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CASE REPORT

Bifid Xiphoid Process: A Case Report

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ABSTRACT

Background: The xiphoid process is the smallest and most variable part of the sternum. Developmental variations such as bifid xiphoid process may occur due to incomplete fusion of the cartilaginous precursors during embryogenesis. Although usually asymptomatic, this variation is clinically important as it can be mistaken for a pathological lesion or traumatic injury on imaging studies.

Case Presentation: During routine dissection of the pectoral region in an 89-year-old female cadaver, a bifid xiphoid process was observed. The process was continuous with the sternal body, and the xiphisternal joint was completely ossified. It was deflected to the right of the median plane and demonstrated 10° anterior eversion. The sternum was otherwise unremarkable.

Conclusion: Bifid xiphoid process is a benign developmental variation of no functional significance. Its recognition is essential to prevent misinterpretation as a traumatic, pathological, or neoplastic lesion during clinical examination and radiological interpretation, and to ensure correct hand placement during cardiopulmonary resuscitation.

KEYWORDS

• Bifid Xiphoid Process • Sternum • Anatomical Variation • Developmental Anomaly • Cadaveric Study • Thoracic Anatomy

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INTRODUCTION

The xiphoid process, also referred to as the ensiform process or xiphisternum, is the smallest and most variable component of the sternum.[1,2] It may be pointed, bifurcated, trifurcated, curved, broad, or deflected. These differences are crucial for preventing misdiagnoses during medical procedures. Initially cartilaginous, it ossifies in adulthood. Located in the epigastrium, it serves as an attachment site for muscles such as the diaphragm and rectus abdominis. Healthcare practitioners must comprehend its anatomy and variations, as the xiphoid process is an essential landmark for cardiopulmonary resuscitation and surgical procedures. Its unique characteristics may influence physical examinations and abdominal interventions.

The morphology of the xiphoid process shows considerable inter-individual variation. While a single tapering point is the most common form, it can also present as a wide or narrow structure, come to a sharp point, split into two prongs, contain an opening, or take on a curved or angled shape.[13] Its location corresponds to the level of the tenth thoracic vertebra.[12] During youth it consists of cartilage, which ossifies more fully after approximately 40 years of age.[10] Later in life, it may fuse with the sternal body itself.

CASE REPORT

A bifid xiphoid process was observed in an 89-year-old female cadaver during routine dissection of the pectoral region in the Department of Anatomy, B.P.S GMC (W), Khanpur Kalan, Sonipat, Haryana, India.

The cadaver showed no deformity and was well preserved. The dissection was carried out according to Cunningham's Manual of Practical Anatomy[2] as follows. Four incisions were made to reflect the skin over the pectoral region: (a) a vertical incision in the median plane from the suprasternal notch to the tip of the xiphoid process; (b) a transverse incision from the sternal end of the clavicle to the acromion; (c) a vertical incision down the lateral side of the arm to the elbow; and (d) a transverse incision from the xiphoid process horizontally, through the nipple, to the posterior axillary fold. The skin was reflected as flaps and the superficial fascia was cleaned to display the cutaneous nerves and vessels. Following this, the deep fascia was incised and the pectoralis major muscle was identified. The pectoralis major was detached from its clavicular, sternocostal, and costal attachments and reflected laterally, exposing the clavipectoral fascia and pectoralis minor, which was in turn detached from the coracoid process and reflected to expose the underlying thoracic wall. The complete sternum, including the xiphoid process, was thus visualised.

The following observations were noted:

- A bifid xiphoid process was observed, deflected from the median plane towards the right side.
- The process was continuous with the sternal body, and the xiphisternal joint was completely ossified.
- It was everted anteriorly by 10 degrees.

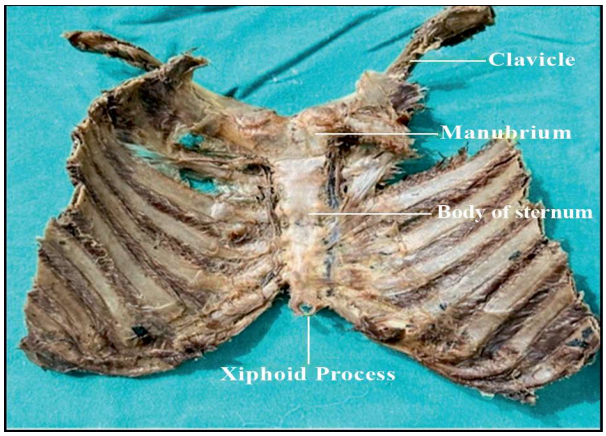


Figure 1: Close-up view of the sternum showing the bifid xiphoid process, deflected to the right of the median plane

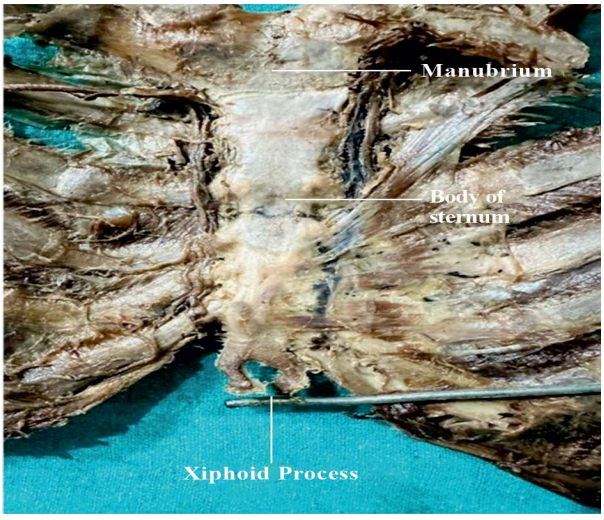


Figure 2: Posterior view of the complete sternum with manubrium, body, and bifid xiphoid process in situ

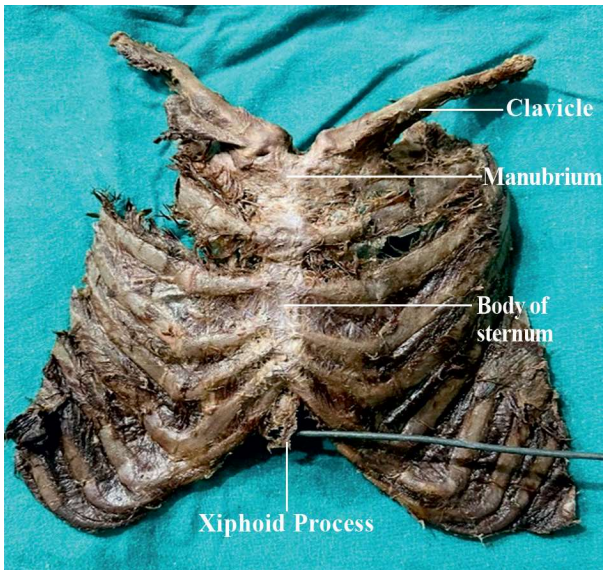


Figure 3: Anterior view of the sternum and costal cartilages demonstrating the continuity of the bifid xiphoid process with the sternal body.

DISCUSSION

- The sternum develops from a pair of longitudinal mesenchymal bands that arise in the lateral body wall during the sixth week of intrauterine life and migrate medially to fuse in the midline, a process that is generally completed by the tenth week of gestation.[1,2] Ossification proceeds later through several centres: one in the manubrium, usually present before birth; a variable number (typically three to four) within the body, termed sternebrae, which fuse together during childhood and adolescence; and finally a centre in the xiphoid process, which characteristically does not appear until around the third year of life and may not ossify fully until the fourth decade or later.[1,10] Because the xiphoid is the last part of the sternum to acquire its ossification centre and complete fusion, it is also the segment most prone to failure of complete midline union. This gives rise to the bifid, trifid, perforated, curved, or otherwise irregular forms that are well documented in the literature.[3,7,9]

A bifid xiphoid process, as encountered in the present specimen, results from incomplete fusion of the paired cartilaginous/ossific elements at the caudal end of the sternal bars, leaving two distinct prongs joined proximally to the body of the sternum.[3,4] This mechanism has been consistently described by other authors reporting similar cadaveric findings, who attribute the anomaly to failure of the sternal bars to fully migrate, unite, or ossify at their inferior extremity.[4,5,6,7] In the present case, the xiphisternal joint itself was fully ossified, indicating that fusion had proceeded normally at the junction with the sternal body while the bifurcation was confined to the distal xiphoid. The process additionally showed a ten-degree anterior eversion together with a rightward deflection from the median plane, features that add to the morphological variability already reported for this anomaly.[6,7]

Reported frequencies of bifid xiphoid termination vary considerably between populations and study methods, ranging from under ten percent to more than forty percent in cadaveric and tomographic series, with most large radiological surveys placing the prevalence in the region of twenty to thirty percent.[3,9,11] Some case reports and larger series have suggested a higher occurrence of xiphoid variants in males, although this sex difference has not been consistent across all populations studied. The present case, observed in an elderly female cadaver, is in keeping with reports describing bifid xiphoid processes in women as well.[5,7,11] The variation is generally regarded as an incidental, asymptomatic finding of no pathological significance in itself, but its clinical relevance lies in the potential for misinterpretation rather than in any functional consequence.

Clinically, awareness of xiphoid variants is important in several contexts. During cardiopulmonary resuscitation, correct hand placement relies on identification of the xiphisternal junction. An atypically shaped or bifid xiphoid may lead to malpositioning of compressions with a theoretical risk of visceral injury.[10] On plain radiographs, computed tomography, or ultrasound of the chest and epigastrium, a bifid or otherwise irregular xiphoid can be mistaken for a fracture, an epigastric mass, or a soft-tissue lesion. This may prompt unnecessary investigation or intervention, particularly in trauma settings where sternal injury is suspected.[9,10] The xiphoid process is also a landmark used during upper abdominal and thoracic surgical approaches, laparoscopic port placement, and echocardiographic windows. Recognition of its variant anatomy is therefore relevant to surgeons, radiologists, and emergency physicians alike. Beyond clinical medicine,

sternal and xiphoid morphology, including bifid and foraminal variants, has also been proposed as a potentially useful adjunct in forensic identification because of the individualising nature of these features.[8,12]

The findings in the present cadaver are consistent with those described in other cadaveric case reports of bifid xiphoid process, which similarly describe a symmetrical or asymmetrical Y-shaped or two-pronged termination of the xiphoid continuous with an otherwise unremarkable sternal body.[4-7] Taken together with the wider literature on sternal variation, this case reinforces the view that the xiphoid process, being the last-ossifying and most variable component of the sternum, warrants careful documentation whenever encountered, whether in the dissection hall, the radiology suite, or the forensic setting.[8,9]

CONCLUSION

Bifid xiphoid process is a benign developmental variation resulting from incomplete midline fusion of the caudal sternal bars, and it carries no functional significance in itself. Its principal importance lies in the potential for it to be mistaken for a traumatic, pathological, or neoplastic lesion during clinical examination or radiological interpretation, and in the theoretical implications for hand placement during cardiopulmonary resuscitation and for surgical or interventional procedures in the epigastric and lower sternal region. This case adds to the existing body of cadaveric evidence on xiphoid variation and underscores the need for anatomists, radiologists, surgeons, and emergency physicians to be familiar with such normal anatomical variants so that diagnostic errors and unnecessary interventions can be avoided.

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