ISSN- O: 2458 - 868X, ISSN–P: 2458 – 8687
Index Copernicus Value: 68 . 16
PubMed - National Library of Medicine - ID: 101731606

International Journal of Medical Science and Innovative Research (*IJMSIR*)

IJMSIR : A Medical Publication Hub

Available Online at: www.ijmsir.com

Volume – 4, Issue – 3, June - 2019, Page No. : 156 – 161

Evaluation of Anatomical Variations of Paranasal Sinuses Using Cone Beam Computed Tomography - A Retrospective Study

[1]M. Amala, MDS, Department of Oral Medicine and Radiology, Meenakshi Ammal Dental College & Hospital, Chennai

[2]K.Saraswathi Gopal, HOD, Department of Oral Medicine and Radiology, Meenakshi Ammal Dental College & Hospital, Chennai

Corresponding Author: M. Amala**,** Department of Oral Medicine And Radiology, Meenakshi Ammal Dental College & Hospital, Chennai

Type of Publication: Original Research Paper

Conflicts of Interest: Nil

Abstract

Aim: The aim of this study is to evaluate anatomical variations of nasal cavity and paranasal sinuses the incidence of Onodi cells, Agger Nasi Cells, Kuhn Cells And Haller Cells and to determine the relationship of these variations with age, side and gender of an individual.

using cone beam computed tomography (CBCT), which is currently used in dental radiology.

Objectives: To evaluate the frequency and relationship of these variants to age and sex.To facilitate surgical planning in patients undergoing endonasal procedure.To aid in diagnosis of facial pain and headache.

Material And Methods: This retrospective study consists of 100 Adult CBCT images of 50 males and 50 females, who were listed for Implant retained Prosthesis and temperomandibular joint disorder. Radiographic assessment of paranasal sinuses including aggernasi cells, Kuhn cells, ondoi cells and haller cells were accurately characterized using customized planmeca romexis software. Age group of 18-60 years were included and Images with gross artifacts, images of trauma and nasal surgery were excluded.

Result: This study showed highly significant results in prevalence of different type of cells. There is no correlation between age and gender. Conclusion: Different anatomical variants may often be found in paranasal sinus region and CBCT imaging is the modality of choice to evaluate these variants since conventional radiographs do not provide adequate information because of structural superimposition. These variants may determinate contact points between nasal structures stimulating **"trigger" points** and determining **facial pain crisis.** Identification of these variants plays an important role while guiding the surgeons preoperatively and preventing iatrogenic complications.

Keywords: Cone Beam Computed Tomography, sinuses, Onodi Cells, Agger Nasi Cells, Kuhn Cells And Haller Cells

Introduction

Paranasal sinuses are usually located in the bones surrounding the nasal cavity. they are called according to the anatomical relations such as maxillary, ethmoid, frontal and sphenoid sinuses. The sinuses develop mostly after birth. Their degree of development varies greatly. It is controversial that paranasal sinuses have an aid to facial growth and development or persist as residual remnants of an evolutionary structure found in an additional role as an adjunct to the nasal cavity. There are numerous results explaining the function of paranasal sinuses.[1,2,3,4,5,6] The sphenoid sinus is radiographically evident by the age of three, frontal sinuses become distinct from the ethmoids by six years. The sphenoid sinuses, which are immediately anterior to the pituitary fossa, are adjacent to the posterior ethmoid sinuses and drain into the superior meatus. They are rarely symmetrical with a deviated midline in the body of the sphenoid bone.[7]In relation with their location, these sinuses contribute to the development of the facial structures, jaws, upper airway, some degree of warmth and humidification to inspired air, thermal isolation, resonance of voice, weight of the skull and expansion of olfactory surfaces.[1]

The paranasal sinuses improves nasal function; they improve the production of nitric oxide and in aiding the immune defences of the nasal cavity.[1,2]With the advantage of three-dimensional imaging, clinicians are able to observe anatomical structures clearly. Cone beam computed tomography (CBCT) is a useful method for the evaluation of the paranasal sinuses and considered equivalent to computed tomography (CT) in obtaining diagnostic information. CBCT has some advantages compared to CT, such as a shorter imaging time, low cost, and low radiation exposure.[8,9]

Methodology

This retrospective study consists of 100 Adult CBCT images of 50 Males and 50 Females were included. This study was done using Planmeca Mid Promax 3D MACHINE and images were analyzed using Planmeca Romexis software. Haller cells are localized under the orbit and on the roof of the maxillary sinus.(fig.1.A & B).Agger nasi are the most anterior ethmoid air cells. Agger nasi are formed by lacrimal bone pneumatisation. Kuhn cell (KC) cell located above the agger nasi cell.The onodi cell is a posterior ethmoid cell. It elongates superiorly to the sphenoid sinus.(fig.1.C)

Inclusion Criteria

- Age group of 18-60 years

Exclusion Criteria

- Images with artifacts.
- Images with fractures or surgical splints
- Images of patients who underwent nasal surgery were excluded.

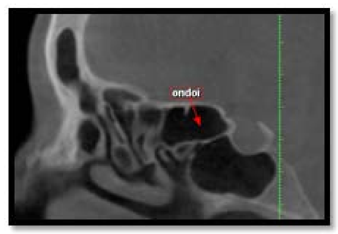


FIG 1.A: Right Ondoi Cells

FIG 1.B: Left Ondoi Cells

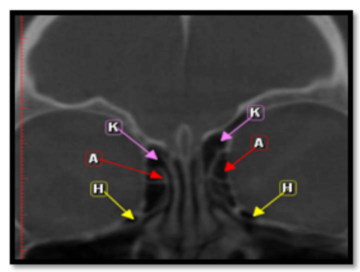


FIG.1.C: Bilateral Presentation of Kuhn Cells, Ondoi Cells, Agger Nassi Cells and Haller Cells

Results

The collected data were analysed with IBM.SPSS statistics software 23.0 Version. To describe about the data descriptive statistics frequency analysis, percentage analysis were used for categorical variables and the mean & S.D were used for continuous variables. To find the significance in categorical data Chi-Square test **(TABLE-**

1) was used similarly if the expected cell frequency is less than 5 then the Fisher's Exact was used. fisher's exact test is highly significant with the correlation value of .0005 In all the above statistical tools the probability value .05 is considered as significant level. **(TABLE-2).** There is no corelation between age and gender

P - Value	** Highly Significant at P ≤ .01

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	60.588[a]	1	.0005		
Continuity Correction[b]	57.490	1	.000		
Likelihood Ratio	68.687	1	.000		
Fisher's Exact Test				.000	.000
N of Valid Cases	100				

a. 0 cells (0.0%) have expected count less than 5. The minimum

b. Computed only for a 2x2 table

Table1: Depicts that pearson chisquare test is highly significant

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	92.063[a]	1	.000		
Continuity Correction[b]	88.138	1	.000		
Likelihood Ratio	118.521	1	.000		
Fisher's Exact Test				.0005	.000
N of Valid Cases	100				

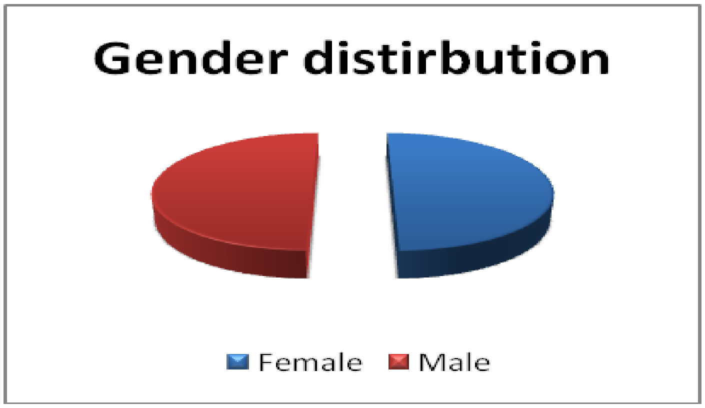
a. 0 cells (0.0%) have expected count less than 5. The minimum

b. Computed only for a 2x2 table

Table 2: depicts that fisher's exact test is highly significant with the correlation value of .0005

Discussion

The anatomy of paranasal sinuses is significantly different in children and adults, with the frontal sinus reaching its maximum size at 18 years.[10] The anatomical variability of frontal recess cells is related to particular embryological features of the ethmoid sinus: the ethmoid derives from cartilage. Unlike the other sinuses which derive from septation and that histologically comprise a rigid and robust bony tissue, ethmoid cells with thin bony lamellae may easily migrate to other paranasal sinuses. When this extramural extension is directed upwards, it generates the various cell combinations observed in the frontal recess (frontal cells, supraorbital cells, etc.). The preoperative identification of the frontal recess anatomical variants may contribute to greatly optimizing surgery and reducing intraoperative risks, causes of failures and possible complications. The classification and identification of the different cells in the frontal recess allows for a better understanding, facilitates the exchange of information and the comparison between different surgical techniques. Recent studies have shown that fronto ethmoid cells posterior and posterolateral to the frontal recess (suprabullar, frontobullar and supraorbital cells) may be more significantly related to the development of frontal sinusitis compared to cells anterior to the frontal recess (agger nasi and Kuhn frontal recess cells). Some Authors attribute the failures of systemic and local medical therapy in this pathological location to an obstruction at the level of the frontal recess.[10]The sphenoid sinus is located in the center of the cranial base and attains its mature size by the age of 14 years[11].The sphenoid sinus may show varying degrees and directions of pneumatization, with its various extensions bringing it in close relationship to the optic nerve, cavernous sinus, internal carotid artery, frontal lobe, ventral surface of the brain stem, cranial nerves III–VI and pituitary gland [12] .Some of these structures may underlie and produce bony prominences and related recesses inside the sinus[13,14]. In our study the distribution of male and female are taken in an equal manner. A total of 100 samples were taken and equal gender distribution of 50 males and 50 females samples are taken.(**GRAPH-1**)



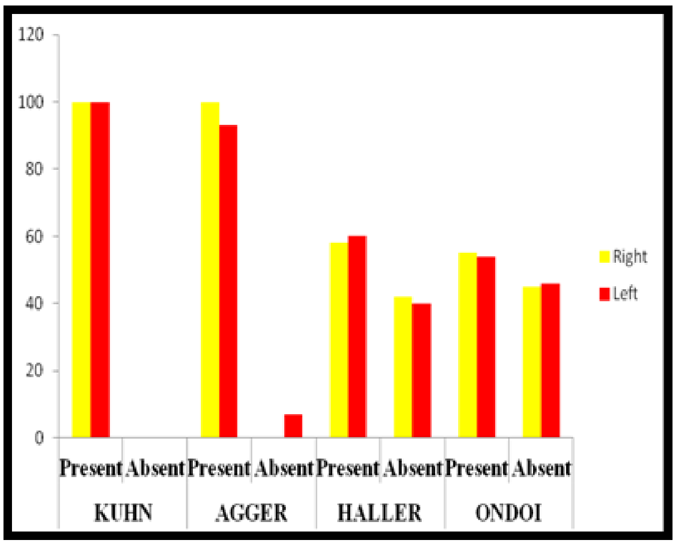
GRAPH-1: It Depicts The Equal Gender Distribution of Males And Females

Haller cells are localized under the orbit and on the roof of the maxillary sinus. Over pneumatization of this cell obstruct the pathway of the maxillary sinus and cause ethmoiditis[15.]Moreover, this may negatively affect the maxillary sinus ventilation and can lead to recurrent maxillary sinusitis. Haller cells are the anatomical variation in paranasal sinuses and not the pathology itself, but they can predispose some patient to sinus diseases by causing obstruction of the opening of the maxillary sinus that can lead to inflammatory disease. Therefore, the diagnosis of Haller cells by Rhinologist becomes important to rule out the cause of sinusitis when no other significant finding on physical examination and endoscopy is seen in association with the disease[16,18.]An enlarged haller cell can lead to an increased risk of ocular complications during endoscopic ethmoidectomy[15,19].The prevalence of Haller cells is variable, ranging from 2 to 70.3%.As per ahanthem study, Haller cells were found in 56% of the study population, out of which 40% were present unilaterally and 16 % bilaterally. Also, 55.5% were noted on the right side and 45.05% on the left side. In our study 58% were present in the right side and 60% in the left side.

Kuhn classified the frontal ethmoid cell.it is classified into four types.These cells alter the frontal recess anatomy, narrowing the frontal sinus ostium and can cause pathological changes. For achieving access to the frontal sinus ostium during endoscopic surgery, the removal of Kuhn cells may be required [10].Kuhn cells are present in 100% of the cases. Accordingly in our study Kuhn cells are present in 100% of cases.

Agger nasi are the anterior ethmoidal air cells, formed by lacrimal bone pneumatization. The enlarged agger nasi cell leads to sinusitis by narrowing the frontal recess [16].The agger nasi cells, affected by sinusitis causes ocular complications.. The reported prevalence of Agger nassi cell in the previous literature varies from 10 to 98.5%.In ahanthem study, the prevalence of Agger nasi cells was 66%, out of which 28% were present unilaterally and 38% bilaterally, and 57.1% were noted on left side and 42.9% on right side[17]. This study was consistent with previous studies conducted by Fadda et al, Talaiepour et al, and Narendrakumar and Subramanian. In our study Agger nassi cells are present in 100% of cases both in left side and 100 % of cases in right side.+

Ondoi cells, Also known as sphenoethmoidal cells, They are ethmoid cells that have migrated to the anterior region of the sphenoid sinus, with anterosuperior location, and intimately related to the optic nerve, causing optic neuropathy in case of certain conditions that affect such cells. Onodi cell is the most posterior ethmoidal air cell that extends laterally. It elongates superiorly to the sphenoid sinus and is located between the sphenoid sinus and skull base. Because of its direct relation to the optic nerve, this cell is very important. Moreover, the skull base is located at the posterior wall of the onodicell [20].The prevalence of Onodi cells varies from 8 to 13%, according to Turna et al (13.5%), Fadda et al (8.5%), and Narendrakumar and Subramanian (6%).According to ahanthem, the prevalence of Onodi cells was 38%, seen only unilaterally and out of which 63.2% were seen on right side and 36.7% on left side[17]. In our study ondoi cells were present in 46 % of cases. Out of which 55% was seen on the right side it was seen, 54% on the left side. The anatomical variations of all the four cells are displayed in **(GRAPH-2)** Most commonly observed cell were kuhn cells and the least commonly found cells was ondoi cells



GRAPH 2:The anatomcal variations of all the four cells are denoted.kuhn cells are present in 100% of the individual, next is the aggercells, onodi cells are the least cells to be seen.

Conclusion

Different anatomical variants are often found in paranasal sinus region and 3D imaging is the modality of choice to evaluate these variants since conventional radiographs do not provide adequate information because of structural superimposition. These variants may determinate contact points between nasal structures stimulating "trigger" points and determining facial pain crisis. Identification of these variants plays an important role while guiding the surgeons preoperatively and preventing iatrogenic complications. Since the results are highly significant with limited number of samples, our findings could be correlated with sinusitis and neuralgia patients and the correlation between them could be obtained.

References

1. Kaan Orhan, Secil Aksoy and Ulas Oz. CBCT Imaging of Paranasal Sinuses and Variations.Chapter 3. CBCT Imaging of Paranasal Sinuses and Variations

2.Keir J. Why do we have paranasal sinuses?. The Journal of Laryngology & Otology.2009;123(1):4–8

3.Gallup AC, Hack GD. Human paranasal sinuses and selective brain cooling: A ventilation system activated by yawning? Medical Hypotheses. 2011;77(6):970–973

4.Koertvelyessy T. Relationships between the frontal sinus and climatic conditions: A skeletal approach to cold adaptation. American Journal of Physical Anthropology.1972;37(2):161–172

5. Irmak MK, Korkmaz A, Erogul O. Selective brain cooling seems to be a mechanism leading to human craniofacial diversity observed in different geographical regions. Medical Hypotheses. 2004;63(6):974–979

6.Ebrahimnejad H, Zarch SH, Langaroodi AJ. Diagnostic efficacy of digital waters' and Caldwell's radiographic views for evaluation of sinonasal area. Journal of Dentistry (Tehran). 2016;13(5):357–364

7. David I. Schor (1993) Headache and Facial Pain—The Role of the Paranasal Sinuses: a Literature Review, CRANIO®, 11:1, 36-47,

8.Wörtche R , Hassfeld S, Lux C, Müssig E, Hensley F, Krempien R et al. Clinical application of cone beam digital volume tomography in childrenwith cleft lip and palate. DentomaxillofacRadiol 2006; 35: 88–94.

9. Dedeoglu N, Altun O, Kucuk EB, Altindis S, HatunogluE. Evaluation of the anatomical variation in the nasal cavity and paranasal sinuses of patients with cleft lip and palate using
cone beam computed tomography.Bratisl Med J 2016; 117 (12).

10.A. Minni, D. Messineo*, G. Attanasio, E. Pianura*, F. D'ambrosio*3d cone beam (CBCT) in evaluation of frontal recess: findings in youth population. European Review for Medical and Pharmacological Sciences. 2012; 16: 912-918

11. A.J. Scuderi, H.R. Harnsberger, R.S. Boyer Pneumatization of the paranasal sinuses. Normal features of importance to the accurate interpretation of CT scans and MR images AJR Am J Roentgenol, 160 (1993), pp. 1101-110

12. Wang Jian, Sharatchandra Bidari, Kohei Inoue, etal. Extensions of the sphenoid sinus: a new classification Neurosurgery, 66 (2010), pp. 797-816.

13.L.C. Carter, A. Pfaffenbach, M. Donley Hyperaeration of the sphenoid sinus: cause of concern ?OralSurg Oral Med Oral Path Oral Radiol Endodontol, 88 (4) (1999), pp. 506-510

14.E.R. Terra, F.R. Guedes, F.R. Manzi, F.N. BoscoloPne umatization of the sphenoid sinus DentomaxillofacRadiol, 35 (1) (2006), pp. 47-49

15.Arslan H, Aydınlıoğlu A, Bozkurt M, Egeli E. Anatomic variations of the paranasal sinuses: CT examination for endoscopic sinus surgery. AurisNasus Larynx 1999; 26: 39-48.

16. Kantarci M, Karasen RM, Alper F, et al. Remarkable anatomic variations in paranasal sinus region and their clinical importance. Eur J Radiol 2004; 50: 296-302.

17. Ahanthem Nandita, Sowbhagya Malligere Basavaraju, Balaji Pachipulusu, Pravin GU. Assessment of Anatomical Variations of Paranasal Sinus Region: A Computed Tomography Study. International Journal of Oral Care and Research, January-March 2017;5(1):1-5

18.Kamdi P, Nimma V, Ramchandani A, Ramaswami E, Gogri A, Umarji H. Evaluation Of Haller Cell On CBCT And Its Association With Maxillary Sinus Pathologies. J Indian Acad Oral Med Radiol 2018;30:41-5.

19. Shechtamn FG, Kraus WM, Schaefer SD. Inflammatory diseases of the sinuses: anatomy. OtolaryngolClin North Am 1993; 26: 509–515

20.Beale TJ, Madani G, Morley SJ. Imaging of the paranasal sinuses and nasal cavity: normal anatomy and clinically relevant anatomical variants. Sem in Ultrasound CT MR 2009;30:2-16.