



Original Articles

Prevalence and Morphologic Characteristics of Ponticulus Posticus: Analysis Using Cone-Beam Computed Tomography



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Abstract

Objective: This study evaluated the prevalence and morphologic characteristics of ponticulus posticus (PP) by using cervical 3-dimensional (3-D) cone-beam computed tomography (CBCT) scan images.

Methods: This was a retrospective study conducted by selecting cervical 3-D CBCT images of 698 patients, which were examined for the presence and types of PP.

Results: In 257 patients, 438 PPs, complete or partial, bilateral or unilateral, were identified on the 698 cervical 3-D CBCT scans; therefore, the prevalence was 36.8%. Bilateral complete PP and partial PP were observed in 6.3% and 16.2% of subjects, respectively. There was a significant difference in the prevalence between males and females ($P = .001$) and between the right and left sides between males and females, but not between age groups.

Conclusion: Ponticulus posticus is a relatively common anomaly in this Turkish sample, which may have implications for those who perform clinical procedures on the upper cervical spine.

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Introduction

The normal atlas is a ringlike structure consisting of 2 lateral masses connected by a short anterior arch and a longer posterior arch. It is the widest cervical vertebra,

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with its anterior arch being approximately half as long as the posterior arch.¹ The ponticulus posticus (PP), speculated to be congenital or to result from degeneration, is a bony bridge arising from the posterior portion of the superior articular process and the posterolateral portion of the superior margin of the posterior arch of the atlas that completely or partially encircles the vertebral artery.^{2,3}

The PP had not been a subject of concern for spine surgeons until its surgical significance in the insertion of screws into the lateral mass of the atlas was recently reported.⁴ There has been a steady increase in the number of patients undergoing the C1 lateral mass screw (C1LMS) procedure through the posterior arch. Although skeletal maturation evaluation⁵ using the cervical vertebrae and its modified version are now commonly used to interpret the growth potential of young patients, inadequate attention is paid to the radiological anatomy of this region with a view to identifying pathology.⁶ Knowledge of this anomaly is critical to surgeons performing posterior atlantoaxial fusions.⁷ Since the treatment of atlantoaxial instability was revolutionized by the introduction of the C1LMS insertion,⁸ many alterations to the method have been described and used successfully.^{9–11} Young et al⁴ reported that mistaking the PP for just a broad posterior arch of the atlas during C1LMS placement could cause injury to the vertebral artery.

The prevalence of PP has been reported to be between 1.3 % and 45.9.^{5,12} We, however, could find only a few studies^{13–15} on its prevalence or morphological characteristics in an Asian population. This information on the posterior neural arch of C1 when performing lateral mass screw insertion is very important to avoid vertebral artery injury. Paraskevas et al¹⁶ believed that the prevalence of the PP is related to age.

Exact characterization of the PP is only possible by three-dimensional (3-D) study, as illustrated by a computed tomography scan. Cone-beam computed tomography (CBCT), which can definitively measure the length of the anatomical structures of the craniofacial region, was introduced as a new and alternative modality. This recently designed technology has become an important tool for the diagnostic imaging of oral and maxillofacial osseous structures, providing professionals with access to excellent image quality and greater diagnostic accuracy and sensitivity. Therefore, we investigated the prevalence and morphological features of the PP in a Turkish population comprising patients reporting to our department who were all healthy and free of any systemic or musculoskeletal problems. The purpose of the present study was to

determine the frequency of the anomaly and to identify its anatomical features in relation to surgical approaches to the posterior aspect of the atlas in a Turkish population by using CBCT.

Methods

The study protocol was approved by the Ethics Committee of the Medical Faculty of Erciyes University. We designed a retrospective study composed of the CBCT (Newtom 5G, QR, Verona, Italy) images of patients who presented to the Dentomaxillofacial Radiology service at Erciyes University's Dentistry Faculty. All the patients had been referred for diagnosis and treatment planning for different problems involving the maxillofacial region.

The CBCT scans were retrieved from the archives of the department and examined for cervical spine anomalies, in particular PP. Exclusion criteria included inadequate picture quality (artifacts caused by metallic implants or osteosynthesis plates, low resolution, and patient movement during imaging). Patients presenting with congenital anomalies such as cleft lip and palate were not included. In addition, patients with other syndromic conditions involving the craniofacial region were excluded. The CBCT images of 313 males and 385 females were examined.

The examination of the PP was made by the consensus of 2 experts (AES and ES) with 5 years of experience in assessing CBCT volumetric data. Selecting and moving the cursor on 1 image to change the center of the view altered the reconstructed slices in 3 orthogonal planes. Tomography sections of 0.25-mm thickness in the axial, coronal, and sagittal planes were created. Axial and cross-sectional images (coronal and sagittal image) were transmitted to a personal computer in digital imaging and communications in medicine format and reconstructed into multiplanar reconstruction images using the digital imaging and communications in medicine viewer ExaVision SX Ver.1.13 (Ziosoft, Inc, Tokyo, Japan). These views were used to examine the PP. The CBCT images were analyzed with the inbuilt software (NNT) in a Dell Precision T5400 workstation (Dell, Round Rock, TX) using a 32-in Dell LCD screen with a resolution of 1280 × 1024 pixels. These images were reconstructed into 3-D images and carefully inspected for the presence of a PP and whether it was complete or partial. *Complete type* was defined as a clear bony bridge between the superior articular process and the posterior arch of the atlas in

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