



A STUDY EVALUATING THE PREVALENCE OF THE BONY BRIDGE IN THE ATLAS POSTERIOR ARCH IN A TURKISH POPULATION

TÜRK POPULASYONUNDA ATLAS POSTERİOR ARKINDAKİ KEMİK KÖPRÜ PREVALANSININ DEĞERLENDİRİLDİĞİ BİR ÇALIŞMA

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ABSTRACT

Objective: The aim of this study was to determine the prevalence of ponticulus posticus (PP) located on the atlas vertebrae of individuals who applied to Necmettin Erbakan University, Faculty of Dentistry, Department of Dentomaxillofacial Radiology for various reasons whose lateral cephalometric radiographs were taken, to determine their relationship with gender and age group, and to analyze our findings in the scientific literature comparison with similar studies.

Material and Method: The presence and types of PP were investigated on 835 lateral cephalograms. Each patient was assigned an identification number, and demographic information, absence/presence of PP, if present, type of PP was recorded. Distributions of obtained values were analyzed using Pearson's Chi-square test. p values < 0.05 were considered statistically significant.

Results: The mean age of subjects was 16.90 ± 5.73 years (range 7–55). In the analyzed sample, PP had a prevalence of 25.1 % (complete form 11.0 %, incomplete form 14.1 %). There was a significant difference between genders (p = 0.001) (more prevalent in male patients: 110/347; 31.7 %). No significant difference was found between age groups (p > 0.05).

Conclusion: PP is not a rare anomaly and the patient must be told of the implications and importance of detecting PP on a lateral cephalogram. Further studies are needed to widen the sample, verify possible regional variations and improve the analysis by more advanced radiological examinations such as CT and cone beam CT scans.

Keywords: Atlas, cephalometric radiographs, ponticulus posticus

ÖZET

Amaç: Bu çalışmanın amacı Necmettin Erbakan Üniversitesi Diş Hekimliği Fakültesi Dentomaksillofasiyal Radyoloji Anabilim Dalı'na çeşitli nedenlerle başvuran ve lateral sefalometrik radyografileri çekilen bireylerde atlas vertebra yerleşimli ponticulus posticus (PP) prevalansının belirlenmesidir. cinsiyet ve yaş grubu ile ilişkisini belirlemek ve bilimsel literatürdeki bulgularımızı benzer çalışmalarla karşılaştırmalı olarak incelemektir.

Gereç ve Yöntem: 835 lateral sefalogramda PP varlığı ve tipleri araştırıldı. Her hastaya bir kimlik numarası verildi ve demografik bilgileri, PP yokluğu/varlığı, varsa PP tipi kaydedildi. Elde edilen değerlerin dağılımları Pearson Ki-kare testi kullanılarak analiz edildi. p değerleri < 0,05 istatistiksel olarak anlamlı kabul edildi.

Bulgular: Deneklerin ortalama yaşı 16.90 ± 5.73 yıldır (aralık 7-55). Analiz edilen örnekte PP'nin prevalansı %25,1'dir (tam form %11,0, eksik form %14,1). Cinsiyetler arasında anlamlı fark vardı (p = 0,001) (erkek hastalarda daha yaygın: 110/347; %31,7). Yaş grupları arasında anlamlı fark bulunmadı (p > 0.05).

Sonuç: PP nadir görülen bir anomali değildir ve hastaya lateral sefalogramda PP'yi saptamanın etkileri ve önemi anlatılmalıdır. Örneklemi genişletmek, olası bölgesel varyasyonları doğrulamak ve CT ve koni ışın CT taramaları gibi daha gelişmiş radyolojik incelemelerle analizi geliştirmek için daha ileri çalışmalara ihtiyaç vardır.

Anahtar Kelime: Atlas, ponticulus posticus, sefalometrik radyografiler

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INTRODUCTION

C1 lateral mass screw (C1LMS) is used in the treatment of atlantoaxial instability. Th modified techniques have been described and used successfully since 1994. In these techniques, the posterior part of the atlas is referenced. Although less intraoperative blood loss is among the most important advantages of these techniques, they are important in terms of vertebral artery bleeding. (Elliott & Tanweer, 2014).

Ponticulus posticus (PP) is the name given to a bony prominence arising from the posterior arch that completely or partially surrounds the vertebral artery or from the superior articular process of the atlas. It is also called by names such as Kimmerle anomaly, Atlas bridge, Arcuate foramen (Giri et al., 2017). It is predicted that it is caused by congenital or degeneration. From the dorsal aspect, it may give the clinician the impression of a thick (i.e. long) posterior arch to adequately place a 3.5 or 4 mm C1LMS (Elliott & Tanweer, 2014). The presence of this anatomical variation may compromise the vertebral artery during posterior arch insertion of the C1LMS in a significant proportion of patients. Therefore, clinicians should be aware of this anomaly before starting operative procedures involving this region. In addition to the prevalence of PP, it has also been stated in the literature that PP is also associated with conditions such as headache and cervical pain syndrome, migraine chronic tension-type headaches (Chen et al., 2015; Sabir et al., 2014).

PP has been investigated in the literature using various methods such as cadavers, lateral cephalograms, and three-dimensional (3D) images. However, orthodontic literature on this anomaly is scarce. Dentists, especially orthodontists, examine lateral cephalograms every day. Orthodontists should record this anomaly. If necessary, they should consult the relevant branch. A lateral cephalogram may be a scan radiograph for PP only if orthodontists are familiar with this anomaly of the first cervical vertebra. As a result, this situation is explained by an old proverb "eyes see what the mind knows" (Giri et al., 2017).

Based on the clinical significance of PP, the aim of this study was to determine the prevalence of PP located on the atlas vertebrae of individuals who applied to Necmettin Erbakan University, Faculty of Dentistry, Department of Dentomaxillofacial Radiology for various reasons whose lateral cephalometric radiographs were taken, to determine their relationship with gender and age group, and to analyze our findings in the scientific literature comparison with similar studies.

MATERIAL AND METHOD

Ethics committee approval was obtained from Necmettin Erbakan University Faculty of Dentistry Research Ethics Committee with date 2022 and number 157. Digital lateral cephalogram of patients who applied for orthodontic treatment between January 2018 and May 2022 were obtained from the archives of Oral, Dental and Maxillofacial Radiology Department, Necmettin Erbakan University, Konya, Turkey.

Patients with poor appearance of the atlas, patients with craniofacial syndrome and cleft lip and palate, and patients with a history of trauma or surgery in the cervical spine region were excluded from the study. According to these criteria, 835 patients, 347 males and 488 females, were included in the study. The mean age was 16.9 years (range 7-55 years). The sample was divided into three categories as 7-13 years old, 14-17 years old and 18-55 years old. The distribution of the sample by age and sex are presented in Table 1.

Table 1 Distribution of PP as per age and sex groups

| | n | Absence PP | | Partial PP | | Complete PP | | p value |
|-------------------|-----|------------|------|------------|------|-------------|------|----------------|
| | | n | % | n | % | n | % | |
| Total | 835 | 625 | 74,9 | 118 | 14,1 | 92 | 11,1 | |
| Gender | | | | | | | | |
| Male | 347 | 237 | 68,3 | 55 | 15,9 | 55 | 15,9 | 0,001** |
| Female | 488 | 388 | 79,5 | 63 | 12,9 | 37 | 7,6 | |
| Age Groups | | | | | | | | |
| 7-13 years | 235 | 176 | 74,9 | 43 | 18,3 | 16 | 6,8 | 0,056 |
| 14-17 years | 318 | 239 | 75,2 | 41 | 12,9 | 38 | 11,9 | |
| 18-55 years | 282 | 210 | 74,5 | 34 | 12,1 | 38 | 13,5 | |

n: Number, %: Percent, PP: Ponticulus Posticus, **p<0,01

All radiographs were taken using J MORITA (2D Veraviewpocs, MFG corp, Kyoto, Japan) machine. The tube voltage of 65 kV, tube current of 10 mA, and exposure time of 4.9 s. All radiographs were taken according to the manufacturer references.

Evaluation of the radiographs was carried out by a single observer (M.A.) on a computer screen with a screen resolution of 1280×800. The presence of PP in the posterior spine of the atlas vertebra was examined. Each lateral cephalogram was classified in one of three ways: absence of PP (Figure 1), partial PP (Figure 1), or complete PP (Figure 1). To assess intra-observer agreement, 50 randomly selected lateral cephalograms were re-examined by the same author 1 month after the initial review. Intra-observer agreement was excellent (Kappa value of 0.987).

SPSS software version 22 (SPSS Inc., IL, USA) was used for data analysis and descriptive statistics were calculated for the samples. Association between the sex and age of the patient and the presence of PP was evaluated using the Chi-square test.



Figure 1. Evaluation of the presence of PP. (a) Absence, (b) Partial and (c) Completed.

RESULT

The mean age of the samples (488 females and 347 males) was 16.90 ± 5.73 years with a range of 7–55 years. PP was observed in 25.1% of cases, of which 14.1% had partial PP and 11.0% had complete PP (Table 1).

The data indicate that this anomaly is higher among males compared to females. 110 males equally (15.9% of male sample) had partial and complete PP. However, females had partial form of this anomaly in 63 samples (12.9% of female sample) and complete PP in 37 samples (7.6%) (Table 1). These differences were statistically significant ($p < 0.01$) (Table 1).

When evaluated according to age groups, although the probability of complete PP is lower in the 7-13 age groups, no statistically significant difference was found in the distribution of PP among all age groups ($p > 0.05$) (Table 1).

DISCUSSION

PP is an important anatomical variation in head and neck surgery, especially in terms of damage to the vertebral artery. The preoperative evaluation of such anomalies in different populations is of great importance (Gibelli et al., 2016). Therefore, in this study, we investigated the prevalence of PP in lateral cephalometry.

In studies in the literature, the prevalence of PP was mostly investigated in plain radiographs or dry atlas samples (Adisen & Misirlioglu, 2017; Chen et al., 2015). Lateral cephalometric radiography is a diagnostic imaging modality used routinely in clinical orthodontics (Mudit et al., 2014). Despite the wide variation in the shape and size of the PP, it is not noticeable on lateral cephalograms. However, it is very important in terms of cervical pathology. Advanced imaging modalities may be computed tomography (CT) or cone-beam computed tomography (CBCT) scanning to identify the morphological features of PP when diagnosed with lateral cephalometry (Sharma et al., 2010). Therefore, we investigated the prevalence of PP in lateral cephalometric images taken before orthodontic treatment.

In a study evaluating the prevalence of PP in Nepalese orthodontic patients in 2017, it was determined that the prevalence of PP was 35.7%. Complete PP was also found in 4.8% of individuals with PP (Giri et al., 2017). Studies conducted in England (Lamberty & Zivanović, 1973) and Northern Greece (Paraskevas et al., 2005) also reported high rates close to this prevalence. However, there are also studies reporting a lower prevalence of PP (Bayrakdar et al., 2014; Kim et al., 2007; Sharma et al., 2010). In 2 separate studies conducted in 2022, 8% (Di Venere et al., 2022) and 9.8% (Najmuddin, 2022) were

determined. In our study, the prevalence of PP was 25.1%. Although these values we obtained are higher than some studies, they are within the range (4.3%-46.0%) reported in the literature (Falah-Kooshki et al., 2022; Sharma et al., 2010). These differences can be attributed to differences in sample size, age range, imaging modalities, and ethnicities.

In this study, the prevalence of partial and complete PP was found to be 14.1% and 11.0%, respectively. Relatively similar to our study, in the meta-analysis conducted by Pekala et al. (Pekala et al., 2018) in 2018, the partial PP rate was 13.8%, while the full PP rate was 9.3%. In the study of Falah-Kooshki et al. (Falah-Kooshki et al., 2022), these rates were quite high compared to ours (complete and partial PP was 40.2% and 59.8%). In the study of Falah-Kooshki et al. (Falah-Kooshki et al., 2022), the prevalence of PP in lateral cephalometrics was performed on 1000 patients aged 18-25 years. This difference in results is probably due to ethnicity.

The prevalence of PP with respect to gender differs from results in the literature. While the prevalence of PP was found to be higher in males in some studies (Hong et al., 2008; Najmuddin, 2022; Paraskevas et al., 2005; Saleh et al., 2018), it was reported higher in females in some studies (Chitroda et al., 2013; Tambawala et al., 2017). In further studies, it was stated that there was no statistically significant relationship between the gender of the patient and the presence of PP (Chen et al., 2015; Cho, 2009; Falah-Kooshki et al., 2022; Gibelli et al., 2016; Giri et al., 2017). In our study, the prevalence of PP in males (%31.7) was higher than in females (%21.5).

Similarly, the results in the literature on the prevalence of PP in terms of age show differences. Some studies indicate that the full form of PP has the highest prevalence between the ages of 15 and 18 years, while the occurrence of the partial form is much more variable (Gibelli et al., 2016). Some studies have suggested that this anomaly is a result of senile ossification and is more common at older ages (Bayrakdar et al., 2014; Chitroda et al., 2013; Paraskevas et al., 2005). However, there are also studies that did not find a significant difference between chronological age and PP (Chen et al., 2015; Geist et al., 2014; Schilling et al., 2010). Consistent with these studies, the PP appears in childhood, but progression with age is not associated with increased calcification (Di Venere et al., 2022).

Studies in the literature have reported that PP is associated with migraine, chronic tension-type headache, and nevoid basal cell carcinoma syndrome (Friedrich, 2014; Leonardi et al., 2010). In addition, it was emphasized that the presence of this anomaly should be investigated for complications before the placement of a lateral mass screw in the first cervical vertebra (Elliott & Tanweer, 2014). Therefore, if this anomaly is detected in the lateral cephalogram, it should be added to the patient's health record for future reference.

The current research has some limitations. The lateral cephalogram is a useful screening tool for the detection of PP. However, the prevalence of PP has been found to be higher in three-dimensional CT/CBCT studies (Adisen & Misirlioglu, 2017). Because of these results, it is predicted that planar radiographs are insufficient (Geist et al., 2014). In addition, lateral cephalometrics cannot diagnose whether PP is bilateral or unilateral (Bayrakdar et al., 2014). Therefore, it could not be determined whether it was unilateral or bilateral in this study.

CONCLUSION

In conclusion, PP is not an uncommon finding and is more common in males. The importance of cervical spine surgical procedures, particularly in treatment modalities that require lateral mass screw placement in the atlas, means that radiologists and dentists in general need to closely examine the vertebral region. If such an abnormality is detected or suspected, it should be recorded on the patient's health chart and specialist referral sought. A three-dimensional radiography via CT or CBCT scanning can be used to confirm further details if needed, such as size, morphology, type, unilateral/bilaterality of the PP.

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Conflict of Interest

The authors report no actual or potential conflicts of interest.

Author Contributions

Plan, design: G.M. Material, methods and data collection: G.M., M.A. Data analysis and comments: G.M., M.A. Writing and corrections: G.M., M.A.

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