

**ORIGINAL RESEARCH**

# Incidence and Clinical Significance of Ponticulus Posterior in Dry Human Atlas

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## ABSTRACT

**Background:** The first cervical vertebra is called Atlas. The atlas's posterior arch has a groove where the vertebral artery is located. Sometimes, the vertebral artery groove might change into a foramen. This is also referred to as the arcuate foramen of the atlas or ponticulus posterior (ponticulus posticus). These foramina could be full or empty. This might cause the vertebral artery to get compressed, which can result in symptoms including headaches, syncope, altered awareness, etc. By limiting blood flow during excessive rotations of the head and neck, it can also make cervical spine manipulation more difficult. It is linked to vertebrobasilar artery stroke as well. The variations of grooves for the vertebral artery should therefore be thoroughly understood by neurosurgeons and orthopaedic surgeons who practise in this region. **Materials and Methods:** The Department of Anatomy, IMS and SUM Hospital, SOA University Bhubaneswar, Odisha, provided 100 fully ossified adult human atlases that were dried and collected for this investigation. The atlases were of unknown age and sex. On the superior surface of the posterior arch of the atlas, each atlas vertebra was carefully examined for the presence or absence of complete or incomplete ponticuli. **Results:** In the 100 vertebrae that were analysed, 14 (14% of them) had ponticuli. There were no ponticuli in any of the 14 atlas vertebrae. None of the atlas vertebra showed a complete ring. Only two (2%) of the 14 ponticuli were discovered to be bilateral, with 12 (12%) of them being unilateral. 8 (or 8%) of the 12 ponticuli were found on the left side and 4 (or 4%) on the right. **Conclusion:** Due to pressure on the third part of the vertebral artery, which is located in the vertebral artery groove, the presence of an incomplete ponticulus posterior may result in cervical pain and potentially cerebrovascular diseases. When treating patients in this area, radiologists, orthopaedic surgeons, neurosurgeons, and doctors need to be aware of the relevant anatomical information.

**Keywords:** Atlas, Cervical Vertebra, Cerebrovascular disorders, Ponticulus Posterior, Vertebral artery.

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## INTRODUCTION

The first cervical vertebra, known as Atlas, is named for the Greek deity "ATLAS," who carried the Earth on his shoulders [1]. The atlas spine has a ring form. It lacks a body and a spine. The atlas vertebra has two lateral masses that are connected by an anterior and posterior arch. The dorsal ramus of the first cervical nerve and the third segment of the vertebral artery are located in a large groove on the superior surface of the posterior arch [2]. The upper edge of the posterior arch of the atlas is where the posterior atlantooccipital membrane is joined. At either lateral

extremity, the vertebral artery and first cervical nerve pass through the defective membrane. The third vertebral artery segment leaves the atlas by the foramen transversarium, travels medially and backwards behind the lateral bulk of the atlas, and then enters this groove on the posterior arch of the atlas. After that, it enters the foramen magnum through the opening in the front section of the posterior atlanto-occipital membrane [3,4]. The vertebral artery groove's bridging oblique ligament of the atlas may occasionally ossify and turn the groove into a foramen [2,5].

**Figure 1: Ponticulus Posterior**

This is also referred to as the arcuate foramen of the atlas or ponticulus posterior (ponticulus posticus) as shown in figure 1. These foramina could be full or empty. Alternative names for this foramen include foramen retroarticular superior, retrocondylar bony foramen, atlas bridging, canalis arteriae vertebralis, foramen sagitale, posterior glenoid process, and speculum and kimmerle anomaly (or deformity) [6]. These ponticuli may lead to vertebrobasilar insufficiency, vertebral artery distortion, or external pressure on the vertebral artery [7, 8].

### MATERIALS AND METHODS

The Department of Anatomy, IMS and SUM Hospital, SOA University Bhubaneswar, Odisha, provided 100 fully ossified adult human atlases that were dried and collected for this investigation. The atlases were of unknown age and sex. The investigation excluded the bones with any evident disease and the injured atlas vertebra. On the superior surface of the posterior arch of the atlas, each atlas vertebra was carefully examined for the presence or absence of complete or

incomplete ponticuli. The following findings were made: 1. The presence or absence of ponticuli on the superior atlas arch surface. 2. Whether or not the ponticuli in the atlas are complete. 3. Whether there are unilateral or bilateral ponticuli. 4. Whether the atlas vertebra's ponticuli are on the right or left side.

### RESULTS

To determine the prevalence of ponticuli on the superior surface of the posterior arch of the atlas vertebra, a total of 100 atlas vertebrae were examined. In the 100 vertebrae that were analysed, 14 (14% of them) had ponticuli. There were no ponticuli in any of the 14 atlas vertebrae. None of the atlas vertebrae showed a complete ring (Table No. 1). 12 (12%) of the 14 ponticuli were discovered to be unilateral, and only 2 (2%) to be bilateral (Table No. 1). There were 12 ponticuli, and of those, 8 (or 8%) were found on the left side and 4 (or 4%) on the right (Table No. 2). They were all posterior ponticuli. There was no evidence of lateral ponticulus in any vertebra.

**Table 1: Percentage of Complete and Incomplete Ponticuli.**

Total No. of Atlas having Ponticuli	% of Incomplete ponticuli		% of Complete Ponticuli
	Unilateral	Bilateral	
14 (14)	12 (12)	2(2)	-

**Table 2: Percentage of Right and Left side of Ponticuli**

Total No. of Atlas having Ponticuli	Right	Left	Bilateral
14 (14)	4 (4)	8(8)	2(2)

### DISCUSSION

The current study's objective was to determine the prevalence of the Ponticulus Posterior in the dry atlas vertebra in the Vidarbha region. Variations of the vertebral artery groove on the superior surface of the posterior atlas arch are frequent. Between the posterior arch of the atlas and the posterior edge of the superior articular facet, an osseous bridge may form completely

or partially [9,10,11]. In the current investigation, we discovered that 14% of patients had incomplete ponticulus posterior, with a higher prevalence of 8% on the left side than the right.

These posterior bridges were divided into six kinds by Hasan M. et al. [12] as follows: Class I included individuals with only the impression of the vertebral artery on the posterior arch of the atlas; Class II

included individuals with deeper impressions, such as a groove or sulcus for the vertebral artery; Class III included individuals with a partial ponticulus posterior present as a bony spicule; Class IV included individuals with a complete ponticulus posterior; and Class V included individuals with a ponticulus lateralis that extended from the lateral mass to the transverse process; Class VI - included those having posterolateral tunnel i.e. combination of complete ponticulus posterior (Class IV) & ponticulus lateralis (Class V).

Although several theories have been advanced, it is still unclear whether congenital or genetic factors contribute to the development of ponticuli. Some claim that it is caused by the ossification of the oblique ligament, which spans the vertebral artery groove, as a result of ageing [2]. Ossification can result from outside influences like bearing a hefty burden. This notion was corroborated by Paraskevas G et al, who discovered that workers have a higher incidence of canal for vertebral artery than non-laborers [19]. LeDouble claimed that the spinal artery's pulse caused the ligament to ossify. He added that the creation of ponticuli is caused by a regressive and vanishing morphological phenomena, not just ossification, which cannot be the main causal mechanism [11]. These imperfect bony ponticuli, according to Paraskevas G et al [19], Kendrick GA & Biggs NL [20], are precursors to the complete bony ponticuli. Uneven weight bearing as a result of a more prevalent left-tilted head posture can explain the increased occurrence of ponticulus posterior on the left side compared to the right side [21]. Ponticuli could be proatlas remains [6,12].

The incidence of incomplete ponticulus posterior was found to be 14% in the current study, which is in line with data from Zambare & Reddy (2011)[16], Krishnamurthy et al. (2007)[14], and Cakmak O et al.(2005)[13]. Having a posterior ponticulus is a surgically significant variant of the atlas. This can cause the vertebral artery to get compressed and result in symptoms including headaches, syncope, altered consciousness, etc.[9,19,22]. By limiting blood flow during excessive rotations of the head and neck, it can also make cervical spine manipulation more difficult [23,24]. Due to the vertebrobasilar artery's dissection in the foramen arcuale as a result of recurrent damage from different movements of the head, it is also linked to stroke [25]. Cervical spine radiography, a relatively straightforward and affordable method to determine if an arcuate foramen exists or not, should be taken into consideration in any patient complaining of headache, vertigo, or pain in the temporal region [13,26]. The variations of grooves for the vertebral artery should therefore be thoroughly understood by neurosurgeons and orthopaedic surgeons who practise in this region.

## CONCLUSION

In the present study, 14% of participants had an incomplete ponticulus posterior. Due to pressure on

the third part of the vertebral artery, which is located in the vertebral artery groove, the presence of an incomplete ponticulus posterior may result in cervical pain and potentially cerebrovascular diseases. When treating patients in this area, radiologists, orthopaedic surgeons, neurosurgeons, and doctors need to be aware of the relevant anatomical information.

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