

Study Of Arcuate Foramen In Atlas Vertebrae In Gujarat Region

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Abstracts: Introduction: Arcuate foramen is less known trait of the human atlas vertebra formed by a delicate bony spiculum, which arches backward from the posterior end of the superior articular process. Method: Examination of 100 human atlas vertebra done. Result: Study revealed that the trait was present in 13% of the samples. The mean length of the arcuate foramen form was 7.16 mm on the left side and 9.99 mm on the right side in bilateral positive samples while it was 8.14 mm and 9.26 mm respectively in unilateral positive samples. The mean vertical height of this foramen was 6.57 mm on the left side and 6.52 mm on the right side in bilateral positive samples while it was 4.91 mm and 5.38 mm respectively in unilateral positive samples. The sides did not show any statistical significant differences. Conclusion: The importance of the arcuate foramen lies in the external pressure it may cause on the vertebral artery as it passes from the foramen transversarium of the first cervical vertebra to the foramen magnum of the skull. [Patel Z. et al NJIRM 2012; 3(2) : 73-75]

Key words: human atlas vertebra, arcuate foramen, vertebral artery

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Introduction: In the human atlas vertebra, immediately behind each superior articular process is a groove (sulcus arteriae vertebralis), transmitting the vertebral artery and the suboccipital (first spinal) nerve. This is sometimes converted into a foramen (arcuate foramen) in about 14% of the individuals by a delicate bony spiculum, which arches backward from the posterior end of the superior articular process¹.

Kimmerle anomaly/variant/deformity, ponticulus posterior (ponticulus posticus) of the atlas, pons posticus, foramen atlantoideum posterius/vertebrale, canalis arteriae vertebralis, foramen sagittale, retroarticular VA ring, foramen retroarticular superior, retrocondylar bony foramen, posterior atlantoid foramen, posterior glenoid process and spiculum are the alternate names used for this foramen². Authors have reported the occurrence of the arcuate foramen of atlas in 9.8–25.9% of the population. The importance of the arcuate foramen lies in the external pressure it may cause on the vertebral artery as it passes from the foramen transversarium of the 1st cervical vertebra to the foramen magnum of the skull. In the present study, the authors have tried to know the incidence, types, phylogenetic and clinical significance of the arcuate foramen in the Indian population.

Material And Methods : A total of 100 complete/undamaged dry human atlas vertebrae of unknown sex and age were studied from the collection in the Department of Anatomy, Govt. Medical College, Bhavnagar in 2011. These vertebrae were examined for evidence of exostosis from the posterior margin of superior articular facet. The specimens exhibiting such bony outgrowths were classified as having either a partial or a complete left and/or right arcuate foramen. Measurements were taken of the maximum dimensions of the arcuate foramen in both ventro-dorsal (length) and rostro-caudal planes (height). Data were recorded separately for both sides and expressed as mean and standard deviation. Side differences were compared using the unpaired "Student's t test", the level of significance was set at P<0.05.

Result: Thirteen vertebrae showed the presence of a bony exostosis from the posterior margin of the superior articular facet. Partial bony outgrowth/incomplete arcuate foramen were found in 10 vertebrae, and 3 vertebrae had a complete arcuate foramen. Bilateral complete foramen was present in 1 of these samples and in the remaining 2 the occurrence was on unilateral side. The mean length of the arcuate foramen form was 7.16 mm on the left side and 9.99 mm on the right side in bilateral samples while it was 8.14 mm and 9.26 mm respectively in unilateral samples. The mean

vertical height of this foramen was 6.57 mm on the left side and 6.52 mm on the right side in bilateral samples while it was 4.91 mm and 5.38 mm respectively in unilateral samples. The sides did not show any statistical significant differences.

Table 1: Different measurements in bilateral arcuate foramen

Sides*	Length of the arcuate foramen	Height of the arcuate foramen
Left	7.16 (1.62; 5.28–9.56), t = 5.85	6.57 (0.834; 5.24–7.36), t = -0.161
Right	9.99 (0.412; 9.35–10.4), t = 5.85	6.52 (0.372; 6.00–6.90), t = -0.161

*Data are shown as mean (standard deviation; range)

Table 2: Different measurements in unilateral arcuate foramen

Sides*	Length of the arcuate foramen	Height of the arcuate foramen
Left	8.14 (1.01; 6.73–9.43), t = 5.40	4.91 (0.670; 3.75–5.93), t = 3.55
Right	9.26 (0.464; 8.63–9.92), t = 5.40	5.38 (0.228; 5.04–5.68), t = 3.55

*Data are shown as mean (standard deviation; range)

Discussion: The ossification of ligamentous structures in various parts of the body may result in clinical problems such as compression to neighbouring structures and complications in regional surgery. The posterior Atlanto-occipital membrane when ossified partly or wholly forms a bony bridge over the vertebral groove, called arcuate foramen³. Previously authors have studied about this foramen and mentioned its occurrence in 9.8–25.9% of the general population^{4–8}. Taitz C⁹ mentioned about the presence of partial posterior bridging of atlas in 25.9% and completes bridging in 7.9% of the population. They also proposed a hypothesis that external mechanical factors, such as carrying heavy objects on the head, could play a role in the development of these bridges. Paraskevas G⁸ mentioned about the higher incidence of complete canal for vertebral artery in laborers to the non-laborers. He also mentioned about the higher occurrence of incomplete canal for vertebral artery in the 5–44-years-age range. Stubbs DM¹⁰ mentions that complete foramen is

significantly more common in males and partial foramen in white females. Mitchell J⁷ mentions that the foramen is lower in whites than in black. Cakmak O¹¹ contradicts the above theory and mentions about the higher occurrence of complete foramen in the females to that of males. Yamamoto A¹² in his study has mentioned that the complete posterior bridge is a normal structure of adult Japanese macaques. Authors like Unur E et al¹³ have studied about the dimensions of the arcuate foramen and mention that the mean height and length are 5.7 mm (3.7–8.5 mm) and 8.1 mm (5.7–10.0 mm) respectively. Tubbs RS et al¹⁴ have found that the mean area of the arcuate foramen is 14.2 mm². Authors like Hasan M et al¹⁵ have classified the arcuate foramen into six groups. In class I: Impression for the vertebral artery was noticeable, class II: Impression was seen as a distinct groove or sulcus, class III: Partial posterior ponticulus was noted as a bony spicule, class IV: Complete posterior ponticulus could be detected, class V: Lateral bridge extended from the lateral mass to the transverse process, class VI: Posterolateral tunnel made its appearance as a combination of complete posterior (class IV) and lateral (class V) bridges. The arcuate foramen is an underestimated structure and clinicians should be alerted to a possible arcuate foramen with patients complaining of vertigo, headache, shoulder-arm, and neck pain. Cervical spine radiography is a simple and useful technique to indicate the presence of arcuate foramen¹¹. Cushing EK et al¹⁶ found an association between the presence of arcuate foramen and tethering of the vertebral artery in the arcuate foramen and dissection from repetitive trauma with movement of the neck.

Conclusion: Neurologists, neurosurgeons and medical community in general should have knowledge about the present variation and try to look for it when dealing with the patients complaining of symptoms of vertebro-basilar insufficiency like headache, vertigo, shoulder and arm pain.

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