Case Report

Accessory articulation of the transverse processes in the cervical spine

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A B S T R A C T

Accessory articulation between the transverse processes of the C6 and C7 vertebrae is an extremely rare anatomic variant that has only been previously described in two instances. In this report, we present the case of a 25-year-old male who sustained numerous injuries associated with a physical assault. A CT study of the cervical spine revealed a linear lucency mimicking a fracture but found on closer inspection to represent an accessory articulation between the anterior tubercles of the right transverse processes of the C6 and C7 vertebrae. In this report, we summarize this patient's clinical course, and provide an up-to-date review of the current literature, imaging characteristics, and potential mechanisms of the development of this anatomic variant. Our case also includes an incomplete version of the anomaly contralaterally as well as features of secondary osseous stress hypertrophy; these features have not been previously described and may aid in diagnosis. Finally, we provide the first-ever augmented reality model of this variant to fully convey its geometry and facilitate its unequivocal identification.

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Introduction

The accessory articulation of the transverse processes of cervical vertebrae is an extremely rare anatomic occurrence. First described in 1960, this congenital variant is caused by the connection of protuberances extending between the anterior tubercles of the transverse processes of adjacent vertebrae [1]. Our literature search revealed six prior descriptions of such accessory articulations occurring between the C5 and C6 levels [2–7]. However, there have been only two previously reported cases of accessory articulations between the C6 and C7 levels [7,8]. In this report, we provide an additional description of an accessory articulation of the transverse processes at C6-C7. Uniquely, our report includes the first observation of a partial or incomplete version of the anomaly contralaterally, as well as secondary features of transverse process hypertrophy. We also provide an augmented reality model of

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Fig. 1 – Accessory articulation of the transverse processes at C6-C7. Axial view of the C7 vertebra in our case reveals an oblique lucency along the anterior tubercle of the right transverse process (A, blue arrowhead). The appearance mimics a common injury pattern: a similar lucency on the left at the C6 level in a different patient (D, orange arrowhead) represents a true fracture. Coronal and sagittal reformatted images more clearly show that the lucency in our case (B and C) reflects an accessory articulation of the transverse processes rather than a subtle fracture line (E and F).

this unique anatomy to illustrate its geometry and aid in diagnosis.

Case report

A 25-year-old male was brought to our emergency department following an assault during which he sustained stab injuries to the left hand and wrist, left flank, right thorax, and right upper quadrant of the abdomen. Management of his injuries necessitated an extended hospital course.

Given the mechanism of injury, he was placed in an immobilizing collar by paramedics prior to arrival, and a CT study of the cervical spine was performed shortly after his stabilization to evaluate for other injuries. Review of the axial images revealed an oblique linear lucency along the anterior tubercle of the right transverse process of the C7 vertebra, mimicking a fracture (Fig. 1). Careful examination of the sagittal and coronal reformatted images, however, revealed that the linear lucency actually represented an area of accessory articulation between a protuberance extending inferiorly from the anterior tubercle of the transverse processes of C6 and a protuberance extending superiorly from the anterior tubercle of the transverse process of C7. Interestingly, best seen on coronal oblique 3-D reconstructions, similar protuberances were also present on the contralateral side, but these were shorter and not fully articulating (Fig. 2).

Further review of sagittal oblique reformatted images revealed hypertrophy of the portion of the right transverse process forming the anterior portion of the foramen transversarium at the C6 level, suggesting an element of chronic bony remodeling and further raising confidence in the absence of an acute traumatic injury in this location (Fig. 3). As a result, a diagnosis of accessory articulation of the transverse processes was made, no further imaging evaluation was recommended, and the immobilization collar was uneventfully discontinued.

Discussion

Anatomically, the anterior tubercles of the C6 and C7 transverse processes have key biomechanical and clinical implications. The anterior tubercle of the C6 transverse process, also known as the carotid or Chassaignac tubercle, serves as a key landmark for anesthetic blocks and surgical procedures [9,10]. It also is a site of origination and insertion for the longus colli, anterior scalene, and longus capitis muscles [11,12]. The
C7 anterior tubercle provides a site of attachment for the supracleural membrane of Sibson and also for the scalenus pleuratis muscle and cervical rib, both of which are anatomic variants [13,14].

The described accessory articulation of the cervical transverse processes derives from embryological development. The C3-C7 cervical vertebrae have three primary ossification centers that appear in utero around gestational weeks 8 and 9, with one ossification center in the centrum and two in the neural arches [15,16]. The centrum develops into most of the vertebral body while the neural arches form the pedicles and laminae while also providing sites of support and attachment for the transverse, inferior articular, superior articular, and spinous processes [16–18]. Specifically, the lateral extension of the neural arch centers form the transverse processes. Typically, the anterior tubercles of the cervical transverse processes are diminutive, but in some patients, they can be elongated. When isolated to C7, this elongation can produce cervical ribs; [19] however, in our case, elongations at C7 as well as C6 extended towards each other to form an accessory articulation. Previous studies have suggested that initiation of this ossification process might be attributable to specific movements and skeletal muscle activation of the fetus [20]. Another explanation for this accessory articulation could derive from the pivotal role of homeobox (Hox) genes in the regulation of vertebral development [21–23]. Previous studies have established the function of the Hox genes in the patterning of the axial skeleton through both gain-of-function and loss-of-function experiments [24–27]. Thus, aberrations in the Hox genes’ regulation of segmental differentiation could explain the elongation of the anterior tubercles seen in our case.
Fig. 4 – Augmented reality model of the C5-C7 vertebrae showing accessory articulation of the right transverse processes at C6-C7. After installing the Schol-AR mobile application, first scan the QR code to download the 3D model, then scan the entire image to view and interactively manipulate the model.

**Conclusion**

Accessory articulation of the cervical transverse processes between the C6 and C7 vertebrae is an extremely rare congenital variant that may mimic a fracture. Careful inspection for the anatomical features described in this report, including the secondary finding of transverse process hypertrophy, should aid in the definitive diagnosis of future cases and prevent unnecessary additional workup and prolonged spinal immobilization.
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