The prevalence of ponticulus posticus among patients visiting JSS dental college - A radiographic study

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Abstract

Objective: The objective of this study was to estimate the prevalence of ponticulus posticus among patients visiting JSS Dental College.

Methods: The occurrence of ponticulus posticus and its forms were assessed in 435 lateral cephalograms (LCs) by 2 independent examiners. Data obtained were subjected to statistical analysis using Chi-square and κ analysis.

Results: The prevalence of ponticulus posticus among patients visiting JSS Dental College was found to be 31.8%, with no significant gender predilection.

Conclusion: Ponticulus posticus has been found to be a common anomaly in the population of Mysuru. Due to its clinical significance during surgical intervention and the association with headaches and migraines, patients must be educated on the consequences of its presence. It must also be recorded as a finding in the LC taken.

Introduction

Atlas is the first cervical vertebra. Historically, named after a Greek myth, Atlas had to carry the weight of the sky on his shoulders for eternity. Similarly, even the atlas bears the weight of the entire head. It is a ring-shaped structure which comprises two lateral masses, transverse process as well as anterior and posterior arches. The two lateral masses consist of superior and inferior articular facets. The superior articular facet forms the atlanto-occipital joint whereas the inferior articular facet forms a lateral atlanto-axial plane joint. The anterior arch forms anterior 2/5th while the posterior arch forms 3/5th of the circumference of the atlantal ring. The superior surface of posterior arch consists of a groove through which the vertebral artery passes. A bridge of ossification named “ponticulus posticus” is seen on the vertebral groove which extends from the lateral mass to posterior arch of atlas. In Latin, ponticulus posticus means little bridge.[1]

Ponticulus posticus is defined as an abnormal small bony bridge which is formed between the posterior portion of the superior articular process and the posteroslateral part of the superior margin of the posterior arch of the atlas. It is also known as atlantal posterior foramen, sagittal foramen, a variant of Kimmerle’s anomaly, arcuate foramen, canalis vertebralis, upper retro-articular foramen, retro-articular vertebral artery ring, retro-articular canal, and retrocondilar vertebral artery ring. However, ponticulus posticus is the most accepted terminology.[2]

Also called as the arcuate foramen, it is a bony arch on the atlas vertebra. It converts from a groove on the upper surface of the arcus posterior Atlantis to this foramen. It comprises significant anatomic structures, such as the vertebral artery and the suboccipital nerve. It is also attached to the atlanto-occipital membrane, which is linked to the dura. Hence, any compression to the vertebral artery or suboccipital nerve might cause symptoms such as migraine, vertigo, diplopia, shoulder pain, and neck pain. It has been reported that it could cause severe complications such as stroke and even death during insertion of C1 lateral mass screws due to the compression of vertebral artery.[3]

With this background in mind, this study has been designed to estimate the prevalence of ponticulus posticus among patients visiting JSS Dental College.

Materials and Methods

This study was conducted in the Department of Oral Medicine and Radiology, JSS Dental College and Hospital, Mysuru. The archived lateral cephalograms (LCs) were recovered from the
department using simple random sampling technique. Totally 435 LCs satisfying the inclusion criteria were selected and appraised by two blinded independent examiners for the existence of ponticulus posticus and its variants, i.e., complete and partial.

**Inclusion criteria**
- LCs with optimum image quality.
- LCs with adequate visibility of atlas which is not obscured or superimposed by the surrounding anatomical structures.

**Exclusion criteria**
- LCs where there is evidence of any anomaly or pathology.
- LCs with positioning and exposure errors.

A complete ponticulus posticus [Figure 1a] is one continuous bridge that extends from the posterior aspect of the lateral mass to the anterior aspect of the posterior tubercle whereas a partial ponticulus posticus [Figure 1b] is one that does not extend fully from the posterior lateral mass to the posterior tubercle.[4]

The selected radiographs were viewed using an X-ray viewer and a magnifying lens. The radiographs were then divided into 3 groups as follows: Group 1 - absence of ponticulus posticus, Group 2 - presence of partial ponticulus posticus, and Group 3 - presence of complete ponticulus posticus.

The prevalence was calculated by including only those radiographs which the examiners agreed upon, pertaining to the presence and absence of ponticulus posticus. The reliability of the two examiners was assessed using k analysis.

**Results**
The interexaminer agreement was 0.61. Among the 435 radiographs, 83 radiographs were excluded from the analysis as there was disagreement between the two examiners regarding the presence and absence of ponticulus posticus. Out of the remaining 352 radiographs, 240 (68.1%) did not show any form of ponticulus posticus whereas its various forms were noted in 112 (31.8%) radiographs. The complete form of ponticulus posticus was noted in 14 (4%) radiographs while the partial form was noted in 98 (27.8%) radiographs [Table 1].

Among the 112 radiographs, 54 (48.2%) were males and 58 (51.7%) were females. No gender predilection was noted [Tables 2 and 3].

**Discussion**
Considered as an important anomaly of the atlas, ponticulus posticus is a bony arch that converts the groove into the foramen. This foramen is called the arcuate foramen which comprises vertebral artery and suboccipital nerve. According to various surgeons, the screw must be inserted in the dorsal aspect of the posterior arch instead at the base of the lateral mass, or at the junction of the posterior arch and the lateral mass. A broad dorsal arch of the atlas is the finest manifestation for this modified screw trajectory. However, in patients with ponticulus posticus, it can be misconstrued for a broad dorsal arch which can cause compression of the vertebral artery, stroke, or even death by thrombosis, embolism, or arterial dissection. Hence, we conducted this radiographic study to aid the surgeons in the lateral mass screw fixation.[4]

According to our study, the prevalence was about 31.8% which was less compared to the study conducted by Kuhta et al. where the prevalence was 45.9%.[2] The difference in prevalence could be because of the geographic or ethnic variations among the populations.

In our study, the prevalence of partial form of ponticulus posticus (27.8%) was found to be more than the complete form (14%). It was similar to the study conducted by Cederberg.
Prevalence of ponticulus posticus

Table 2: The cross-tabulation of examiners 1 and 2 regarding the presence and absence of ponticulus posticus in males

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CP: Complete ponticulus posticus, PP: Partial ponticulus posticus, 01: Examiner 1, 02: Examiner 2

Table 3: The cross-tabulation of examiners 1 and 2 regarding the presence and absence of ponticulus posticus in females

<table>
<thead>
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</table>

CP: Complete ponticulus posticus, PP: Partial ponticulus posticus, 01: Examiner 1, 02: Examiner 2

et al. where the prevalence of partial form was about 27% and complete form was about 11%.[5]

Numerous studies have been conducted to explain the mechanism of ponticulus posticus formation. Among the suggested etiologies are genetics, ossification by age, or external mechanical factors.[4] A study conducted by Paraskevas suggested that the incidence of complete form of ponticulus posticus was more in laborers as compared to non-laborers. However, we did not take the occupation into consideration.[7]

He also hypothesized that the partial form of ponticulus posticus is precursor of the complete form. It was supported by Kendrick GA and Biggs NL who reported a case, wherein two females presented with the partial form of ponticulus posticus, and over a time of 1-2 years, it was converted into a complete form.[4]

Various studies have found an association of ponticulus posticus with migraine without aura.[6] It was suggested that, due to the attachment of ponticulus posticus to the atlanto-occipital membrane and dura mater, pressure exerted on the dura results in a type of headache seen in migraine.

Innumerable studies put forth that, due to the presence of ponticulus posticus, occlusion of the vertebral artery occurs and shows symptoms such as headache, vertigo, and diplopia from vertebrobasilar insufficiency.[10] In 1972, a similar yet significant study described by Eriksen reports two such cases of thrombosis of the vertebrobasilar arterial system in the absence of identifiable arterial disease, but in the presence of ponticulus posticus.[10]

Further research should be conducted on other populations with larger sample size to compare age, racial, and genetic predisposition for Ponticulus posticus.

Conclusion

Ponticulus posticus has been established to be a common anomaly among patients visiting dental colleges. Due to its clinical significance during surgical intervention and the association with headaches and migraines, patients must be educated on the consequences of its presence. It must also be recorded as a finding in the LCs taken.

References


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