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RESEARCH ARTICLE

PREVALENCE OF PONTICULUS POSTICUS AMONG CENTRAL KERALA POPULATION – A DIGITAL RADIOGRAPHIC STUDY

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ABSTRACT

Background: Ponticulus posticus is a cervical spine anomaly which can be detected on a routine lateral cephalogram that is mostly neglected by the dentists. **Aims:** To estimate the prevalence of ponticulus posticus and its relationship with gender in Central Kerala population. **Methods and Materials:** A sample of 525 patients lateral cephalogram were randomly selected from the archived records in the department. Eighty one lateral cephalograms were excluded, and only 444 lateral cephalograms were taken with patients aged between 8-50years. Each digital radiograph was inspected for the presence and absence of ponticulus posticus. It was further evaluated for either partial or complete form and the results were statistically analyzed. **Results:** Ponticulus posticus was observed in 32% of the patients, of which 3.8% had complete and 28.2% had partial type. Even though there was some male predilection, no statistically significant association was found between gender of the patient and presence of ponticulus posticus. **Conclusion:** Ponticulus posticus is a common anomaly; therefore, lateral cephalogram should be carefully examined to check for the presence of this anomaly.

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INTRODUCTION

The most common diagnostic radiographs used in clinical orthodontics are panoramic and lateral cephalometric radiographs. Significant cervical spine pathology can be detected on routine lateral cephalogram. Cervical vertebrae maturation index (CVMI) is the most common index used to measure the growth potential in young patients where often the cervical spine pathology is omitted and inadequate attention is paid to this region. One such anatomical anomaly is ponticulus posticus of first cervical vertebrae (atlas) (Govindraju and Mahesh Kumar, 2017). Ponticulus Posticus means "little posterior bridge" in Latin which is defined as an abnormal small bony bridge which is formed between the posterior portion of the superior articular process and the posterolateral portion of the superior margin of the posterior arch of the atlas (Chitroda *et al*., 2013; Young *et al*., 2005; Sabir *et al*., 2014). It is also known as pons posticus, arcuate foramen, foramen arcuale, retroarticular vertebral artery ring, Kimmerle anomaly, foramen atlantoideum, foramen sagitale, canalis arteriae vertebralis, and retroarticular canal of the atlas (Gupta *et al*., 2014).

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Atlas is the widest cervical vertebra which is a ring-like structure consisting of two lateral masses connected by a short anterior arch and a longer posterior arch. On its upper surface is a wide groove for the vertebral artery and the first cervical nerve. In 1–15% of the population, a bony arch may form thereby converting this groove into a foramen through which these structures pass. This bony arch is known as the ponticulus posticus (Sharma, 2010). Ponticulus posticus is common in the lower primates. Its history dates back to the 12th century (Govindraju and Mahesh Kumar, 2017; Wysocki *et al*., 2003), when it was reported that these anatomical structures were found in the human skeletons. The earliest description of the structure was given by Cleland in 1861 (Govindraju and Mahesh Kumar, 2017; Buna *et al*., 1984; Romanus and Tovi, 1964), and the first report onponticulus posticus was by Louis Bolk, a Dutch anatomist, in 1906 (Govindraju and Mahesh Kumar, 2017; Kuhta *et al*., 2010). The clinical significance of this anomaly is somewhat controversial because studies have found a possible association of this cervical spine anomaly with conditions like Migraine, cervicogenic headache and vertigo but there are patients who are asymptomatic despite having ponticulus posticus (Giri *et al*., 2017). Any compression to the vertebral artery or suboccipital nerve might cause symptoms such as migraine, vertigo, diplopia, shoulder pain, and neck pain. However, failure to detect ponticulus posticus can have grave complications such as stroke and even death during cervical

spine surgical intervention, especially those requiring screw placement in lateral mass region of Atlas vertebra (Patil K. *et al*., 2016). The prevalence hasbeen reported to be between 5.14 and 37.83% with a female predominance in the Western population (Govindraju and Mahesh Kumar, 2017; Stubbs, 1992). Miki *et al*. classified ponticulus posticus into three types:

Full type: It forms a complete bony ring

Incomplete type: Some portions of the bony ring are defective

Calcified type: There is a linear or amorphous calcification (Govindraju and Mahesh Kumar, 2017; Kim *et al*., 2007). With this background, the purpose of the present study is to estimate the prevalence of ponticulus posticus and its relationship with gender among Central Kerala population using digital lateral cephalogram.

MATERIALS AND METHODS

The study was carried out in Department of Oral Medicine and Radiology. A sample of 525 patients lateral cephalograms were retrieved from the archives of the department (Sirona Orthophos XG5). The inclusion criterias were lateral cephalograms with optimum image quality, no history of cervical vertebral injuries and lateral cephalograms with adequate visibility of atlas. 81 lateral cephalograms where there was evidence of other bony anomaly or pathology and poor display of posterior arch of first cervical vertebra due to overlapping of mastoid process or occiput were excluded from the study. After implementing exclusion criteria, 444 radiographs (194 males and 250 females) with clearly visible skull base and age range between 8-50years were included in the study. Each digital radiograph was examined for the presence and absence (Figure 1). of ponticulus posticus and were further evaluated for both the partial (Figure 2). and complete (Figure 3) form.

Figure 1. Lateral cephalogram showing absence of ponticulus posticus

Figure 2. Lateral cephalogram showing partial ponticulus posticus

Figure 3. Lateral cephalogram showing complete ponticulus posticus

During initial examination all lateral cephalograms were observed by two of the authors. To eliminate any error 100 randomly selected lateral cephalograms were re-examined separately by the same two authors 1 month after initial examination. There was complete agreement between the two authors and the two examinations and results were statistically analyzed. Data analysis was done by using SPSS software. Chi-square test was used to analyze the differences between males and females regarding prevalence of ponticulus posticus.

RESULTS

The sample consisted of a total of 525 patients lateral cephalograms, of which 81 radiographs were not of good quality and were excluded from the study. Of the remaining 444 radiographs, 194 (41.4%) were males and 250 (58.6%) were females. The mean age of the samples was 20.65 ± 5.3 years with a range of 8-50 years (Table 1). Ponticulus posticus was observed in 32% of cases (Table 2, Graph 1), of which 28.2% had partial ponticulus posticus and 3.8% had completeponticulus posticus (Table 3). Male predominance was found with a prevalence of 34.2% (63 out of 121) and female prevalence of 30.4% (79 out of 181) (Table 4, Graph 2).

Table 1. Mean age

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
AGE	444	8	44	20.6577	5.3361

Table 2. Present and absent

Present/Absent		
	Frequency	Percent
Present	142	32
Absent	302	68
Total	444	100

Table 3. Prevalence of ponticulus posticus

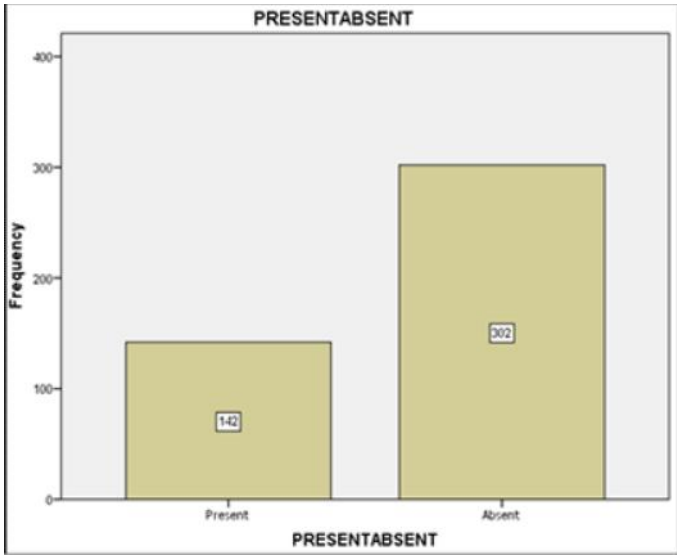
Partial/Full					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Partial	125	28.2	88	88
	Full	17	3.8	12	100
	Total	142	32	100	
Missing	System	302	68		
Total		444	100		

Table 4. Comparison of gender wise prevalence of ponticulus posticus

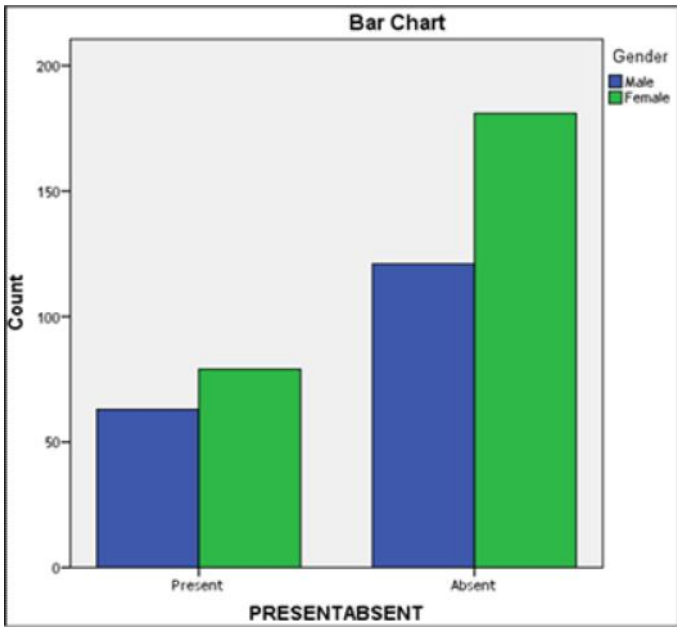
Gender				
			Count	Column N %
Male	Presentabsent	Present	63	34.20%
		Absent	121	65.80%
Female	Presentabsent	Present	79	30.40%
		Absent	181	69.60%

Table 5. Shows the prevalence of complete ponticulus posticus as reported in the literature

Authors	Year	Prevalence
Pyo *et al*.	1950	12.6%
Kendrick and Biggs	1963	15.8%
Romanus	1964	14.3%
Lambarty and Zivanovic	1973	7.5%
Takaaki *et al.*	1979	4.89%
Sweat and Crowe	1987	13%
Stubbs	1992	13%
Malas	1998	2.6%
Wight *et al.*	1999	18%
Unur *et al.*	2004	5.1%
Cakmak	2005	7.2%
Kim *et al.*	2007	4%
Sharma *et al*.	2008	4.3%
Chitroda *et al.*	2013	8%
Govindraju and Kumar	2016	2.78%
Giri *et al.*	2017	4.8%
Present Study	2018	3.8%



Graph 1. Prevalence of ponticulus posticus



Graph 2. Comparison of gender wise prevalence of ponticulus posticus

DISCUSSION

In this cross sectional study, lateral cephalograms of a group of Central Kerala patients were evaluated for the presence of ponticulus posticus. The current study found that the prevalence of ponticulus posticus was 32% with complete ponticulus posticus present in 3.8% of samples. Table 5 shows the prevalence of complete ponticulus posticus as reported in the literature. The prevalence of Western population has been reported to be 5.1 – 37.8%. The total prevalence of ponticulus posticus in our study was 32% which was almost similar to about 35.7% in a study done by Giri *et al*. (2017) and Patil *et al*. (2017) in which the prevalence was 31.8% (Patil *et al*., 2016). However studies done by Govindaraju *et al*. (2017) and Kendrick *et al*. (1963) where the prevalence was 14.4% and 15.8% respectively have reported a lower prevalence rate of ponticulus posticus than the present study and there are few studies reporting higher prevalence such as in case of study conducted by Kuhta *et al*. (2010) and Buyuk *et al*. (2017) where the prevalence was 45.9% and 43.04% respectively. The possible causes for this ponticulus posticus can be congenital,

genetic, ossification due to age or external mechanical factors (Govindraju and Mahesh Kumar, 2017).Complete ponticulus posticus has been found to be between 2.6% and 14.3% in radiological and between 3.4% and 15% in osteological studies (Govindraju and Mahesh Kumar). The prevalence of complete ponticulus posticus in our study was 3.8% which was similar to the study done by Patil *et al*.(2016) where the prevalence of complete ponticulus posticus was 3.7%. Female predominance has been described as most common in literature (Govindraju and Mahesh Kumar, 2017). Male predominance was noted in our study and there was no statistically significant association between gender and presence of ponticulus posticus. This finding was in accordance to the study done by Sharma *et al*. where the authors showed male predominance (Sharma V. 2010). The reason for this can be difference in sample size and sample distribution (Govindraju and Mahesh Kumar, 2017). Partial ponticulus posticus was found to be present in 28.2%.This is similar to the study done by Giri *et al* where the prevalence of partial ponticulus posticus was almost 30.9% (Giri *et al*., 2017). The limitations of the study were that the lateral cephalogram cannot determine if the anomaly is unilateral or bilateral, and that the study was done retrospectively; hence, future studies should be done prospectively considering the clinical feature of headache, especially migraine on other populations with larger sample size to compare age, racial, and genetic predisposition for ponticulus posticus (Govindraju and Mahesh Kumar, 2017).

Conclusion

Ponticulus posticus is a common anomaly in Central Kerala population and is independent on gender. Therefore, lateral cephalograms should be carefully examined to check for the presence of this anomaly before screw placement in the lateral mass of the atlas to avoid vertebral artery injury. If this anomaly in lateral cephalogram is detected or suspected, a three dimensional imaging modality such as CBCT or CT scan is supplemented for that purpose. Thus, lateral cephalogram can be used as a screening radiograph for this anomaly.

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