Mini Review

DOI: 10.5455/amaj.2016.03.027

Zygomatic Air Cell Defect – a Brief Review

Shishir Ram Shetty, MD, PhD[1]
Sura Ali Ahmed Foud Al-Bayati, MD, PhD [2]
Shakeel Santerbennur Khazi, MD [3]
Sesha Manchala Reddy, MD [3]

The aim of this paper was to analyst the literature published in the research related to zygomatic air cell defect. An internet search using keyword Zygomatic air cell defect was used to obtain details of the published literature in this research area from 1985 to 2016. The data available in the articles were analyzed in terms of ethnicity, prevalence, occurrence (unilateral/bilateral) and gender distribution.

Keywords: Zygomatic air cell defect, prevalence, imaging.

[1] Assistant Professor, Department of Oral Medicine and Radiology, College of Dentistry, Gulf Medical University, Ajman, United Arab Emirates.

[2] Associate Dean and Head of the Department of Oral Medicine and Radiology, College of Dentistry, Gulf Medical University, Ajman, United Arab Emirates.

[3] Department of Periodontics, College of Dentistry, Gulf Medical University Ajman, United Arab Emirates

Correspondence:
Shishir Ram Shetty, MD, PhD,
Assistant Professor, Department of Oral Medicine and Radiology, College of Dentistry, Gulf Medical University, Ajman, United Arab Emirates.
email: drshishirshettyomr@yahoo.com
Phone: + 91 9986221047

Introduction

Zygomatic Air Cell Defect (ZACD) previously referred to as pneumatised articular eminence, it refers to the formation asymptomatic of air filled cavity within the bone. [1] These are accessory cells in the zygomatic process and articular eminence of the temporal do not extend further anteriorly than the zygomatico-temporal suture. [2] The other synonym is called Pneumatised Articular eminence (PAT) was coined by Tyndall and Matteson in the year 1985. [2]

It is believed that the pneumatisation of the bone occurs as a result of opportunistic epithelial expansion into the bone.[3] Mastoid air cells commonly undergo pneumatisation but sometimes accessory air cells develop in the other locations of temporal bone like the zygomatic arch region.[4]

Clinical importance of the zygomatic air cell defect

The ZACDs are located in close proximity to the temporo-mandibular joint TMJ and hence provide a path of least resistance to various pathologies of the joint such as fractures even with minor trauma, inflammation and tumors.[5,6] With recent advances in implants, long zygomatic implants are sometimes used as partial or complete alternative to maxillary bone augmentation procedures.[7] Zygomatic bone is surgically manipulated in esthetic contouring procedures which is popular in Asian population. [8] The air cells are believed to play an important role in the development of temporal acoustic dissipation, protection from external trauma, and minimizes of the skull mass.[9] Another important clinical factor is that the ZACDs must be differentiated from pathologies like aneurysmal bone cyst and central hemangioma of the zygomatic region because they mimic the features of these pathologies as all these lesions needs special concern but in different ways.[4,10]

Al Faleh et al stated that ZACD causes increased fragility of temporo-mandibular joint by structurally weakening the roof of glenoid fossa due to pneumatisation. They also stated that in such cases any massive to the jaws leads to the impingement of the head of the condyle into the middle cranial fossa.[11]

Studies involving zygomatic air cell defect

Studies involving zygomatic air cell defect have been conducted using different imaging modalities over the years also taking into consideration occurrence (unilateral/bilateral) and gender distribution.[12-27] (Table1)

Table 1. Showing prevalence rates, gender distribution, occurrence (unilateral/bilateral) and imaging modalities used in different studies on ZACD.

Researchers and year	Sample size	Prevalence	Male	Female	Unilateral cases	Bilateral cases	Imaging modality
Tyndall & Matteson 1985 [13]	1061	28 (2.6%)	13	15	23	5	Panoramic radiography
Kaugars et al 1986 [5]	784	8 (1%)	1	7	4	4	Panoramic radiography
Carter et al 1999 [14]	2734	40 (1.5%)	20	20	32	8	Panoramic radiography
Hofmman et al 2001 [15]	1084	20 (1.8%)	9	11	16	4	Panoramic radiography
Orhan et al 2005 [16]	1006	19 (1.9%)	7	12	12	7	Panoramic radiography
Orhan et al 2006 [17]	1049	17 (1.62%)	9	8	10	7	Panoramic radiography
Yavus et al 2009 [18]	8107	83 (1.03%)	42	41	56	27	Panoramic radiography
Orhan et al 2010 [19]	1405	48 (3.42%)	12	36	32	16	Panoramic radiography
Miloglu et al 2011 [20]	514	41 (8%)	16	25	31	10	Cone beam CT
Zamaninaser A et al 2012 [4]	2600	94 (3.6%)	35	59	70	24	Panoramic radiography
Ladeira et al 2013 [21]	658	140 (21.3%)	-	-	76	64	Cone beam CT
Shokri et al 2013 [12]	1563	98 (6.2%)	33	65	64	34	Panoramic radiography
Srivathsa et al 2014 [22]	1688	50 (2.96%)	23	27	38	12	Panoramic radiography
Arora et al 2014 [23]	600	19 (3.16%)	6	13	9	10	Panoramic radiography
Khojastepour et al [24]	3098	64 (2.1%)	23	41	40	24	Panoramic radiography
Ribeiro-Nascimento et al 2015 [3]	698	23 (3.3%)	13	10	7	16	Cone beam CT
Mosavat et al 2015 [25]	239	51 (21.3%)	25	26	35	16	Cone beam CT
İlgüy et al 2015 [26]	111	73 (65.8%)	19	54	31	42	Cone beam CT
Arora et al 2016 [27]	6825	133 (1.94%)	84	49	112	21	Panoramic radiography

CT - Computed Tomography

Prevalence of zygomatic air cell defect

A wide variation of the prevalence rates of zygomatic air cell defect have been observed ranging from as low as 1% (Kaugars et al 1985) to as high as as 65.8% (İlgüy et al 2015) [5,26]. However most of the researchers who evaluated the ZACD using the panoramic radiograph have found prevalence rates lower than 5%.[5,13-19,22-24,27] only one study conducted by Shokri et al in 2013 using panoramic radiography stated a prevalence rate of 6.2%.[12]. In contrast most of the studies using the cone beam computed tomography (CBCT) have reported higher prevalence rates.[20,21,25,26] however only one study by Ribeiro-Nascimento et al (2015) using CBCT has reported lower prevalence rate of 3.3%.[3] Prevalence rate as high as 68.5% also have been reported in studies conducted using CBCT.[26]

Gender variation in the occurrence of ZACD

Most of the studies have reported of a higher rate of occurrence in the female study subjects when compared to male study, however the difference have not been statistically significant in many of these studies.[5,12,13,15,16,19,20,22-24,26] Some studies have reported no gender predilection between male and female study subjects.[14,17,18,25] However very few studies have shown a higher male predilection.[27]

Occurrence of ZACD (unilateral/bilateral)

In majority of the studies the occurrence of ZACD was unilateral.[13-27]. Equal number of unilateral and bilateral occurrence have been reported rarely.[5]

Ethnicity and occurrence of ZACD

Although studies on ZACD have been conducted at many countries most of the published literature originates from population based studies from Iran [4,12,24,25], Turkey [16,17,18,19,20] India [22,23,27], USA[5,13, 14], Brazil [3,21], Germany [15]. the prevalence rates of ZACD was observed to more in studies conducted on the Iranian, Turkish and American population when compared to Indian population, however it is to be noted that most of the recent studies on the later population has been conducted with CBCT therefore more prevalence was observed owing to better visualization of the ZACD.[26,25]

Imaging modality used to asses ZACD

Majority of the studies published before 2010 have been carried out using panoramic radiography.[13,16,19]. However after 2010 researchers have preferred using cone beam computed tomography for their research.[3,20,21,25] The increased use of CBCT by the researchers could be attributed to its higher diagnostic accuracy compared to panoramic radiography especially in areas like the medial portion of the articular eminence.[28] Panoramic radiographs present with disadvantages like superimposition of adjacent structure, distortion, and low resolution. CBCT overcomes the superimposition problem thus is an ideal imaging modality for the assessment of air spaces in the skull base.[20]

With recent advances in the imaging modalities it would be easier to detect the presence of ZACD and differentiate it from other pathologies which may have similar radiographic features thus preventing unnecessary surgical intervention as demonstrated in few published cases.[29]

References

1. Tremble GJ. Pneumatization of the temporal bone. Arch Otolaryngol 1934;19(2):172-182.
2. Tyndall D, Matteson S. The appearance of the zygomatic air cell defect (ZACD) on panoramic radiographs. Oral Surg Oral Med Oral Pathol 1987;64:373-376.
3. Ribeiro-Nascimento HA, Guedes-Visconti MA, Silva Macedo PT, Haiter Neto F· Freitas DQ. Evaluation of the zygomatic bone by cone beam computed tomography. Surg Radiol Anat (2015) 37:55–60.
4. Zamaninaser A, Rashidipoor R, Mosavat F, Ahmadi A. Prevalence of zygomatic air cell defect: Panoramic radiographic study of a selected Esfehanian population. Dent Res J 2012;9:S63-8.
5. 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; 113:55–57
6. Ladeira DBS, Barbosa GLR, Nascimento MCC, Cruz AD, Freitas DQ, Almeida SM. Prevalence and characteristics of pneumatisation of the temporal bone evaluated by cone beam computed tomography. Int J Oral Maxillofac Surg 2013;42:771–775.
7. Esposito M, Worthington HV. Interventions for replacing missing teeth: dental implants in zygomatic bone for the rehabilitation of the severely deficient edentulous maxilla. Cochrane Database Syst Rev. 2013 doi:10.1002/14651858.
8. Zou C, Niu F, Liu J, Chen Y, Wang M, Su R, Xu J, An G, Gui L. Midface contour change after reduction malarplasty with a modified L-shaped osteotomy: a surgical outcomes study. Aesthetic Plast Surg. 2014 doi:10.1007/s00266-013-0239-5.
9. Balzeau A, Herve GD. Cranial base morphology and temporal bone pneumatization in Asian Homo erectus. J Hum Evol 2006;51:350-9.
10. Park YH, Lee SK, Park BH, Son HS, Choi M, Choi KS. Radiographic evaluation of the zygomatic air cell defect. Oral and Maxillofac Radiol 2002;32:207-11.
11. Al-Faleh W, Ekram M. A tomographic study of air cell pneumatization of the temporal components of the TMJ in patients with temporomandibular joint disorders. about10 p. Available from: http://iadr.confex.com/iadr/saudi06/preliminaryprogram/ abstract_87138.htm. [Last accessed on 2011 Oct 12].
12. Shokri A, Noruzi-Gangachin M, Baharvand M, Hamed Mortazavi H. Prevalence and characteristics of pneumatized articular tubercle: First large series in Iranian people. Imaging Science in Dentistry 2013; 43: 283-7.
13. Tyndall DA, Matteson SR. Radiographic appearance and population distribution of the pneumatized articular eminence of the temporal bone. J Oral Maxillofac Surg 1985; 43: 493-7.
14. Carter LC, Haller AD, Calamel AD, Pfaffenbach AC. Zygomatic air cell defect (ZACD). Prevalence and characteristics in a dental clinic outpatient population. Dentomaxillofac Radiol 1999; 28: 116-22.
15. Hofmann T, Friedrich RE, Wedl JS, Schmelzle R. Pneumatization of the zygomatic arch on pantomography. Mund Kiefer Gesichtschir 2001; 5: 173-9.
16. Orhan K, Delilbasi C, Cebeci I, Paksoy C. Prevalence and variations of pneumatized articular eminence: a study from Turkey. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2005; 99:349-54.
17. Orhan K, Delilbasi C, Orhan AI. Radiographic evaluation of pneumatized articular eminence in a group of Turkish children. Dentomaxillofac Radiol 2006; 35: 365-70.
18. Yavuz MS, Aras MH, Güngör H, Büyükkurt MC. Prevalence of the pneumatized articular eminence in the temporal bone. J Craniomaxillofac Surg 2009; 37: 137-9.
19. Orhan K, Oz U, Orhan AI, Ulker AE, Delilbasi C, Akcam O. Investigation of pneumatized articular eminence in orthodontic malocclusions. Orthod Craniofac Res. 2010;13:56-60
20. Miloglu O, Yilmaz AB, Yildirim E, Akgul HM. Pneumatization of the articular eminence on cone beam computed tomography: prevalence, characteristics and a review of the literature. Dentomaxillofac Radiol 2011; 40: 110-4.

21. Ladeira DB, Barbosa GL, Nascimento MC, Cruz AD, Freitas DQ, Almeida SM. Prevalence and characteristics of pneumatisation of the temporal bone evaluated by cone beam computed tomography. Int J Oral Maxillofac Surg 2013; 42: 771-5.
22. Srivathsa SH, Malleshi SN, Patil K, Guledgud MV. A retrospective study of panoramic radiographs for zygomatic air cell defect in children. S J Oral Sci 2014;1(2):79-82.
23. Arora KS, Binjoo N, Negi LS, Modgil R , Sareen M , Kaur P , Mohapatra S. Zygomatic Air Cell Defect: A Panoramic Radiographic Study Of Population Of Jaipur And Surrounding Areas. J Oral Maxillofac Pathol Med 2014; 1(1):28-30.
24. Khojastepour L, Mirbeigi S, Ezoddini F, Zeighami N. Pneumatized Articular Eminence and Assessment of Its Prevalence and Features on Panoramic Radiographs Journal of Dentistry, Tehran University of Medical Sciences, Tehran, Iran 2015; 12(4): 235-242.
25. 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. Journal of Dentomaxillofacial Radiology, Pathology and Surgery 2015; 4(3): 10-14.
26. İlgüy M, Dölekoğlu S, Fişekçioğlu E, Ersan N, İlgüy D. Evaluation of Pneumatization in the Articular Eminence and Roof of the Glenoid Fossa with Cone-Beam Computed Tomography Balkan Med J 2015;32:64-8
27. Arora KS, Kaur P, Kaur K. ZACD: A Retrograde Panoramic Analysis among Indian Population with New System of Classification. JCDR 2016; 10(1): ZC71-ZC73.
28. Hasnaini M, Ng SY. Extensive temporal bone pneumatization: incidental finding in a patient with TMJ dysfunction. Dent Update 2000 May;27(4):187-9.
29. Romano-Sousa, E Garritano-Papa E. Romano-Sousa C M, Garritano-Papa E. Pneumatization of the temporal portion of the zygomatic arch: The contribution of computed tomography to the reconstruction in volumetric two-dimensional and three-dimensional, with the aid of image rendering protocols. Indian J Dent Res 2015;26:324-7