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Pneumatized Articular Tubercle in Northeastern Population of Iran (Using Panoramic Radiography)

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ABSTRACT

Objective: This study tended to evaluate the frequency and features of pneumatized articular tubercle (PAT) in a selected Iranian population using panoramic radiography.
Methods & Materials: 3000 digital panoramic radiographs of 1582 women and 1418 men were evaluated. Chi square and Shapiro-Wilk tests were used for statistical analysis.
Results: PAT frequency was 2.7%. PAT was found in 42 men and 40 women aged 14.9 ± 3.28 years, ranging from 2 to 70. There was no significant difference in presence of PAT between two sexes (p=0.825). Unilateral type (77%) was more frequent than bilateral type (23%) with a ratio of 3.34:1. The results showed that 43 cases had unilocular and 39 cases had multilocular internal structure; there was no significant difference between their frequencies (p=0.659). There was a significant relationship between unilateral or bilateral and internal structure of defect (p=0.009).
Conclusion: Unlike many anatomical variations which occur bilaterally and symmetrically, unilateral PAT was more frequent in the studied Iranian population. This could make it more difficult for physicians to diagnose. On the other hand, lack of proper knowledge of PAT may lead to unnecessary referrals or unwanted complications during surgery. Therefore, accurate examination of panoramic images and CBCT images can prevent the occurrence of unwanted complications, which are sometimes hazardous to the patient life.

Key words: Panoramic radiography, Pneumatization, Articular tubercle, Defect, Iranian population

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INTRODUCTION

Pneumatization refers to propagation of air-filled cavities in bone [1]. In addition to paranasal sinuses and multiple areas in the skull [2], ten points have been identified in temporal bone, in which lateral air cells may be found; one of these points is zygomatic process [1,3]. These air cells may be single or cluster [2,4]. These cells are visible in panoramic radiographs and there are numerous studies in relation to radiographic diagnostic methods [2,5-9]. The internal structure of PAT is divided into unilocular and multilocular based on panoramic radiographic view [10].

Using panoramic radiography, Tyndall et al. evaluated the pneumatized articular eminence in 1061 patients. PAT prevalence was 2.6%. This study considers panoramic radiography as an effective way to show articular eminence and PAT [5].

Kaugars et al. investigated 784 panoramic radiographs for examining the presence of PAT through a retrospective study. This study recommends pre-operative tomography to evaluate PAT extent [11].

A case study was published by Stoopler et al., in which multilocular radiolucency was observed in the right articular eminence in panoramic radiography considered as PAT [8].

Another study concluded that, contrary to what was thought in studies, pneumatization of minor cavities

begins before puberty. Moreover, awareness of these structures helps to accurately interpret panoramic radiographic images and differential diagnosis of pathological changes in the area [12].

Yavuz et al. suggested that temporal bone fractures in the presence of PAT can occur more easily than when the defect does not exist [7].

Miloglu et al. evaluated the prevalence and features of PAT using CBCT and reported that in patients requiring surgery, CBCT is recommended as a supplement to panoramic images [13].

Panoramic radiography and Trans-maxilla or trans-orbital radiography is useful to show PAT. In recent studies, computed tomography (CT) and CBCT have been considered as selective methods for evaluating bone structures and air cells in the skull [13-15]. Due to low cost, ease of use, wide access, low radiation dose and a good view of articular eminence, panoramic radiography is considered as the primary method for diagnosis of PAT [16,17].

MATERIALS AND METHODS

In this study, 3000 digital panoramic radiographs available in the Department of Oral and Maxillofacial Radiology, School of Dentistry, Mashhad University of Medical Sciences (in northeastern Iran), from 2014 to 2016, were randomly selected and evaluated. All radiographs were taken using the RAYSCAN Alpha panoramic device (RAY Co., 332.7 Samsung 1-ro, Hwaseong-si, Gyeonggi-do, 18380, Korea) at 72 kvp and 10 mA. All images were evaluated in a dim room on a Flat panel monitor 2011H (Dell, Round Rock Tx, China), 20 inches with a resolution of 1600 × 900 pixels. The cases where zygomatic process was not clearly visible due to technical error or anatomical superimpositions or there was a history of fractures, trauma or maxillofacial anomalies were excluded. The presence of PAT was confirmed in the presence of pneumatization or observation of a unilocular or multilocular radiolucent defect (similar to mastoid air cells) with a definite, non-degenerative articular tubercle, located entirely posterior to the zygomaticotemporal suture. The presence of PAT, unilateral or bilateral involvement, and unilocular or multilocular internal structure of it were identified in terms of age and sex by a dentistry student and confirmed by an oral and maxillofacial radiologist (Figures 1-4).

SPSS software (version 19) was used for statistical analysis. Shapiro–Wilk test and chi-square tests were used to analyze the data. In all tests the significance level of 5% was assumed.

In this study, no intervention was done and only panoramic radiographs available in archives of the radiology department were used. This research project was approved by the Regional Ethics Committee for Medical Research.

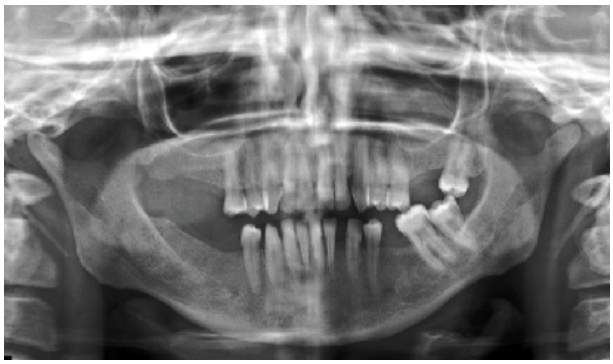

Figure 1: Unilateral unilocular PAT of temporal bone

Figure 2: Unilateral multilocular PAT of temporal bone

Figure 3: Bilateral unilocular PAT of temporal bone

Figure 4: Bilateral multilocular PAT of temporal bone

RESULTS

Panoramic radiography images of 3,000 people, including 1582 women (52.7%) and 1418 men (47.3%), were studied. Of these, 82 cases of PAT (pneumatized

articular tubercle) were observed in radiographs. These 82 cases belonged to 42 men (51.2%) with a mean age of 28 ± 13.13 and 40 women (48.8%) with a mean age of 28.5 ± 16.7 years. The mean age of all people with defect, regardless of sex, was 28.3 ± 14.9 (2 to 70 years old). In these cases, unilateral or bilateral PAT, the side involved with PAT in unilateral cases and internal structure (multi- or unilocular defect) were investigated. Assuming that the studied population is an example of total number of patients referring to the Department of Radiology, the results were analyzed. First, normal distribution of age data was investigated using the Shapiro-Wilk test; it was determined that data distribution does not follow the normal distribution.

The highest frequency of PAT was observed in people younger than 20 years old (Figure 5).

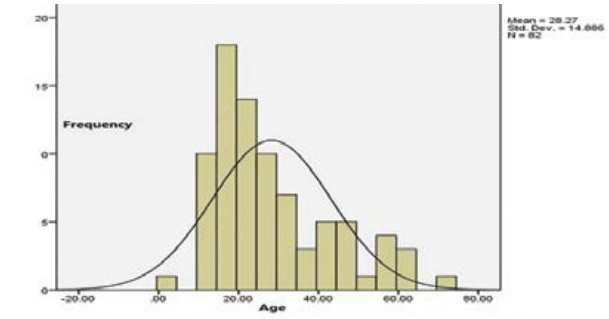

Figure 5: Histogram of age of cases with PAT

Sex

PAT was observed in 42 men (51.2%) and 40 women (48.8%). According to Chi-square test, there was no significant difference between men and women in terms of presence of PAT (p=0.825).

Unilateral and bilateral defect

PAT was unilateral in 63 cases (76.8%) and bilateral in 19 cases (23.2%). According to Chi-square test, there was a significant difference in frequency of unilateral and bilateral cases (p<0.001).

Side engaged in unilateral cases

Out of 63 unilateral defects, 17 cases (27%) were on the right side and 46 cases (73%) were on the left side. In unilateral defects, according to the Chi-square test, frequency of left defects was significantly higher than the right side (p<0.001).

Defect structure

In 43 cases (52.4%), this defect was unilocular and multilocular in 39 (47.6%) cases. According to Chi-square test, there was no significant difference between frequency of unilocular and multilocular defects (p=0.659).

In the group with unilateral defect, 33 cases (52.4%) were male and 30 cases (47.6%) were female. In the group with bilateral defect, 9 cases (47.4%) were male and 10 cases (52.6%) were female. According to chi-square test, there was no significant relationship between unilateral or bilateral defect and sex (p=0.702).

The relationship between unilateral or bilateral defect and its structure

In the group with unilateral defect, 38 cases (60.3%) had unilocular defect and 25 cases (39.7%) had multilocular defect. In the group with bilateral defect, 5 cases (26.3%) had unilocular defect and 14 cases (73.7%) had multilocular defect. frequency of unilocular structure was higher in unilateral cases, while frequency of multilocular structure was higher in bilateral cases. According to chi-square test, there was a significant relationship between unilateral or bilateral defect and its structure (p=0.009).

The relationship between the side with PAT in people with unilateral defect and sex

In men with unilateral PAT, the defect was on the right side in 5 cases (15.2%) and on the left side in 28 cases (84.8%). In women with unilateral defect, however, the defect was on the right side in 12 cases (40%) and on the left side in 18 cases (60%). Therefore, there was a significant relationship between the side with PAT and sex (p=0.026).

The relationship between defect structure (unilocular and multilocular) and sex

22 cases (52.4%) of unilocular defect and 20 cases (47.6%) of multilocular defect were observed in men. In women, 21 cases (52.5%) of unilocular defect and 19 cases (47.5%) of multilocular defect were observed. Therefore, there was no significant relationship between defect structure and gender (p=0.991).

The relationship between PAT structure (unilocular or multilocular) and the side with defect in people with unilateral defect

In the right side, 11 cases (64.7%) had unilocular defect and 6 cases (35.3%) had multilocular defect. In the left side, however, 27 cases (58.7%) had unilocular defect and 19 cases (41.3%) had multilocular defect. Based on Chi-square test, there was no significant relationship between unilocular or multilocular defect and the side involved (p=0.665).

DISCUSSION

The growth of air cells prior to formation of bone cavity is a natural physiological process associated with perieosteal activity [15].

Diagnosis of PAT is important because this defect facilitates the spread of various pathologies including tumor, inflammation and fractures to the joint due to decreased bone resistance. In cases requiring articular eminence surgery, PAT may complicate the condition [18].

PAT may be considered as spread of mastoid air cells. Bronoosh et al. showed that the presence of PAT is significantly correlated with higher levels of pneumatization in other parts of the temporal bone, particularly petrous apex [19].

Panoramic radiography is a useful tool for detecting PAT. In recent studies, computed tomography (CT) and CBCT have been considered as selective method for evaluating bone structures and air cells in the skull [13,15]. Due to low cost, ease of use, wide access, low radiation dose and a good view of articular eminence, panoramic radiography is considered as the primary method for diagnosis of PAT [16,17].

Several studies using panoramic radiography have reported the frequency of PAT between 1% and 2.6% [7,12,17,19,20], which is consistent with our findings. PAT frequency was estimated at <5% in studies using panoramic radiography. The only exception was two studies [2,13], reporting >5% frequency of PAT in panoramic images. The reason for the difference in results of these two studies with the present study may be related to their smaller sample sizes (about 1/2 and 1/4 of our sample size, respectively).

Studies using CBCT images have reported 5%-51.8% frequency of PAT [10,14,15,17,19]. The higher frequency of PAT in these studies may be due to CBCT technique, which allows three-dimensional analysis. CBCT application provides more detail due to display of medial part of articular eminence and may increase the percentage of PAT diagnosis [14].

But two other studies [2,17] estimated PAT frequency in CBCT images in the range of results from panoramic images. In these studies, the mean frequency of PAT observation was slightly more than panoramic images. CBCT may be better than panoramic radiography only in diagnosis of small, non-clinically significant, air cells.

Some studies [21-24] have indicated a higher frequency of PAT in patients with temporomandibular joint disorder (TMD) and malocclusion compared to normal population.

In the present study, the mean age of subjects with PAT was 28.3 ± 14.9 years and the highest frequency of PAT was observed in subjects younger than 20 years. The mean age of subjects with PAT in other studies is between 30 and 48 years [5,12,14,15,20]. The reason for the high mean age of subjects with PAT in these studies is that children were excluded with the explanation that PAT occurs only after puberty [13,14,16]. Pneumatization of mastoid process is often completed at the age of five, but air cells may continue to expand until puberty. The age at which pneumatization of air cells occurs in the articular region remains unknown, although studies have shown that pneumatization of accessory air cells can begin before puberty [10].

In the present study, the youngest person with PAT was 2 years old. The age of the youngest person with PAT in other studies [6,7,14,15,20,25,26] was 4-11 years old, confirming that pneumatization of accessory air cells can begin before puberty.

In the present study, the age range of patients with PAT was 2 to 70 years, indicating wide range of age in PAT involvement. Similarly, other studies also reported a large age range [6,10,13-16].

The previous studies reported a mean ratio of women to men with PAT at 1.1:1 [7,13,26] that is in accordance with our findings (0.95:1). Moreover, there was no significant difference between men and women in terms of PAT. This result was similar to other studies [2,7,10,15-17,21,25,26]. Unlike the current study, İlgüy et al. reported a higher prevalence of PAT in women (73.6%) than men (51.3%) (1.43:1) [14]; this difference may be due to the difference in imaging used (CBCT), difference in the population studied and difference in the sample size.

Different studies have reported the ratio of unilateral PAT involvement to bilateral involvement at 2.4:1, on average [2,5,7,13,15,20]. In the present study, frequency of unilateral PAT (77%) was significantly more than bilateral type (23%) and the ratio of unilateral involvement to bilateral involvement was estimated at 3.34:1, which is consistent with above studies.

The results of this study indicated that frequency of left-sided lesions (73%) was statistically higher than the right side (27%) in cases of unilateral involvement. The results of various studies are contradictory in this regard [7,20,27].

In the present study, there was no significant difference between the frequency of unilocular and multilocular defects. Consistent with this study, Miloglu et al. [13] and Shokri et al. [15] reported no significant difference between the frequency of unilocular and multilocular defects. In terms of pneumatization structure, most researchers reported almost identical distribution of unilocular and multilocular defects [7,16,20]. Except Ladeira et al. [17] and İlgüy et al. [14], reported the prevalence of multilocular defect (98.7% and 86.1%) was higher [17]. The reason for the difference in these studies with current study may be due to differences in the technique used, the difference in sample size, the difference in the population studied, or the difference between the observers [14].

LIMITATIONS

Panoramic radiography has limitations such as superimposition of adjacent structures, distortion and low resolution. CBCT has overcome superimposition and therefore it is an ideal imaging modality for evaluating skull base airspace.

IMPLICATIONS

1. Due to higher accuracy of CT scan images and CBCT compared to panoramic imaging, future studies are suggested to use these imaging modalities in PAT evaluation, particularly for three-dimensional analysis of mediolateral and buccolingual dimensions.

2. Some studies have indicated a higher incidence of PAT in patients with TMD. The design and implementation of longitudinal studies is recommended to investigate this.

CONCLUSION

Unlike many anatomical variations which occur bilaterally and symmetrically, the frequency of unilateral PAT is greater in the Iranian population, making it more difficult for doctors to diagnose. Moreover, incorrect diagnosis of PAT can lead to unnecessary referrals and unwanted complications during surgery.

CONFLICT OF INTEREST

Authors declare there is no conflict.

REFERENCES

1. Tremble GE. Pneumatization of the temporal bone. Arch Otolaryngol 1934; 19:172-82.
2. Orhan K, Delilbasi C, Orhan AI. Radiographic evaluation of pneumatized articular eminence in a group of Turkish children. Dentomaxillofac Radiol 2006; 35:365-70.
3. Allam AF. V pneumatization of the temporal bone. Ann Otol Rhinol Laryngol 1969; 78:49-64.
4. Hollinshead WH. Anatomy for surgeons: Volume 1-The head and neck. LWW 1968.
5. Tyndall D, Matteson S. Radiographic appearance and population distribution of the pneumatized articular eminence of the temporal bone. J Oral Maxillofac Surg 1985; 43:493-7.
6. Carter L, Haller A, Calamel A, et al. Zygomatic air cell defect (ZACD). Prevalence and characteristics in a dental clinic outpatient population. Dentomaxillofac Radiol 1999; 28:116-22.
7. Yavuz MS, Aras MH, Güngör H, et al. Prevalence of the pneumatized articular eminence in the temporal bone. J Craniomaxillofac Surg 2009; 37:137-9.
8. Stoopler ET, Pinto AA, Stanton DC, et al. Extensive pneumatization of the temporal bone and articular eminence: An incidental finding in a patient with facial pain. Case report and review of literature. Quintessence Int 2003; 34:211.
9. Koudstaal M, van der Wal K. A radiolucency in the articular eminence of the temporal bone: An air bubble? Ned Tijdschr Tandheelkd 2003; 110:193-4.
10. Mosavat F, Ahmadi A. Pneumatized articular tubercle and pneumatized roof of glenoid fossa on cone beam computed tomography: Prevalence and characteristics in selected Iranian population. J Dentomaxillofacial Radiol Pathol Surg 2015; 4:10-4.
11. Kaugars GE, Mercuri LG, Laskin DM. Pneumatization of the articular eminence of the temporal bone: prevalence, development, and surgical treatment. J Am Dent Assoc 1986; 113:55-7.
12. Shetty SR, Al PSAAF, Bayati M, et al. Zygomatic air cell defect-A brief review. AMAJ 2016; 1:89-92
13. Miloglu O, Yilmaz A, Yildirim E, et al. Pneumatization of the articular eminence on cone beam computed tomography: Prevalence, characteristics and a review of the literature. Dentomaxillofac Radiol 2011; 40:110-4.
14. İlgüy M, Dölekoğlu S, Fişekçioğlu E, et al. Evaluation of pneumatization in the articular eminence and roof of the glenoid fossa with cone-beam computed tomography. Balkan Med J 2015; 32:64.
15. Shokri A, Noruzi-Gangachin M, Baharvand M, et al. Prevalence and characteristics of pneumatized articular tubercle: First large series in Iranian people. Imaging Sci Dent 2013; 43:283-7.
16. Khojastepour L, Mirbeigi S, Ezoddini F, et al. Pneumatized articular eminence and assessment of its prevalence and features on panoramic radiographs. J Dent (Tehran) 2015; 12:235.
17. Ladeira DB, Barbosa GL, Nascimento MC, et al. Prevalence and characteristics of pneumatization of the temporal bone evaluated by cone beam computed tomography. Int J Oral Maxillofac Surg 2013; 42:771-5.
18. de Rezende Barbosa GL, Nascimento Mdo C, Ladeira DB, et al. Accuracy of digital panoramic radiography in the diagnosis of temporal bone pneumatization: A study in vivo using cone-beam-computed tomography. J Craniomaxillofac Surg 2014; 42:477-81.
19. Bronoosh P, Shakibafard A, Mokhtare MR, et al. Temporal bone pneumatisation: A computed tomography study of pneumatized articular tubercle. Clinical radiology Clin Radiol 2014; 69:151-6.
20. Orhan K, Delilbasi C, Cebeci I, et al. Prevalence and variations of pneumatized articular eminence: A study from Turkey. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2005; 99:349-54.
21. Groell R, Fleischmann B. The pneumatic spaces of the temporal bone: Relationship to the temporomandibular joint. Dentomaxillofac Radiol 1999; 28:69-72.

22. Friedrich RE, Viezens L, Grzyska U. Pneumatization of the zygomatic process of temporal bone on computed tomograms. GMS Interdiscip Plast Reconstr Surg DGPW 2016; 5:Doc16.
23. Gupta D, Rashmi NC, Sheikh S, et al. The prevalence, radiographic appearance, and characteristics of zygomatic air cell defects (ZACDs) in symptomatic temporomandibular joint disorder patients in North Indian population. Oral Maxillofac Surg 2014; 18:453.
24. Orhan K, Ulas O, Orhan AI, et al. Investigation of pneumatized articular eminence in orthodontic malocclusions. Orthod Craniofac Res 2010; 13:56–60.
25. Gupta D, Sheikh S, Pallagatti S, et al. Zygomatic air cell defect: A panoramic radiographic study of a North Indian population. J Investig Clin Dent 2013; 4:247-51.
26. Hofmann T, Friedrich RE, Wedl JS, et al. Pneumatization of the zygomatic arch on pantomography. Mund Kiefer Gesichtschir: MKG 2001; 5:173-9.
27. Jadhav AB, Fellows D, Hand AR, et al. Classification and volumetric analysis of temporal bone pneumatization using cone beam computed tomography. Oral Surg Oral Med Oral Pathol Oral Radiol 2014; 117:376-84.