Are We Missing Something in the CT-PNS Report? – an Observational Study on the Rate of Reporting the Presence of Dental Disease and the Probable Etiology of Sinusitis on CT Scans

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SIDDHARTH VIJAYAKUMAR
SANCHANAA SREE BALAKRISHNAN
RAJEEV PULIMI

*Author affiliations can be found in the back matter of this article

ABSTRACT

Objectives: To (i) identify the prevalence of dental disease, (ii) identify the proportion of sinusitis cases that could be considered odontogenic in origin and, (iii) audit the rate of diagnosis of incidental dental disease and odontogenic sinusitis in radiology reports on CT scans covering the maxillary teeth and sinuses.

Materials and methods: Images and reports of CT studies performed in our institution that covered the paranasal sinuses and maxilla were retrospectively audited for documentation of findings pertaining to maxillary sinusitis and maxillary dental disease. Trauma cases, edentulous and pediatric patients and patients without maxillary sinusitis or dental disease were excluded. The etiologies of maxillary sinusitis was defined as likely odontogenic, indeterminate and rhinogenic sinusitis. Only molar and pre-molar tooth disease were considered as these are most commonly in direct contact with the floor of the maxillary sinus.

Results: One-hundred sixty CT studies were reviewed. The prevalence of dental caries and periapical lucency was 80.6% and 15.0%, respectively. The cause of sinusitis was determined to be likely odontogenic in 30.0%, rhinogenic in 33.1% and of indeterminate origin in 36.9%. The rate of reporting dental findings or raising the suspicion of odontogenic sinusitis was 8.5% (n = 14).

Conclusions: Under-reporting of dental disease and odontogenic sinusitis is common. Early recognition results in higher chances of salvaging the diseased tooth, preventing complications and providing appropriate treatment. An urgent and collective effort by the radiological fraternity is warranted to recognize the significance of reporting of dental pathologies, even in CT scans done for other indications.

CORRESPONDING AUTHOR:

Sanchanaa Sree Balakrishnan

Sri Ramachandra Institute of Higher Educationa and Research, IN

sanchanaasree@outlook.com

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odontogenic sinusitis; reporting rate; dental disease; maxillary sinusitis; paranasal sinuses

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immediately adjacent to the diseased tooth or presence of an obvious erosion in the floor of the maxillary sinus adjacent to a diseased tooth (Figures 2 and 3).

Figure 1 Dental caries (arrowhead) and periapical lucency (arrow) in the same tooth with adjacent polypoidal mucosal thickening (dashed arrow).

Indeterminate etiology of sinusitis: Polypoidal mucosal thickening involving the floor of the maxillary sinus, but not limited to the area of diseased tooth.

Rhinogenic (non-odontogenic) sinusitis: No evidence of dental disease in the region of mucosal thickening; mucosal thickening involving all the walls of the maxillary sinus, in a non-polypoidal (uniformly flatted/peripheral) pattern.

We considered only the molar and pre-molar teeth in determining likelihood of odontogenic sinusitis as these were most commonly in direct contact with the floor of the maxillary sinus.

OBSERVATIONS AND RESULTS

PREVALENCE OF VARIOUS DENTAL FINDINGS (CARIES, PERIAPICAL LUCENCY, AND PROJECTION OF TOOTH INTO SINUS), AND DISTRIBUTION OF PATHOLOGY IN VARIOUS TOOTH TYPES

It was found that 80.6% of patients (n = 129) had one or more carious teeth. The first molar tooth was most frequently diseased (n = 80 patients), followed by the second molar (n = 51), the second premolar (n = 43), the third molar (n = 33), and the first premolar (n = 30). The canine teeth were less commonly involved (n = 21).

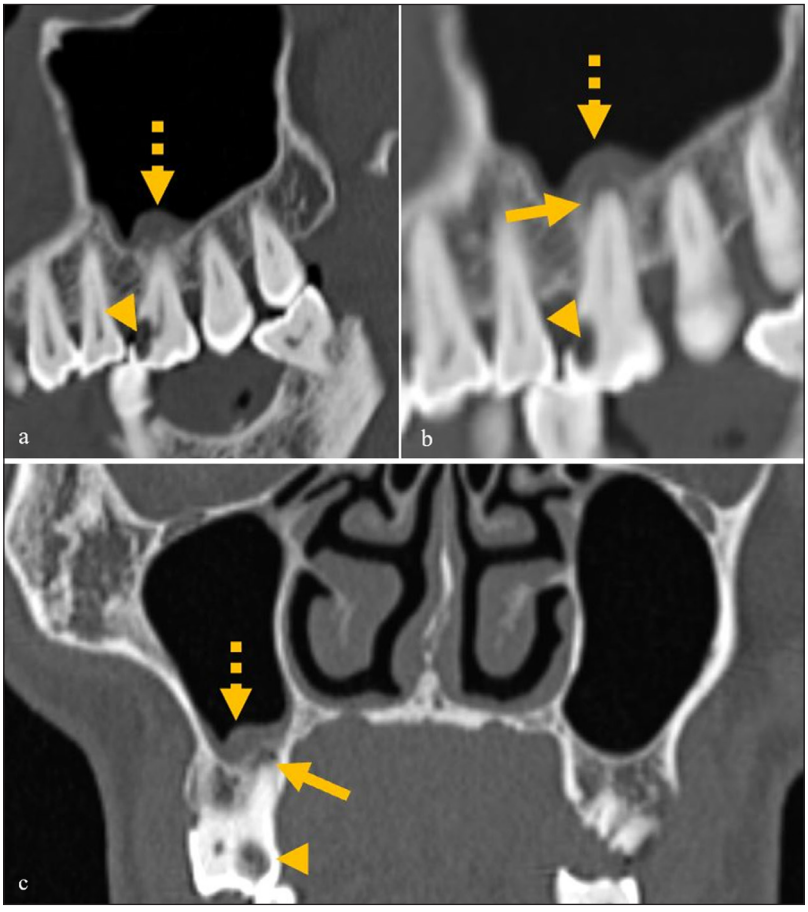

Figure 2 (a–c) A case of mild odontogenic sinusitis, showing dental caries (arrowhead) and mild periapical lucency (arrow) in the same tooth with mild mucosal thickening only adjacent to the diseased tooth (dashed arrow).

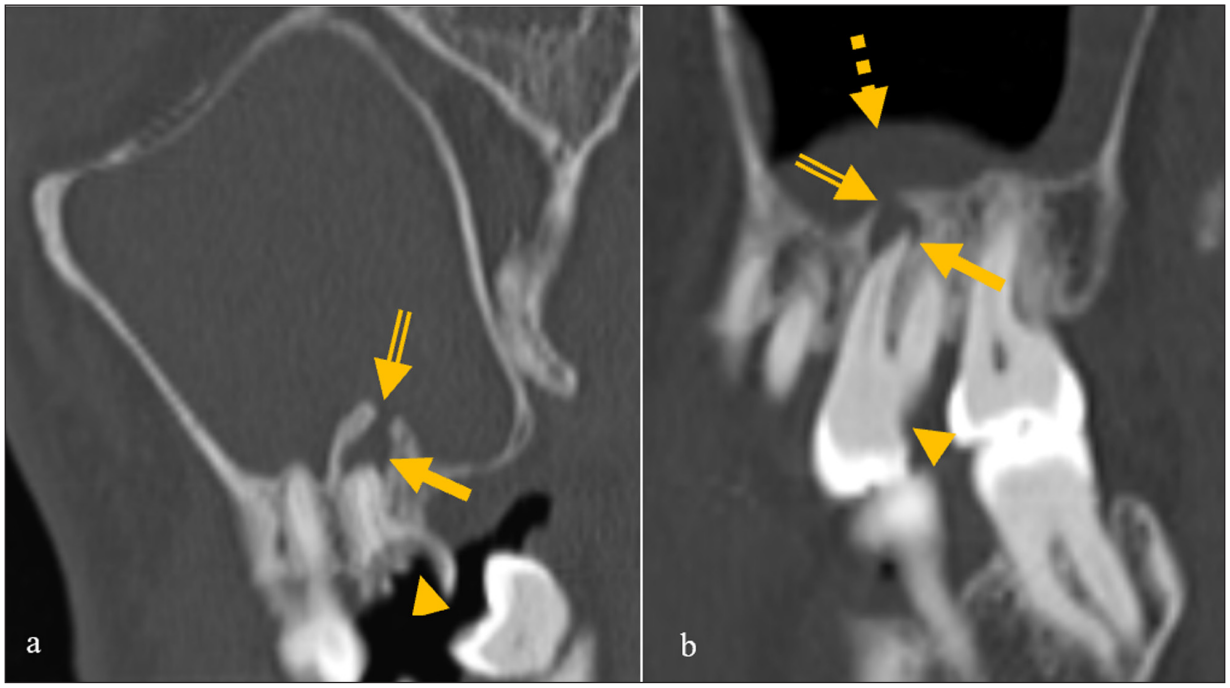

Figure 3 Images of two different patients showing dehiscence of the floor of the maxillary sinus (double lined arrow) and mucosal thickening and the causative diseased tooth with caries (arrowhead) and periapical lucency (arrow).

In 15.0% of patients (n = 24) periapical lucency was found and was mostly seen around the second molar, followed by the first and third molars respectively, and less commonly, in the premolars (1st > 2nd). Seventy-five percent of these patients had maxillary sinusitis (18/24). Of these, 44.4% (8/18) were found to have sinusitis of likely odontogenic origin, while in 50% (n = 9), origin of sinusitis was indeterminate. In one patient (5.6%) there was rhinogenic sinusitis.

The roots of one or more teeth were projecting into the floor of the maxillary sinus in 45% of patients (n = 72).

PREVALENCE, DISTRIBUTION, AND ETIOLOGY OF SINUSITIS

Many authors have defined different criteria for determining maxillary sinus pathology. Using our criteria, as defined in the methodology section, we determined the cause of sinusitis to be likely odontogenic in 30.0% (39/130) of cases, rhinogenic in 33.1% (43/130), and of indeterminate origin in 36.9% (48/130).

Of the 21 patients with unilateral solitary maxillary sinus involvement, 28.6% (n = 6) were likely odontogenic, 42.8% (n = 9) were rhinogenic, and 28.6% (n = 6) were of indeterminate cause. In the nine cases with unilateral multiple sinus involvement, 11.1% (n = 1) were likely of odontogenic origin, while 55.6 % (n = 5) were of rhinogenic origin, and 33.3% (n = 3) were indeterminate. Of the 20 patients with bilateral involvement of only the maxillary sinuses, 45% (n = 9) were of likely odontogenic origin, while 25% (n = 5) were of rhinogenic origin and 30% (n = 6) were indeterminate. In the 80 cases with bilateral multiple sinus involvement, 28.7% (n = 23) were likely of odontogenic origin, 30.0% (n = 24) were of rhinogenic origin, and 41.3% (n = 33) were indeterminate.

In our study population, 13 patients had some form of dental procedure, with treatment material/implants seen on imaging. Of these patients, 30.7% (4/13) patients did not have any sinusitis, while 69.3% (9/13) of patients had maxillary sinusitis. Of these patients 55.6% (5/9) were considered to have odontogenic origin of sinusitis ipsilateral to the prosthesis. Sinusitis was indeterminate for odontogenic origin in 33.3% (3/9) patients and rhinogenic in 11.1% (1/9) patients.

RATE OF REPORTING

The overall rate of reporting dental findings or raising the suspicion of odontogenic sinusitis was found to be 8.5% (n = 14). In 91.5% of cases, dental findings including caries, periapical lucency, or probable association of dental findings to mucosal thickening in the floor of the maxillary sinus, was not commented upon.

DISCUSSION

The incidence of dental disease in India is high. The Global burden of disease survey (2016) showed that 31% males and 33% females in India had carious permanent teeth [2]. In our study, we found that the proportion of patients with caries was much higher (80%). This ranged from early-stage disease with just enamel loss to advanced stage caries with extensive crown destruction.

The existing literature showed significant variation in the range of prevalence of periapical pathology. Maillet

et al. found that the prevalence of periapical lucency in their study was 65.4%, whereas Bajoria et al. reported a prevalence of 36.1% [3, 4].

Proximity of the apex of tooth to the floor of the maxillary sinus is an important factor that weighs in the spread of infection. Normally, the cortex of the maxilla acts as effective barrier to the spread of infection from the tooth to the maxillary sinus. However, if the apex of the tooth is close to, abutting, or projecting into floor of the maxillary sinus, only the thin Schnederian membrane may be left separating the apex of the tooth and the sinus cavity, predisposing to the spread of infection. The floor of the maxillary sinus is closest to the roots of the maxillary molar and premolar teeth with a mean distance of 1.97 mm [5]. This proximity explains why infections of the molars and premolars can easily spread to the maxillary sinus. In our study we found that in 45% of patients the tooth was abutting or projecting through the floor of the maxillary sinus. Thus, identifying and reporting dental pathology is essential to diagnose or rule out OS. Whyte et al. stated that mucosal thickening was ten times more common in individuals with periapical lesions, demonstrating the far-reaching effects of dental infection and the need to address it [6].

Although, Lindahl et al. reported that a relation to dental infections was found in 47% of cases of chronic maxillary sinusitis as early as in 1982, the incidence of OS has long been underestimated at 10–12% [7, 8]. Much of recent literature, however, estimates the prevalence more accurately. The prevalence of OS was found to be 51.8% by Maillet at al. (2011), 31% by Nascimento et al. (2016), 40% by Fredriksson et al. (2017), and 48% by Ly (2018) [3, 9–11].

In corollary, studies have also shown that 70–80% of teeth with periapical lesions are associated with OS [12, 13]. In our study 75% of cases with periapical pathology had maxillary sinus changes, of which 44.4% were determined to be of likely odontogenic origin and 50% were indeterminate, while only a meagre proportion was rhinogenic. In their 2013 article, Chapman et al. described unilateral focal related to periapical pathology as highly suspicious for a casual relation [8]. Although unilateral maxillary sinusitis in spatial relation to a diseased tooth is pathognomonic for odontogenic etiology, bilateral maxillary sinus involvement as well as multiple sinus involvement can also occur [6, 14, 15].

Apart from naturally developing dental disease, multiple studies have found iatrogenic etiology to be a significant contributor to odontogenic sinusitis [16–18]. In our study, in patients with a dental prosthesis or implant in the maxillae, we determined the cause of sinusitis was likely odontogenic in 55.6% in those with dental prosthesis, while 33.3% were indeterminate. Only one appeared to be clearly rhinogenic. This agrees with existing literature. Hence, special attention must be given to look for endo-antral syndrome in patients with odontogenic sinusitis who have had dental procedures and implants in the past.

The overall rate of reporting dental findings and consideration of odontogenic sinusitis in our study was a dismal 8.5% (n = 14). In 91.5% of cases, dental findings including caries or periapical lucency or probable association of dental findings to mucosal thickening in the floor of the maxillary sinus were not commented upon.

It stands to reason that early recognition of incidental dental disease could potentially allow patients to seek dental care in the early stages of disease – at which point the treatment protocol would be simpler and less expensive, apart from the higher likelihood of the diseased tooth being salvaged. While a CT of the head and neck regions would not be advocated merely for the detection of early-stage dental disease, there is potential for improvement in quality of life if a patient should choose to seek early help for incidentally detected disease.

Odontogenic sinusitis differs from rhinogenic sinusitis in several respects. Sinusitis due to odontogenic cause may be more severe due to the formation of biofilms [12]. Also, the microbes involved in odontogenic sinusitis are different from those involved in rhinogenic sinusitis [19]. Streptococcus pneumoniae, Hemophilus influenzae, Moraxella catarrhalis, Hemolytic streptococci, Microaerophilic streptococci, and Staphylococcus aureus are implicated in rhinogenic maxillary sinusitis. In contrast, anaerobic gram-negative oral flora including Peptostreptococcus, Fusobacterium, pigmented Prevotella, and Porphyromonas spp, predominate in dental infections and OS. Thus, OS harbours different microbes that demands vastly different antibiotics.

The overall approach to the management of OS and non-OS is also different. Treatment of the dental source is an indispensable initial step in treating odontogenic sinusitis [20]. Several studies state that failure to recognize and eliminate a dental source first may lead to failure of functional endoscopic sinus surgery (FESS) performed to treat the sinusitis [21]. The American Association of Endodontists recommends the treatment of primary endodontic infection before undertaking FESS. Newsome found that 15–20% of OMS may resolve with an antibiotic regimen, ruling out the need for surgery in some cases [14]. In their study, Tomomatsu et al found that 51% of patients improved with dental treatment and antibiotics [22]. In another study by Safidi et al., OS involving the frontal sinus was found to resolve without frontal sinusotomy once the dental infection was treated and middle meatal antrostomy was performed [23]. They stated that there was no justification for performing frontal sinusotomy for OS involving the frontal sinus and went on to state that it was in fact contraindicated.