Literature review

Radiographic evaluation of the maxillary sinus by icatvision. a retrospective observational study on the etiological factors of maxillary sinusitis

Published in Spanish Científica Dental Vol. 11. Nº 1. 2014.

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Received: 13 February 2014.
Accepted (or accepted for publication): 4 April 2014.

ABSTRACT

Objective: To identify and evaluate the frequency of the different odontogenic causes that produce maxillary sinusitis and to perform an adequate differential diagnosis by using a Cone Beam Computerized Tomography (CBCT). To indicate the relation between frequency and severity of odontogenic sinusitis.

Patients and Methods: CBCT scans made by means of iCATVision of patients being treated in the Master's Degree Programme of Bucco-facial and Implantology of the UCM in the last 2 years, with radiographic evidence of unilateral or bilateral sinus fluid increase. The radiographic severitywas classified according to the volume of the sinus occupied by means of the Compudent program as: none, mild (less than 33%), moderate (between 33% and 66%) or severe (more than 66%). The causes of sinusitis were dental pathology (chronic periodontitis, acute periodontitis, periapical cysts and dental retention) or iatrogenic causes (root canal treatment, extraction, treatment with implants, sinus lifting, treatment of periodontal disease and oroantral communication).

Result: We studied 153 CBCT, from patients not presenting any systemic pathology considered exclusion criteria, obtaining 40 maxillary sinuses belonging to 32 patients between 37 and 83 years of age. The most common cause of sinus occupation was chronic periodontitis in 19 cases and root canal treatment in 9 cases. Of the cases, 72.5% presented a mild increase in fluid, and only in 10% the increase was severe.

Conclusions: The most common cause is chronic periodontitis, which begins with dental caries in an antral tooth, with greater frequency in the first and second molar. In addition, odontogenic sinusitis produces for the most part mild sinus fluid increases, although a larger sample is needed to corroborate the results.

KEYWORDS

Maxillary sinusitis; Odontogenic infection; Periapical abscess; Oroantral fistula, Iatrogenesis.

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INTRODUCTION

Sometimes patients with symptoms of pain in the maxillary premolar and molar region first go to the dentist's office. Performing a differential diagnosis will be necessary, including maxillary sinusitis as the cause of the possible odontalgia of the patient in order to carry out the adequate treatment in each case.

Maxillary sinus pathology can occur when the mucosa is altered due to diverse causes such as dental infections, traumatism, osteitis, cellulitis or iatrogenic causes such as extractions, endodontic treatment or placement of osseointegrated implants[1-5].

The diagnosis of sinusitis of odontogenic origin requires the evaluation of the patient's symptoms backed by a complete medical history and its correlation with the physical signs found. The pain may present in an acute or latent form, or there may be sensitivity in multiple antral teeth. Thus, it is sometimes difficult to know whether the origin is dental and to proceed to its treatment (endodontia, extraction, etc.). To help us make a good differential diagnosis, we must carry out a series of diagnostic techniques suited to this type of pathology[1,2].

The cone-beam computerised tomography (CBCT) has a high spatial resolution and a lower dose of radiation than the traditional computerised tomography. In addition, it has high precision in diagnosing apical periodontitis and Mucosal thickening in comparison with two-dimension images[6,7].

The unilateral opacification of the maxillary sinus along with ipsilateral symptoms may yield the definitive diagnosis[8].

MATERIAL AND METHOD

In order to prepare this paper, we used the specialised journals in the field of Surgery and Implants available in the Library and Newspaper Archives of the School of Dentistry of the Complutense University of Madrid (UCM).

The base material for this paper consists of the CBCT registers of the patients that went to the Department of Medicine and Bucco-facial Surgery of the School of Dentistry (Master's Degree Programme in Bucco-facial Surgery and Implantology) during the period of 2009 to 2011.

The CBCT registers were selected by means of the iCATVisionwith radiographic evidence of the increase of unilateral or bilateral sinus fluid in maxillary dentate patients or in those in whom an antral tooth had been recently extracted. The CBCT registers of the selected patients and their medical history were studied, with which we assessed whether or not the increase of fluid was due to an odontogenic cause through the different panoramic, cross or axial slices provided by the iCATVision program (Figure 1).

The criteria for inclusion were: Patients over 18 years of age, of both sexes, and with increased sinus fluid.

In the criteria for exclusion, we included those CBCT without maxillary teeth or those performed to evaluate acute traumatic injuries, with a history of nasal polyps, cystic fibrosis, immunocompromised or allergic fungal sinusitis.

The radiographic severity of the sinus fluid was classified according to the volume of the inflamed sinus using the Compudent program. For this, the CBCT obtained by the iCATVision program were transformed in order to be able to study them in Compudent. In the Compudent program, the CBCT were selected to study, tracing the panoramic and paraxial slices of the area of interest, which in this case is the maxillary sinus. We coloured all the slices in which the sinus appears and the program calculated the occupied volume of the sinus and its total volume.

The severity of the sinus occupation was classified as none, mild (less than a third), moderate (between a third and two-thirds) and severe (over two-thirds).

The possible causes of odontogenic sinusitis (OS) were classified as dental causes, such as chronic periodontitis (CP), acute periodontitis, periapical cysts and dental retention, or in iatrogenic causes, such as

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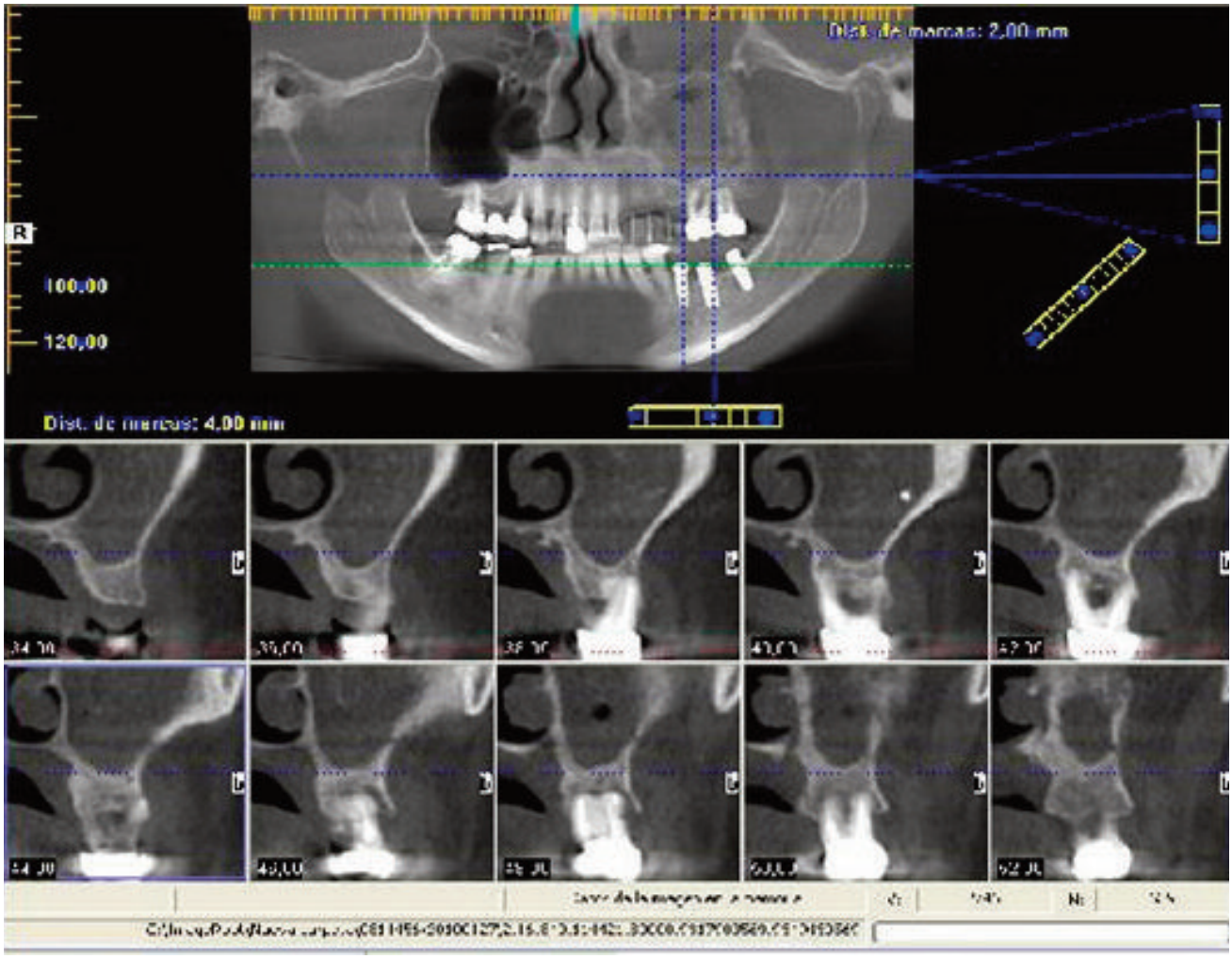

Figure 1. Panoramic view of a CBCT by means of iCATVision with almost complete occupancy of the left maxillary sinus.

tooth extraction, endodontic treatment, treatment with implants, sinus lifting, treatment of periodontal disease and oroantral communication (OAC).

For the obtaining of the results, the statistics program SPSS19 for Windows was used. Contingency tables and the Chi-squared test were performed for qualitative data (cause/occupancy), and one-way ANOVA was calculated for the relation between the percentage of occupancy and its cause.

RESULTS

We studied 153 CBCT of which 61 had increased uni- or bilateral sinus fluid, that is, 39.8%. We ruled out 13 for not having antral teeth and 16 for being of rhinogenic cause. Therefore, the prevalence of odontogenic sinusitis in this study is 20.9% (32/153).

Finally, we obtained 32 CBCT with an increase of sinus fluid and among them, 8 were bilateral; there-

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fore, we obtained 40 maxillary sinuses to study in which the mean age of the patients was 61.4 (37-83 years). As for gender, the sample obtained is 1/1, 16 men and 16 women. No patient had any systemic pathology in their medical history that was within the criteria of exclusion.

The most frequent causes of sinus occupancy were chronic periodontitis as dental pathology in 19 cases (47.5%), and root canal treatment as the iatrogenic cause in 9 cases (22.5%) (Tables 1 and 2).

We differentiate the degree of occupancy as mild (less than 1/3), moderate (between 1/3 and 2/3) and severe (over 2/3). Of the cases, 72.5% (29/40) had a mild increase of fluid, while only 17.5% (7/40) had moderate and 10% (4/40) had severe increases (Table 3).

To study the cause in relation to the degree of occupancy, we prepared some contingency tables and performed the Chi-squared test for qualitative data, finding that there are statistically significant differences in the responses of the cause in the occupancy, (P=0.027).

In chronic periodontitis, the most significant was that there was no case of severe occupancy, while in acute suppurative periodontitis there was no case of mild sinus occupancy; therefore, the difference between them is statistically significant. In dental retention, it should be pointed out that all the cases were classified as moderate. To study whether there are differences between the percentage of occupancy and its cause we conducted an ANOVA test with its corresponding descriptive table. Sinus lifting, treatment with implants and cysts have to be eliminated because there was only one case of each.

Of the rest, ANOVA analysis yielded a P=0.013, therefore, there are significant differences in the occupancy. As we wanted to know what differences may exist, we performed the Bonferroni (post-hoc) test and the only mean difference that was found is between chronic and acute periodontitis for the occupancy percentage, since as we see in the tables, there is no case of severe occupancy in CP, while the same occurs in acute periodontitis but of mild occupancy.

It is likely that we would find differences among other causes, but due to the small sample size in the majority of them there are no statistically significant differences.

Table 1. History of dental pathology

Dental Pathology	Number of cases	%
Chronic periodontitis	19	79.1
Acute periodontitis	2	8.3
Cysts	1	4.1
Dental retention	2	8.3
TOTAL	***24***	***100***

Table 2. Iatrogenic causes of sinusitis

Iatrogenic cause	Number of cases	%
Root canalTX	9	56.2
Exodontia	2	10.5
PD TX	0	0.0
Sinus lifting	1	6.2
Implant TX	1	6.2
OAC	3	18.7
TOTAL	***16***	***100***

Root canal TX = Root canal treatment.
PD TX = Periodontal disease treatment.
Implant TX = Treatment with implants.
OAC = Oroantral communication.

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Table 3. Volume of sinus fluid

Cause	<1/3	1/3-2/3	>2/3
Chronic periodontitis	16	3	0
Acute periodontitis	0	1	1
Cysts	1	0	0
Dental retention	0	2	0
Root canal TX	7	1	1
Exodontia	2	0	0
PD TX	0	0	0
Sinus lifting	0	0	1
Implant TX	1	0	0
OAC	2	0	1
TOTAL	***29***	***7***	***4***

Root canal TX = Root canal treatment.
PD TX = Periodontal disease treatment.
Implant TX = Treatment with implants.
OAC = Oroantral communication.

The maxillary second molar was the tooth that has produced more cases of sinusitis (18/40). However, there is no case coming from the canine or from the first premolar.

DISCUSSION

In our study, we observed a 20.9 % prevalence of odontogenic sinusitis. However, other authors report a 10-12% prevalence[2,9,10] or even lower (5.2%) as reported by Lee[11]. The prevalence of odontogenic sinusitis among the cases of maxillary sinusitis was 52.4%, which coincides with the figures given by Maillet et al., in their retrospective study of 871 CBCT on the radiographic characteristics of the OS[12]. Obayashi et al.[13] also found that 71.3% of cases of dental infection were associated with changes in the maxillary sinus.

According to the cause and frequency of maxillary sinusitis, our results differ from other studies. We found that the most common causes were chronic periodontitis, which occurred in 47.5% of dental pathology cases, followed by root canal treatment in 22.5% of iatrogenic cases. Anavi et al[14] reported a 7-35% complication rate after sinus lifting (13 cases of maxillary sinusitis) while we only found one case out of forty.; therefore, a larger sample is needed in order to study this relationship. Charfi et al[15] did coincide with our results, with 68% of cases of OS represented by chronic periodontitis. Arias-Irimia et al[3] conducted a meta-analysis of 15 articles with at least 10 cases of OS, concluding that the iatrogenic was the most common cause (55.9%), with oroantral communication, exodontia and root canal treatment, while within the dental pathology the most characteristic was chronic periodontitis. Brook I[2]

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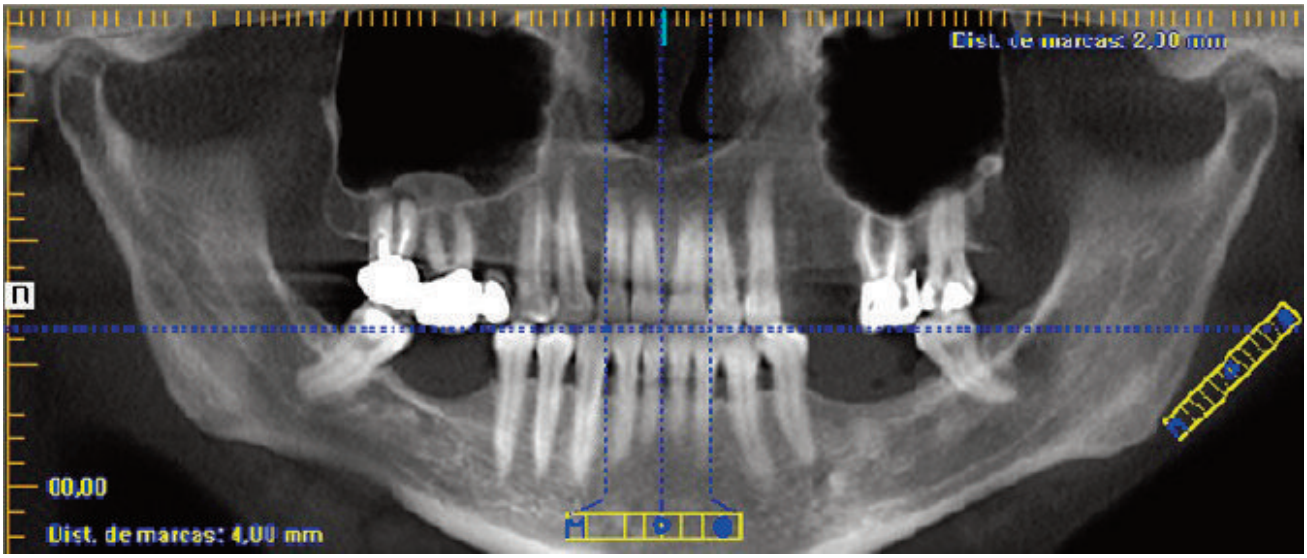

Figure 2. Mild occupancy in right sinus due to an apical process in 17 due to defective root canal treatment.

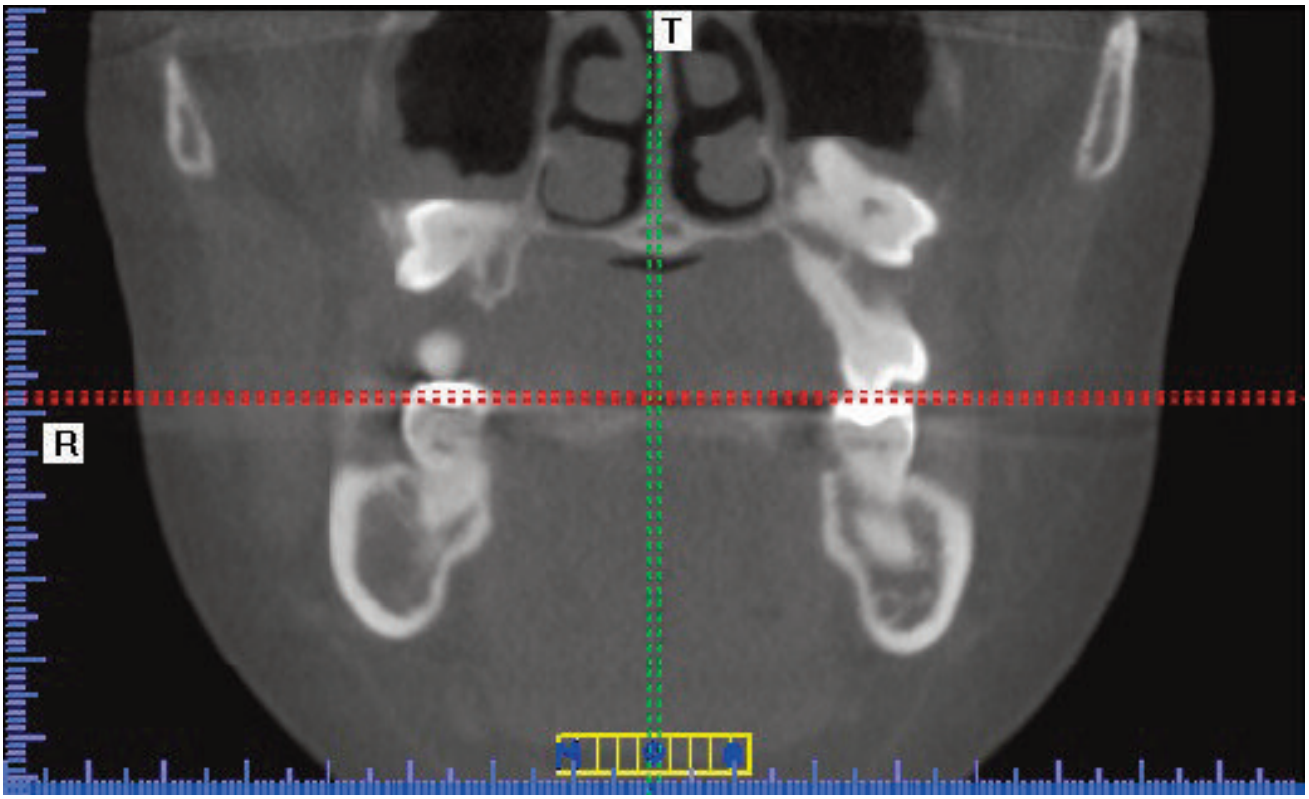

Figure 3. Moderate bilateral occupancy due to both maxillary wisdom teeth inclusion.

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indicated in his review that the most common were chronic periodontitis and dental extraction that includedforeign bodies. Bomeliet al[9] only found statistical differences between oroantral communication and chronic periodontitis. Treatment with implants was the most common cause (10 cases out of 27 patients) as reported by a recent paper[11], (10 cases out of 27), while in our study there was only one case, followed by dental extraction (8/27). Although in our sample we only had two cases of dental extraction, Some authors report a higher incidence of sinus complications, maybe because this type of treatment is very commonly performed in dental clinics. Another recent study of 21 cases of OS found no iatrogenic cause but chronic periodontitis with oroantral fistula in five cases (1%)[15].

The frequency of odontogenic sinusitis decreases as severity increases, with 72.5%mild, 17.5% moderate and 10% severe. However, in the paper by Bomeli et al.[9], the results showed that the sinus fluid can be more attributable to an odontogenic infection as the amount of fluid increases, reaching an incidence of 79% in sinuses with occupancy higher than 2/3. The reason for this difference may be a much greater sample size in their study (166 occupied sinuses) as compared to ours (40 occupied sinuses).

The mean age of all the patients studied was 61.4. But the majority of studies commented that the frequency is greater in the 4th decade of life[3,5,10,11]. Only two papers[9,15] came close to our results with a mean age of 54.9 and 53 years, respectively.

With regard to the patient's gender, some authors report a higher incidence in men while other report the opposite. We obtained a 1:1 ratio sample of 16 men and 16 women.

As in the article by Lee[11], in our retrospective study, the maxillary second molar was the tooth that produced more cases of OS (18/40). We can explain these findings knowing that the second molar is closer to the sinus floor[16] and even that both molars are within the sinus in 2% of the cases[17]. The research by Maillet et al. was the only one that included the root of the causing tooth and obtained that the palatal root of the first molar was the most common followed by the mesio-buccal root of the second molar[12].

Maestre-Ferrín et al.[18] compared the panoramic radiography with computed tomography (CT), confirming that CT was easily available and the safest method for the diagnosis of the maxillary sinus pathology. They chose 30 patients intended for treatment with implants. The prevalence of sinus findings was 38.3%, with mild sinus fluid increase in 23.3% of the cases, moderate in 10% and severe in 5%. However, they did not differentiate whether or not this pathology was of odontogenic cause. Cymerman et al.[19] evaluated the use of the CBCT in a case series and concluded that the thickening of the sinus membrane was identified four times more often than with conventional periapical radiographs, and that it was useful for differentiating the etiology and extension of the oral pathology with respect to the maxillary sinus. Another series of cases stated that the three-dimensional images are an accessible modality, with low cost and dose that aid the diagnosis of odontogenic sinusitis[6]. Shabazian et al.[7] reviewed the diagnostic value of bidimensional and tridimensional images and affirmed that the CBCT with low dose of radiation can be particularly useful in OS, especially when the patient does not respond to treatment, although more research is still needed to validate these results.

It is important to differentiate when the sinusitis is of odontogenic cause since antibiotic therapy differs from that needed in other types of maxillary sinusitis, because of an increased concentration of anaerobic bacteria. Thus, priority is given to the treatment of the dental cause, with either root canal treatment or extraction[2,4,9,20].

CONCLUSIONS

The radiographic image is an important tool for establishing the diagnosis, although not the only one. A CBCT can show the relation of the odontogenic ori-

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gin with the defect of the sinus floor and the affected tissues, differentiating whether it is dental pathology or iatrogenic cause, being able to locate the exact position of a foreign body and the situation and extension of an oroantral communication.

The most common cause is chronic periodontitis due to untreated dental caries producing a periapical abscess and due to the close proximity of the antral teeth, especially the first and second molar, the maxillary sinus can be acutely or chronically affected.

In this retrospective study, we can conclude that sinusitis of odontogenic origin usually produces mild increases of sinus fluid (less than 1/3), although a larger sample would be needed to corroborate these results.

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