

ORIGINAL ARTICLE

Prevalence of Ponticulus Posticus in Orthodontic Patients of the Local Population of Islamabad, Pakistan

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ABSTRACT

Objective: To determine the prevalence and association of Ponticulus Posticus with dental and skeletal malocclusions in our local population.

Study Design: Cross sectional, observational study

Place and Duration of Study: Orthodontics department of a tertiary care hospital based in Islamabad using records between the duration of 1st March, 2014 – 31st February 2018.

Materials and Methods: The study was conducted using lateral cephalograms of the patients visiting the Orthodontic department which were analysed against age, gender, skeletal and dental malocclusions of the patients obtained from the patient records. For the incidence of Ponticulus Posticus a total of 1194 radiographs were obtained using convenience sampling and analysed using SPSS version 17 and Pearson's Chi-Square test was applied.

Results: A combined frequency of PP was found to be 18.1% (181/817). A higher frequency in males 22.6% (77/264) as compared to females 15.8% (104/553) exhibited a significant difference ($p < 0.05$).

Partial type of Ponticulus Posticus was more frequent (61.3%) as compared to Full (38.7%). Partial variant expressed a higher frequency in skeletal (49.5%) and dental (48%) class II malocclusion. Whereas, the full variant of Ponticulus Posticus exhibited a higher frequency in Dental Class II (48.6%) and skeletal Class I (55.7%) respectively.

Conclusion: Our data suggests that frequency of Ponticulus Posticus in our local population shows male preponderance in dental class II malocclusion, however, no significance was established in relation to its association with skeletal or dental malocclusions.

Key Words: *Arcuate Foramen, Atlas, Dental and Skeletal Malocclusion, Kimmerle Anomaly, Ponticulus Posticus.*

Introduction

Ponticulus Posticus (PP) is a morphological variation of the ATLAS/C1 (the first cervical vertebra), famous for anatomical disparity leading to various clinical manifestations such as; migraine, neck pain, hearing loss and most importantly, incorrect assessment during orthopaedic surgery for atlanto-axial fixation causing vertebral artery damage.¹ Ponticulus posticus is a Latin word meaning "LITTLE POSTERIOR BRIDGE".^{1,2} It is a membranous ossification found between the posterior portion of the superior

articular process and posterolateral portion of superior margin of the posterior arch of Atlas.³ This anatomical anomaly has been termed in the literature using various terminologies such as Arcuate Foramen, Kimmerle anomaly, Foramen Atlantoideum being a few of them.^{4,5} Origin of PP with clinical implications is not yet fully understood⁶ and subjected to ongoing research with endochondral origin from the dorsal arch of atlas proposed in the literature.⁷

PP has prevalence ranging from 1.3% - 60%³ with ethnic variation.⁸ There is a lack of data on the Asian population,⁹ no such study is yet reportedly conducted in Pakistan. Recent meta-analysis shows preponderance in female gender (18.5%) as compared to males (16.7%).⁸ The analysis is commonly done using various assessing/ investigating tools such as CBCT,² dried specimens of C1 (Atlas)^{10,11} and most commonly employed method comprising lateral cephalograms.¹²⁻¹⁴ Using these investigative techniques, the establishment of presence of PP and types can be assessed which can

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Funding Source: NIL; Conflict of Interest: NIL
Received: October 23, 2018; Revised: August 20, 2019
Accepted: August 27, 2019

be Partial (incomplete) and Full (complete).¹⁵⁻¹⁹ Skeletal deformities, head, neck, cervical posture and morphological deviation along with variable orthopaedic findings are believed to have an association with malocclusion.^{20,21} Studies have also reported a relationship between mandibular positioning and cervical vertebral morphology.²² D'Attilio et al presented a statistically significant correlation between mandibular plane angle, position, length and overjet to the cervical curvature.²³ All these studies showing an association of orthopaedic findings with certain orthodontic findings led us to investigate the prevalence and association of Ponticulus Posticus with dental and skeletal malocclusions in our local population.

Materials and Methods

A cross-sectional study was undertaken at the Islamic International Dental Hospital, using the records from the archives of the Orthodontics department of patients who had undergone orthodontic treatment/consultation during a period of March 01, 2014 – February 31, 2018. A total of 1194 lateral cephalograms were acquired using non-probability convenience sampling. The ethical approval was obtained from the Institutional Ethical Review Committee. A total of 196 radiographs were excluded, the exclusion criteria comprised of poor visualization of posterior arch of atlas and patients with congenital facial abnormalities and/or syndromes. Radiographs were recorded using ART PLUS Dental X-Ray - FIN-02150 and examined by direct visualization under adequate illumination for the presence of the anomaly, and if present whether complete or partial. Gender, age, dental and skeletal malocclusions were noted.

Radiographs were examined by two observers twice on different occasions to reduce intra operative error. In case of a disagreement, a third observer from the radiology department was consulted. The observers followed the classification by Miki et al which radiographically classifies the Ponticulus posticus into three types:²⁴

“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.”

Due to many intermediate forms of partial (PP) which

may range from a spicule to some being ossified but not completely encircling the posterior arch, the variations were dichotomized to Complete and Partial for this study.

All data was entered and subjected to statistical analysis using SPSS version 17. Using Pearson's Chi-square test, data was analysed to establish any association between occurrence, gender, age and malocclusions (skeletal & dental).

Results

The mean age of the subjects was 17.76 ± 5.41 years (range 7 – 51 years) and categorized into three groups, Group I (7-14 years), Group II (15-20 years) & Group III (21 and above). Highest prevalence of PP was found in Group II, Partial form of PP was 44.1% and full form of PP was 37.1%. Total number of PP detected were 181 with a prevalence of 18.1% out of 998 radiographs (Partial: 61.3%, Full: 38.7%). Male patients showed a preponderance of PP $n=77$ (22.6%) as compared to females $n=104$ (15.8%) with significant difference ($p<0.05$) however, no significant difference ($p>0.05$) was observed between partial and full form of PP, age, skeletal & dental malocclusions.

With the analysis of malocclusion groups, partial PP showed a relative predominance of dental 49 (48%) and skeletal 52 (49.5%) Class II malocclusions and conversely cases of complete/full PP showed a relative predominance of dental 32 (48.6%) Class II and skeletal 39 (55.7%) Class I malocclusion. However, there was no significant difference between different malocclusion groups (skeletal or dental) ($p>0.05$). Detail description available in Table I & II.

Table I: Frequency of PP Based on Gender in Local Population, $P < 0.05$

	Ponticulus Posticus Absent	Ponticulus Posticus Present
Male	264 (77.4%)	77 (22.6%)
Female	553 (84.2%)	104 (15.8%)
Total	817 (81.9%)	181 (18.1%)

Table II: Frequency of PP Based on Dental and Skeletal Malocclusions, $P > 0.05$

	Dental		Skeletal	
	Partial	Full	Partial	Full
Class I	36.3%	36.8%	38.1%	55.7%
Class II	48%	48.6%	49.5%	38.6%
Class III	15.7%	12.9%	12.4%	5.7%

Discussion

The cross-sectional study comprises of cephalograms of the Orthodontically treated patients, as shown in figures 1(A) & (B), of our local population, the evaluation showed a prevalence of 18.1% with partial 61.3% & full 38.7%. The analysis of malocclusion groups showed a predominance of partial type PP in Dental Class II malocclusion and full type PP in Skeletal Class I.

Different methods have been used to investigate PP, that entail plain radiography, CBCT, CT-scans and examination of dried specimens of Atlas. Various studies have been undertaken in different populations with highly variable results (1.3% – 60% prevalence), reported prevalences consist of a meta-analysis conducted by Przemyslaw A. et al which states that the least amount of cases of PP were reported in Asia as opposed to North America where the frequency of PP was highest.⁸

Compared to our population, similar prevalences were reported by Jae Taek Hong (15.6%),²⁵ Young et al, (15.5%).²⁶ Kyeong Hwan Kim et al, Elliot & Tanweer (16.6%)²⁷ and Yong Jae (14%) and (15.5%) respectively.^{4,28} However, V Sharma et al. (4.3%),²⁹ Chitrodka PK et al. (60%)⁹ showed contrasting results. A significant male predominance was observed in our local population ($p < 0.05$) which is in coherence with a study conducted by Adisen and Misirlioglu.³ Though a female predominance was also reported in a study with no significant difference established between the genders ($p > 0.05$).⁹ Whereas, some studies also suggested that there is no significant difference in the prevalence of the PP among the two genders.^{7,27} Adisen and Misirlioglu, in their attempt to study the relationship between mandibular position and cervical vertebra morphology, no association could be established but it was recommended to investigate the presence of PP in different dentoskeletal patterns in future studies. Middle Anatolian population had a higher frequency of the anomaly (PP) detected in Angle class III patients (22.2 %). Although no significant difference was observed between malocclusion groups ($p > 0.05$)³ which is in coherence with the results of this study.² According to Sevki et al 2017 in Turkish population PP was most frequently detected in class III patients (13.8%) followed by class II (12.2%) and class I patients (10.5%). Statistically

significant differences between the different sagittal skeletal groups were observed ($p = < 0.05$). In the Turkish population, highest frequency of PP was found in Angle class III patients. Both these findings are in accordance with the study conducted by Sonnesen et al 2007 which showed significant ($p = < 0.001$) relationship with mandibular overjet and cervical column morphological deviations as compared to the control group.³⁰

Many studies have tried to find any association with age, but none has been able to do so, while some studies have gone as far as to negate any such association.²⁹ Some claim it to be congenital, citing cadaveric and radiologic studies that have shown its presence in fetuses and children, with some still in the cartilaginous stage yet to ossify which supports the study conducted by Geist whose findings oppose the theory of it being a degenerative phenomenon which occurs as a result of aging.¹⁸ Some studies have shown that in some cases it is able to ossify over the years³¹ while in others it remains in a spicule/partial form throughout life, which suggests no association of the bridging process with life.

One of the limitations in the study design was that the lack of extensive Computed Tomography which could have revealed the frequency more accurately by determining if the anomaly was bilaterally present or unilaterally. The observers were not trained radiologists and a trained radiologist was only consulted in cases where both the observers opinions differed.

Conclusion

Our data suggests that frequency of Ponticulus Posticus in our local population shows male preponderance in dental class II malocclusion, however, no significance was established in relation to its association with skeletal or dental malocclusions. A larger sample should be taken in future studies conducted, CBCT or CT scans are recommended to find the full extent of PP including unilaterally and bilaterally present variants.

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