence of superior articular facet of lower vertebra and inferior articular facet of upper vertebra. Inter-vertebral foramen is persistent.

## DISCUSSION

In the present study, rare phenomenon of fusion of thoracic vertebrae synostosis and its effect on clinical diagnosis is brought out. Three cases of Thoracic vertebrae synostosis were found in 200 dry specimens.

In the literature, similar study was carried out in North India by Preethi Goswami, et al and found out two sets of anomalies out of 350 specimens [7]. Similarly, Khaleel Ahmed, et al found out single set of thoracic vertebrae synostosis out of 594 dry specimens [8]. Kulkarni V, et al have done similar study on spectrum of synostosis and found out cervical and thoracic anomalies out of 270 vertebrae and 136 skulls [9].

Radiologically, single fused cervical segment seen in 25% of patients, multiple contiguous fused segments in 25% of patients and multiple noncontiguous fused segments seen in 50% patients [10].

The vertebral column develops from somites derived from paraxial mesoderm. Each somite further differentiates sclerotome and dermomyotome. Sclerotome takes part in the development of vertebral column. Cells of sclerotome form mesenchymal cells. They condense around the notochord to form the centrum which forms the vertebral body. Mesenchymal cells condense around neural tube to form right and left vertebral arches which form pedicles, laminae, spine, articular process and transverse process. Mesenchymal cells condense in the body wall adjacent to proximal part of neural arches to form costal process. They form costal elements of transverse process [11].

The segmentation of the vertebra occurs at the time of organogenesis. The non-segmentation of the primitive sclerotome is the cause for fused vertebra or block vertebra [12]. The intervertebral discs excluding the first two vertebrae form fifth of the post axial vertebral column. Cervical and lumbar regions having, in proportion to length, a greater contribution than the thoracic and thus being the more pliant [13].

The absence of intervertebral discs leads to shortening of vertebral column. The thoracic vertebrae and intervening disc along with the ribs help to maintain the shape and length of the thorax. Fusion of thoracic vertebrae and the absence of intervertebral disc will narrow the thorax and can lead to respiratory distress [14].

## CONCLUSIONS

Vertebral fusion can be congenital or acquired. This can lead to various complications affecting the different systems of the body and also can lead to wrong calculations of vertebrae. The knowledge of this fusions is very much useful for the Ortho-surgeons and Neurologists during clinical diagnosis of patients.

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