Maxillary sinusitis of odontogenic origin: cone-beam volumetric computerized tomography–aided diagnosis

Umadevi P. Nair, DMD, MDS,[a] and Madhu K. Nair, DMD, MS, PhD,[b] Gainesville, Florida
UNIVERSITY OF FLORIDA COLLEGE OF DENTISTRY

Objective. Study of radiographic features of maxillary sinusitis of odontogenic origin as visualized on 3-dimensional advanced imaging is essential for prompt diagnosis and appropriate management. This study attempted to describe and delineate radiographic characteristics of this condition.
Study design. Three cases of failed endodontic therapy presenting with confounding clinical signs and symptoms were subjected to 3-dimensional imaging with cone-beam volumetric computerized tomography (CBVCT) to evaluate changes in the maxillary sinuses.
Results. CBVCT showed varying involvement of the ipsilateral maxillary sinus in all 3 cases. The presentation varied from presence of intrasinus fluid to reactionary osseous response within the sinus.
Conclusions. CBVCT as a diagnostic aid to evaluate the involvement of the maxillary sinuses in cases of endodontic treatment failure seems to assist with formulation of a definitive diagnosis. Appropriate interventions may be instituted, including an otolaryngology consultation. **(Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2010;110:e53-e57)**

Maxillary sinusitis originating from odontogenic infections has previously been described in the literature by various authors.[1-4] Historically, the estimated incidence has been reported to be 10%-12%.[5] Increased risk of maxillary sinusitis has been reported with periapical abscesses, periodontal diseases, dental trauma, tooth extraction, and implant placement, especially when the schneiderian membrane is perforated.[6] The patients often present with symptoms of chronic sinusitis as well as pain associated with the involved tooth. The unique presentation can pose as a diagnostic challenge due to variations in symptoms and clinical findings. Patients are often referred to the otolaryngologist owing to lack of definitive diagnosis.[3] Diagnostic challenges also stem from the use of bitewing and panoramic radiographs alone for the situation, because these imaging modalities do not quantitatively estimate the amount of bone loss.[7] Periapical radiographs, used routinely for endodontic diagnosis, do not consistently predict an oro antral communication.[8]

Recent advances in oral and maxillofacial imaging have provided dentists with information that was unavailable more than a decade ago. Cone-beam volumetric computerized tomography (CBVCT), is a new technique that produces 3-dimensional (3D) images at reduced radiation doses than conventional computerized tomography (CT).[9] We present herein a series of cases that posed a diagnostic challenge. The presence of maxillary sinusitis resulting from odontogenic infection was confirmed through CBVCT studies.

CASE 1

A 62-year-old African American woman presented to the graduate endodontic clinic for evaluation of tooth #14. Medical history was significant in that the patient was on Actonel (bisphosphonates) for management of severe osteoporosis for the past 3 years. Clinical exam revealed extensive restoration of the maxillary and mandibular teeth with crowns and bridges. Tooth #14 had previous root canal therapy and was part of a long-span fixed dental prosthesis. The tooth responded positively to percussion and palpation. There was 10 mm probing depth along the mesiobuccal root (Fig. 1). The patient complained of postnasal dripping whenever she was positioned in the dental chair with the chin raised to facilitate clinical examination. Periapical radiograph revealed the presence of periradicular radiolucency along the mesiobuccal root (Fig. 2). Because the presentation was classic for a vertical root fracture, visualization of the fracture was important. After consultation with the patient's physician, it was determined that the patient was a poor candidate for surgical treatment, given the history of bisphosphonate therapy. Reflection of the gingival tissue, without exposing any bone, to visualize the fracture was unsuccessful. The next treatment option was to remove the fillings from the root canals and to attempt to visualize the fracture through the surgical microscope. Upon accessing, the canals were found to be obturated using Thermafil carriers. When the carrier was removed from the mesiobuccal canal, there was a significant amount of serous fluid that drained from the canal. The patient subsequently had a CBVCT study done using the iCAT unit (Imaging Sciences International, Hatfield, PA). The CBVCT images showed almost complete obliteration of the patient's

[a]Assistant Professor, Endodontics.
[b]Associate Professor and Chair, Oral Diagnostic Sciences.
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Fig. 1. Ten-mm probing along the mesiobuccal root of tooth #14.

Fig. 2. Periapical radiograph, revealing radiolucency around the mesiobuccal root.

left maxillary sinus with presence of fluid and also a direct communication of the mesiobuccal root with the left sinus (Figs. 3–5). There was an associated loss of buccal cortical plate on the mesiobuccal root. A poor prognosis of the tooth was determined owing to the excessive loss of bone around

Fig. 3. Sagittal view CBVCT, showing communication of the mesiobuccal root with the maxillary sinus with fluid collection in the ipsilateral sinus.

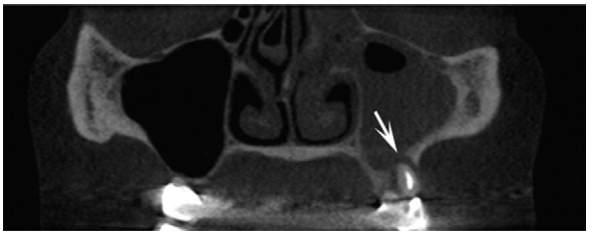

Fig. 4. Coronal view CBVCT.

the roots. The lack of mobility on the tooth was attributed to the presence of the long-span bridge. The patient was referred to oral surgery for extraction of tooth #14. A definitive diagnosis of a vertical root fracture of the mesiobuccal root was confirmed during extraction. After extraction, the patient had severe postoperative swelling and infection for which she was hospitalized and treated. The patient reported 1 month later for a follow-up evaluation, at which time all sinus-related complaints had resolved.

CASE 2

A 63-year-old European American woman was referred by a general dentist for evaluation of tooth #14. The tooth had a 9 mm probing depth along the mesiobuccal root. There was mild swelling and tenderness to palpation on the buccal radicular surface. The periapical radiograph revealed a radiopaque lesion in relation to the roots of the tooth (Fig. 6, *a*). CBVCT was acquired using the 3D Accuitomo 80 unit (J. Morita, Kyoto, Japan) to further evaluate the extent of the lesion. The study revealed a well circumscribed radiopaque mass in relation to the mesio-

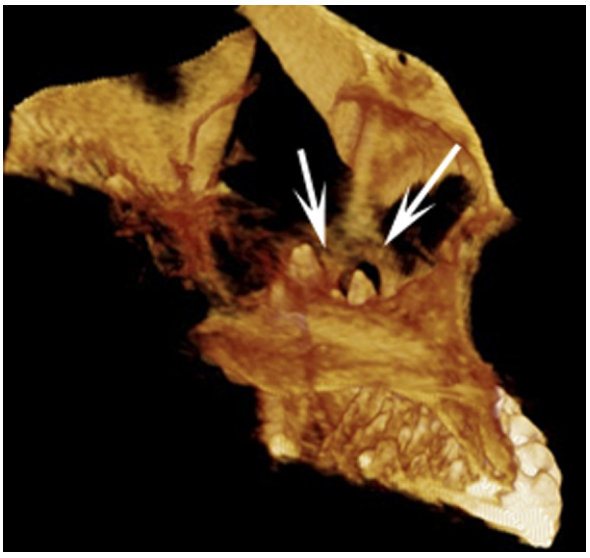

Fig. 5. Volumetric rendering of the left maxillary sinus from above, showing perforation of the inferior alveolar plate.

buccal root and extending into the sinus. This was determined to be reactive bone deposition in response to chronic inflammation (Fig. 6, *b* and *c*). There was associated bone loss along the mesial root, and a vertical root fracture was evident on the mesiobuccal root (Fig. 6, *b*). It was decided to resect the fractured root. During the surgical procedure, there was minimal sinus exposure, and healing was uneventful after root resection.

CASE 3

A 60-year-old female patient presented with continued pain and discomfort in relation to tooth #6 after root canal therapy. The tooth was originally necrotic with symptomatic apical periodontitis. The periapical radiograph did not reveal any radiolucency. Although the fill appeared to be adequate, the tooth was sensitive to percussion and palpation. The tooth was retreated, but symptoms remained the same (Fig. 7). A CBVCT study was conducted using the 3D Accuitomo 80 unit to check the relationship of the tooth to the sinus before surgical treatment, because the length of the tooth was 28 mm. The CBVCT revealed fluid level filling almost half of the sinus. The root was in close proximity to the sinus (Figs. 8 and 9), and the buccal cortical plate was intact. A conservative approach to treatment was decided on, and the patient was referred to an otorhinolaryngologist for treatment of the sinus infection, which resulted in resolution of her complaints. The patient could not be brought back for recall visits, because her symptoms had resolved.

DISCUSSION

These 3 cases demonstrate the variation in presentation of maxillary sinusitis attributable to odontogenic infections. In case 1, the patient complained of a postnasal drip, which was in fact suggestive of a sinus infection. The periapical radiograph failed to show the sinus involvement before the procedure. The chronic periapical pathology had led to the sinus involvement in this case. The communication between the sinus and the periodontal pocket was not established, because no drainage was evident through the periodontal pocket. In case 2, the vertical root fracture on the mesiobuccal root had served as a source of chronic inflammation, and its proximity to the sinus had resulted in reactive bone formation into the sinus. The reaction of the sinus mucosa to chronic inflammation, in this case, cannot be categorized as sinusitis, because there was no fluid accumulation in the sinus. The third case may have been sinusitis induced by periapical inflammation on tooth #6, which failed to resolve with endodontic treatment and retreatment. The possibility of the sinusitis being independent of the odontogenic source cannot be ruled out in this case, because there was no apparent periapical pathology associated with tooth #6. The patient could have been experiencing referred pain from sinusitis. The thickness of the anterior wall of the maxillary sinus varies from 2 to 5 mm, and the thinnest portion is in the center of the canine fossa.[1] Apicoectomy of #6 in this case would have created an oroantral communication, and this was a deciding factor to first treat the patient conservatively. Specific treatment for maxillary sinusitis was required to treat the patient's symptoms.

Maxillary sinuses, by virtue of their anatomic location, can be easily invaded by microorganisms from the oral cavity. The mesiobuccal root of the maxillary second molar was shown to be closest to the sinus in a study using CT scans.[10] Diagnosis of sinusitis of odontogenic origin requires thorough clinical evaluation and acquisition of appropriate radiographs. The various radiographs used to visualize the maxillary sinus include panoramic radiograph and specialized skull views, such as the Water projection. CT is considered to be the gold standard for adequate maxillary sinus imaging, because it allows visualization of bone and soft tissue and has the ability to obtain thin sections and generate multiplanar views for interactive viewing.[2] A recent retrospective study of CTs from a 6-year period that reported a diagnosis of acute maxillary sinusitis indicated a correlation between the levels of fluid in the maxillary sinuses as seen on axial images to the presence of odontogenic infections. The presence of odontogenic infections were based on 3 radiographic findings: 1) projecting tooth root into the sinus; 2) periapical abscess; and 3) oroantral fistula. That study found a direct correlation between the amount

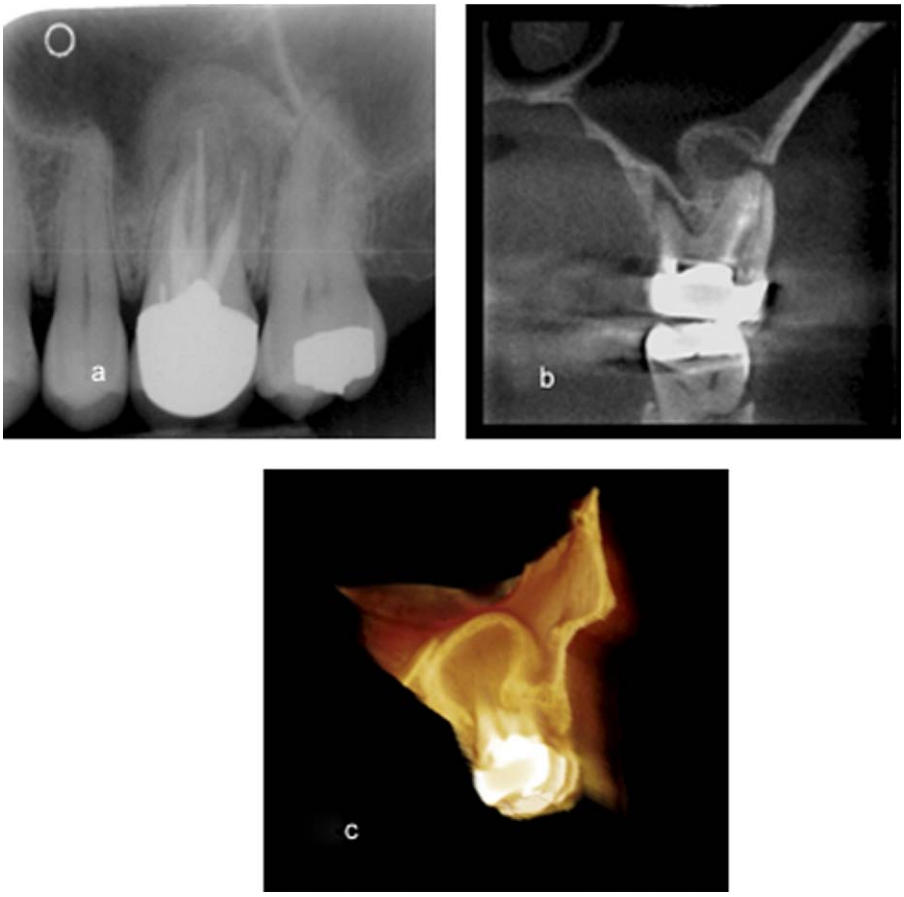

Fig. 6. **a,** Periapical radiograph, showing radiopaque mass around the roots of tooth #14. **b,** Coronal view CBVCT, showing vertical root fracture on the mesiobuccal root and reactive bone formation within the sinus. Associated mucosal thickening is also noted. **c,** Volumetric rendering of the left maxillary sinus, showing reactive bone formation.

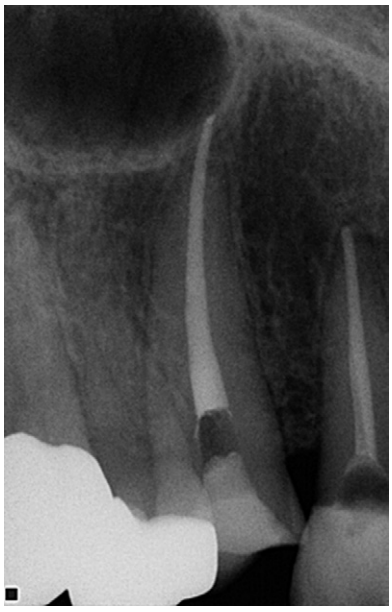

Fig. 7. Periapical radiograph of tooth #6 after retreatment. No periapical pathology was noted on the radiograph.

of fluid level and the presence of odontogenic infections. The incidence was 17% when the sinus had a fluid level of less than one-third of its volume, and increased markedly to 79% when the fluid level increased to more than two-thirds. Maxillary sinuses with more than two-thirds' fluid presence and mucosal thickening had identifiable dental sources in 86% of cases.[3]

Maxillary sinusitis of dental origin has been shown to be associated with marginal periodontitis as frequently as with periapical pathology.[4] The latter authors proposed the diagnosis of chronic sinusitis of dental origin to be associated with the presence of an oroantral fistula, a close connection between the sinus mucosa and the apex of a nonvital tooth, or a periodontal or periapical pathology.[4] Presence of fluid levels within the maxillary sinus during a radiographic exam can be considered to be closely correlated with acute bacterial sinusitis, and the volume of sinus fluid is directly proportional to possi-

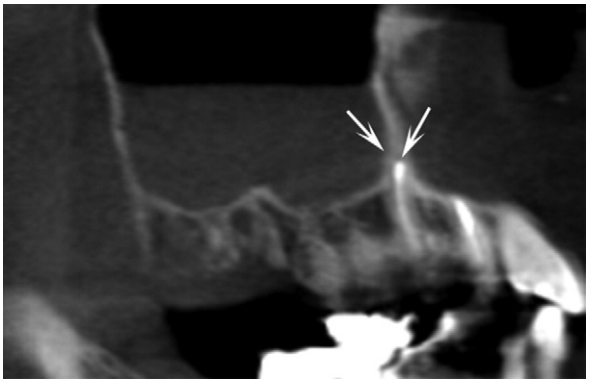

Fig. 8. Sagittal view CBVCT, showing close relationship of the root apex to the maxillary sinus with collection of fluid.

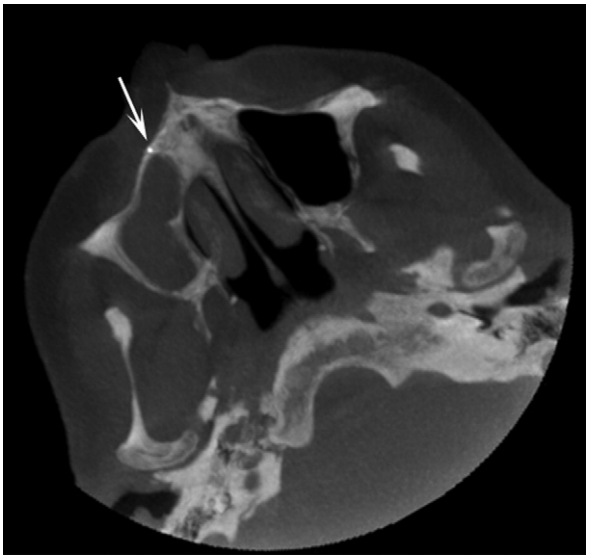

Fig. 9. Axial view CBVCT, showing fluid collection in the maxillary sinus and the relationship of the root tip of tooth #6 to the sinus.

bility of finding a concurrent odontogenic infection.[3] Sinusitis originating from odontogenic infections should be considered to be different, owing to the difference in pathophysiology, microbiology, and management.[1] A higher incidence of anaerobic bacteria has been reported in acute maxillary sinusitis resulting from odontogenic infections.[2] The presence of anaerobic organisms in periapical abscess and the corresponding maxillary sinuses has also been reported.[11] The incidence of aspergillosis of the sinus as a reaction to extruded sealer has also been reported in literature.[12] This is seen most commonly with zinc oxide–based sealers, because zinc is indispensible for the growth of *Aspergillus*.[13] The value of CT imaging in the diagnosis of orbital abscess after root canal therapy has also been reported.[14]

The relatively high incidence of maxillary sinusitis resulting from an odontogenic infection should be taken into consideration during diagnosis. The above case reports illustrate the added value of a low-dose, low-cost, and easily accessible 3D imaging modality as an aid in diagnosis of challenging cases.

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Reprint requests:

Madhu K. Nair, DMD, MS, PhD
P.O. Box 100414
Gainesville, FL 32610-0414
nairmk@radiology.ufl.edu