Prevalence of incidental paranasal sinus opacification in an adult dental population

Bong-Hae Cho, Yun-Hoa Jung

Department of Oral and Maxillofacial Radiology, College of Dentistry, Pusan National University

ABSTRACT

Purpose : The purpose of this study was to determine the prevalence of sinus opacification among adult dental patients.

Materials and Methods : Five hundred and sixty-four Cone Beam Computed Tomography (CBCT) scans of dental patients over the age of 18 were reviewed for sinus opacification. Opacification was graded as clear, mild, moderate or severe. Patients with any sinus-related signs or symptoms were excluded.

Results : Sinus opacification in one or more sinuses was found in 59.2% of the patients. The sinus opacification was mild in 49.8%, moderate in 8.3%, and severe in 1.1%. The maxillary (37.7%) and ethmoid (37.4%) sinuses were most frequently affected. The prevalence was higher in the older age group and showed a male predomination ($p < 0.05$).

Conclusion : Sinus opacification in asymptomatic adults is very common and emphasizes the importance of clinical correlation before deciding on the final diagnosis and treatment. (***Korean J Oral Maxillofac Radiol 2009; 39 : 191-4***)

KEY WORDS : Adult, Cone-Beam Computed Tomography, Sinusitis

Introduction

Incidental sinus abnormalities are sometimes noted in patients who present with dental problems. Even though CT is regarded as the "gold standard" in paranasal sinus imaging,[1,2] its main disadvantages of cost and high radiation dosage limit its application.[3,4]

CBCT was introduced in the late 1990s and has provided opportunities for dental practitioners to obtain multiplanar imaging. CBCT has major limitations in soft tissue differentiation, but it easily identifies sinus opacification and can provide valuable information on paranasal sinus inflammation without additional exposure.

Imaging plays a key role in diagnosis, choice of treatment and surgical planning for sinus disease, but many studies have concluded that there is little correlation between CT findings and symptoms.[5-8]

In previously reported studies,[8-20] the incidences of sinus abnormalities of the asymptomatic subjects varied between 10.9% and 69.1%. It is not clear whether these symptomless abnormalities developed into active symptomatic sinus disease or remained dormant. To avoid unnecessary treatment, the significance of asymptomatic sinus opacification should be clarified.

The purpose of this study was to investigate the prevalence of paranasal sinus opacification in patients presenting with dental problems to provide baseline data for the Korean population.

Materials and Methods

1. Materials

The study population comprised 564 adult patients (287 males and 277 females) and the mean age was 42.7 (range 18-80). CBCT images were taken in all patients for the reasons of orthodontic treatment, tooth impaction or implant planning. Patients who had a clinical suspicion of sinus disease or those who were to have tooth implantation of maxillary posterior teeth were excluded from the study.

2. Methods

CBCT scans were obtained using the DCT Pro (Vatech, Kihung, Korea) consisting of an X-ray tube, a source collimator, and an amorphous-silicon flat-panel detector. CBCT scans were performed with a rotation of 360 degrees for data acquisi-

*This study was supported by a grant of Pusan National University Hospital, Busan 602-739, Korea.

Received July 29, 2009; Revised August 24, 2009; Accepted September 7, 2009

Correspondence to : Dr. Yun-Hoa Jung

Department of Oral and Maxillofacial Radiology, College of Dentistry, Pusan National University, Busan 602-739, Korea

Tel) 82-55-360-5262, Fax) 82-55-360-5029, E-mail) yhjung@pusan.ac.kr

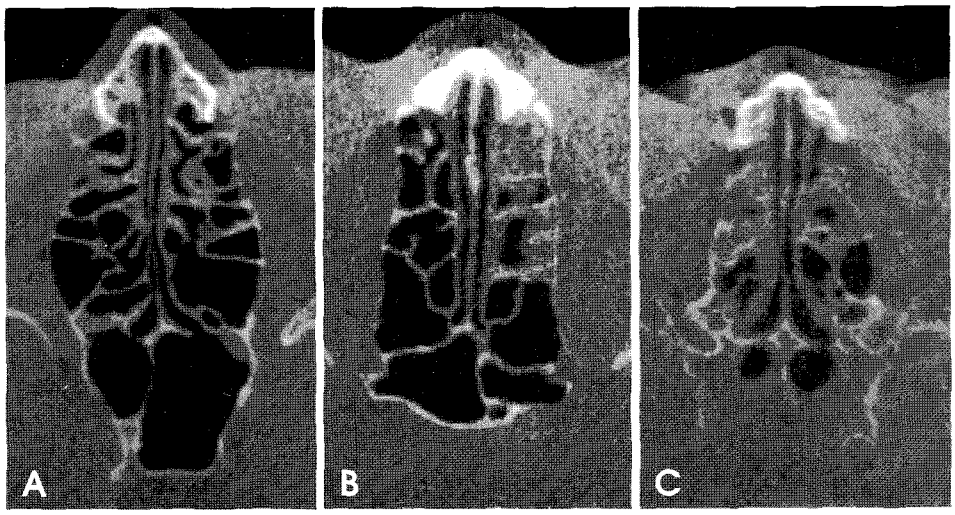

Fig. 1. Examples of grading scale for ethmoid sinus opacification A. Mild, B. Moderate, C. Severe.

Table 1. Paranasal sinus findings of the patients

	Sinuses, N (%)				
	Frontal	Ethmoid	Sphenoid	Maxillary (Rt. & Lt.)	All sinuses*
Clear	513 (91.0)	353 (62.6)	535 (94.9)	703 (62.3)	230 (40.8)
Mild	44 (7.8)	181 (32.1)	26 (4.6)	389 (34.5)	281 (49.8)
Moderate	6 (1.1)	27 (4.8)	3 (0.5)	33 (2.9)	47 (8.3)
Severe	1 (0.2)	3 (0.5)	0 (0.0)	3 (0.3)	6 (1.1)

*Classification based on the highest rate among five paranasal sinuses

Table 2. Distribution of paranasal sinus findings by age and gender

		Age group (years), N (%)					Gender, N (%)	
		18-29	30-39	40-49	50-59	>60	Male	Female
All sinuses*	Clear	69 (53.1)	50 (42.4)	44 (36.1)	46 (37.1)	21 (30.0)†	88 (30.7)	142 (51.3)‡
	Mild	52 (40.0)	64 (54.2)	62 (50.8)	64 (51.6)	39 (55.7)	164 (57.1)	117 (42.2)
	Moderate	7 (5.4)	4 (3.4)	14 (11.5)	13 (10.5)	9 (12.9)	32 (11.1)	15 (5.4)
	Severe	2 (1.5)	0 (0.0)	2 (1.6)	1 (0.8)	1 (1.4)	3 (1.0)	3 (1.1)
	Total	130 (100)	118 (100)	122 (100)	124 (100)	70 (100)	287 (100)	277 (100)

*Classification was based on the highest rate among five paranasal sinuses.

†: correlation among age groups (Spearman rank correlation coefficient, $p < 0.05$)

‡: statistically significant differences between male and femal groups (χ^2 analysis, $p < 0.05$)

tion. The exposure factors were field of view 20 × 19 cm, 90 kVp, 4-5 mA, and a 24 s exposure time. Images were reconstructed using a high spatial frequency reconstruction algorithm and the acquired image data consisted of a 14-bit scale with a 0.568 mm^3 voxel size.

Two experienced oral and maxillofacial radiologists reviewed the CBCT images for sinus opacification. To specify the severity of mucosal inflammation, opacification was graded as follows: 0=clear, 1=mild (less than one-third of the sinus), 3=moderate (from one third through two-thirds), or 4=severe (greater than two-thirds of the sinus) (Fig. 1). Frontal, ethmoid, sphenoid, left and right maxillary sinuses were evaluated separately for the absence or presence of opacification. In cases of disagreement between the examiners' findings, the two specialists discussed the results together and reached a consensus.

The data were analyzed by Spearman's rank correlation coefficient and the χ^2-test for age and gender group, respectively. Significance levels were set at 0.05. The calculations were performed using the SPSS software program (version 12.0 for Windows, SPSS Inc, Chicago, Ill, USA).

Results

The overall incidence of sinus opacification in this study is shown in Table 1. The number of patients who had sinus opacification in at least one sinus was 334 (59.2%). Mild grade was the most common finding, seen in 281 patients (49.8%), and only 53 patients (9.4%) showed either moderate or severe manifestation. The maxillary (37.7%) and ethmoid (37.4%) sinuses were among the most frequently involved sinuses.

Table 2 shows the distribution by age and gender. A correlation was found between the age of patients and sinus opacification, showing a higher occurrence rate in older patients ($p < 0.05$). In addition, there was a statistically significant difference between male and female patients ($p < 0.05$).

Discussion

In the present study, we used the existing CBCT images taken for dental purposes as a diagnostic tool to verify abnormal mucosal changes in the paranasal sinuses. CBCT is more cost- and radiation-effective than the conventional CT and we had no difficulties in defining sinus opacification on the CBCT images.

Previous studies[8-18] regarding incidental sinus abnormalities showed a wide range of incidence from 10.9% up to 69.1% with the majority between 30-50%. For the asymptomatic Korean population, Nam et al.[19] and Min et al.[20] presented incidences of 36.3% and 38%, respectively. The present study found a 59.2% incidence of sinus opacification. The discrepancies reflect the diversity of methods used among studies. Studies vary in terms of imaging modalities, population and the definition of abnormality and there are no previous CBCT studies to compare. Generally, magnetic resonance imaging (MRI) seems to demonstrate higher levels of incidental sinus abnormalities than CT scans.[12,15,18] We used CBCT images for dental problems while Nam et al.[19] used cranial CT images taken for head injuries. Dental patients seem to have sinus opacification more frequently than other populations. The reason is unclear, but we assume that the adjacency of dental structures to paranasal sinuses might have been related to the high incidence. Problems in a structure would exert a bad influence on neighboring structures. Furthermore, there is a possibility that the patients could have mistaken discomfort in sinuses as being of dental origin. The criterion to define abnormality also attributes the difference of the results. The fact that we took minimal mucosal thickening into account, would be another explanation for our high incidence. In many studies,[12,15,17,21] the authors have chosen a cut-off level between 2-5 mm.

This study demonstrated that adults have more abnormalities than children, contrary to another report.[22] Comparing with our previous study[23] using the same imaging modality and definition, the occurrence rate for the pediatric population was 48.1%. In adults, the overall prevalence was high, but most of the opacification came under the mild category. Only 9.4% of the total population showed either moderate or severe opacification in comparison to 18.3% in children. In accordance with other studies,[9,14,15,18] the most commonly affected sinuses were the maxillary and ethmoid.

Several studies[9,11,17] reported no relationship between age group and prevalence of abnormality, but our study found a correlation between the patient age and sinus abnormality, which is in agreement with the findings of Iwabuchi et al.[18] Even though Tarp et al.[17] reported that there was no significant relationship between sinus opacification and gender, we found that men were more often affected than women ($p < 0.05$). Duvoisin et al.[11] and Nam et al.[19] presented the same results and Havas et al.[9] showed a male predominance with no statistical relationship. In contrast with the results of this study, our previous study for the pediatric population[23] showed no statistically significant differences for age or gender.

There is some controversy over the significance of abnormal sinus images and their relationship to clinical disease. A recent European position paper on the treatment of rhinosinusitis states that CT should not be regarded as the primary step in diagnosis of rhinosinusitis but rather corroborates history and endoscopic examination after failure of medical therapy.[24]

It can be inferred from the high frequency of minimal mucosal abnormalities in asymptomatic patients that a certain degree of sinus opacification is normal. Thus, the patient's history and physical examination should be taken into consideration when interpreting radiographic images. Rak et al.[12] mentioned that up to 3 mm of mucosal thickening may commonly be seen in asymptomatic patients. Thus, clinical correlation is required rather than blanket medical therapy.

In summary, our results indicate that sinus opacification is very common in the adult dental population. However, most of the cases showed only minimal opacification with no clinical complaints. Considering that positive image findings without clinical signs and symptoms do not define a diagnosis of sinusitis, we recommend that an adequate clinical examination should be performed before treatment.

References

1. Anzai Y, Yueh B. Imaging evaluation of sinusitis: diagnostic performance and impact on health outcome. Neuroimaging Clin N Am 2003; 13 : 251-63.
2. Mafee MF, Tran BH, Chapa AR. Imaging of rhinosinusitis and its complications: plain film, CT, and MRI. Clin Rev Allergy Immunol 2006; 30 : 165-86.
3. Konen E, Faibel M, Kleinbaum Y, Wolf M, Lusky A, Hoffman C, et al. The value of the occipitomental (Waters') view in diagnosis of sinusitis: a comparative study with computed tomography. Clin Radiol 2000; 55 : 856-60.
4. White PS, Robinson JM, Stewart IA, Doyle T. Computerized tomography mini-series: an alternative to standard paranasal sinus radiographs. Aust N Z J Surg 1990; 60 : 25-9.
5. Stankiewicz JA, Chow JM. A diagnostic dilemma for chronic rhinosinusitis: definition accuracy and validity. Am J Rhinol 2002; 16 : 199-202.
6. Stewart MG, Johnson RF. Chronic sinusitis: symptoms versus CT scan findings. Curr Opin Otolaryngol Head Neck Surg 2004; 12 : 27-9.
7. Hwang PH, Irwin SB, Griest SE, Caro JE, Nesbit GM. Radiologic correlates of symptom-based diagnostic criteria for chronic rhinosinusitis. Otolaryngol Head Neck Surg 2003; 128 : 489-96.
8. McNeill E, O'Hara J, Carrie S. The significance of MRI findings for non-rhinological disease. Clin Otolaryngol 2006; 31 : 292-6.
9. Havas TE, Motbey JA, Gullane PJ. Prevalence of incidental abnormalities on computed tomographic scans of the paranasal sinuses. Archives Otolaryngol Head Neck Surg 1988; 114 : 856-9.
10. Conner BL, Roach ES, Laster W, Georgitis JW. Magnetic resonance imaging of the paranasal sinuses: frequency and type of abnormalities. Ann Allergy 1989; 62 : 457-60.
11. Duvoisin B, Agrifoglio A. Prevalence of ethmoid sinus abnormalities on brain CT of asymptomatic adults. AJNR Am J Neuroradiol 1989; 10 : 599-601.
12. Rak KM, Newell JD 2nd, Yakes WF, Damiano MA, Luethke JM. Paranasal sinuses on MR images of the brain: significance of mucosal thickening. AJR Am J Roentgeno 1991; 156 : 381-4.
13. Moser FG, Panush D, Rubin JS, Honigsberg RM, Sprayregen S, Eisig SB. Incidental paranasal sinus abnormalities on MRI of the brain. Clin Radiol 1991; 43 : 252-4.
14. Cooke LD, Hadley DM. MRI of the paranasal sinuses: incidental abnormalities and their relationship to symptoms. J Laryngol Otol 1991; 105 : 278-81.
15. Patel K, Chavda SV, Violaris N, Pahor AL. Incidental paranasal sinus inflammatory changes in a British population. J Laryngol Otol 1996; 110 : 649-51.
16. Savolainen S, Eskelin M, Jousimies-Somer H, Ylikoski J. Radiological findings in the maxillary sinuses of symptomless young men. Acta Otolaryngol Suppl 1997; 529 : 153-7.
17. Tarp B, Fiirgaard B, Christensen T, Jensen JJ, Black FT. The prevalence and significance of incidental paranasal sinus abnormalities on MRI. Rhinology 2000; 38 : 33-8.
18. Iwabuchi Y, Hanamure Y, Ueno K, Fukuda K, Furuta S. Clinical significance of asymptomatic sinus abnormalities on magnetic resonance imaging. Arch Otolaryngol Head Neck Surg 1997; 123 : 602-4.
19. Nam EC, Lee BJ. Prevalence of sinus abnormality observed in the cranial computed tomograms taken to evaluate head injury patients. Korean J Otolaryngol 1998; 41 : 488-92.
20. Min YG, Choo MJ, Rhee CS, Jin HR, Shin JS, Cho YS. CT analysis of the paranasal sinuses in symptomatic and sysmptomatic groups. Korean J Otolaryngol 1993; 35 : 916-25.
21. Gordts F, Clement PA, Buisseret T. Prevalence of paranasal sinus abnormalities on MRI in a non-ENT population. Acta Otorhinolaryngol Belg 1996; 50 : 167-70.
22. Gordts F, Clement PA, Destryker A, Desprechins B, Kaufman L. Prevalence of sinusitis signs on MRI in a non-ENT paediatric population. Rhinology 1997; 35 : 154-7.
23. Cho BH, Jung YH. Prevalence of incidental paranasal sinus opacification in dental paediatric patients. J Oral Maxillofac Radiol 2008; 38 : 219-23.
24. Fokkens W, Lund V, Bachert C, Clement P, Helllings P, Holmstrom M, et al. EAACI position paper on rhinosinusitis and nasal polyps executive summary. Allergy 2005; 60 : 583-601.