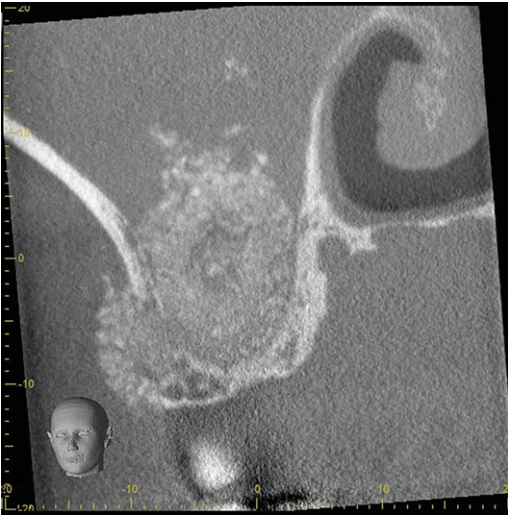


Management of Wound Infection and Acute Bacterial Rhinosinusitis After Sinus Elevation Surgery: A Case Report

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Introduction: Sinus graft infection with consequent acute bacterial rhinosinusitis (ABRS) is a complication that can occur during the postoperative period following sinus augmentation surgery. A small group of bacteria appear to predominate in ABRS, and these bacteria are empirically susceptible to tetracycline antibiotics, barring the presence of resistant strains. Historically, clinicians have mixed tetracycline with various biomaterials or hydrated biomaterials in a dilute tetracycline solution in the treatment of periodontal disease and for ridge preservation/augmentation indications.

Case Presentation: In the present case, a 39-year-old African-American male with sinus graft infection and signs and symptoms consistent with ABRS was successfully treated by removing the initial graft material, thoroughly debriding and irrigating the antrum, and placing a freeze-dried bone allograft hydrated in an aqueous tetracycline solution.

Conclusion: Given the typical bacteria present in ABRS, locally applied tetracycline may be useful prophylactically in sinus elevation surgery or as an adjunct in managing postoperative sinus graft infection. *Clin Adv Periodontics* 2018;8:54–60.

Key Words: Allografts; dental implants; histology; maxillary sinusitis; surgical wound infection; tetracyclines.

Background

Wound infection with signs and symptoms of acute bacterial rhinosinusitis (ABRS) after sinus elevation procedures can occur, with reported incidences of sinus graft infection ranging from $\approx 1\%$ to $\approx 12\%$.¹⁻³ Moreno Vazquez

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et al.³ found that 15 of 127 patients (11.8%) undergoing sinus augmentation surgery experienced wound infection, abscess, dehiscence with drainage, or signs and symptoms of sinusitis. Smokers, patients with uncontrolled diabetes, and immunocompromised patients appear more susceptible to acute complications, whereas patients reporting a history of repeated sinusitis episodes are at increased risk for the rare but distressing complication of chronic sinusitis.⁴⁻⁶ In 2012, an expert panel provided a 19-point list of recommendations for reducing incidence of infection-related complications after sinus augmentation surgery.⁷ Antibiotic prophylaxis, preoperative skin disinfection, and use of sterile draping were among the recommendations.⁷

Received May 29, 2017; accepted July 20, 2017

doi: 10.1902/cap.2017.170039



FIGURE 1 Initial buccal view of tooth #3 area demonstrating slight horizontal ridge deficiency.



FIGURE 4 FDDB in place.

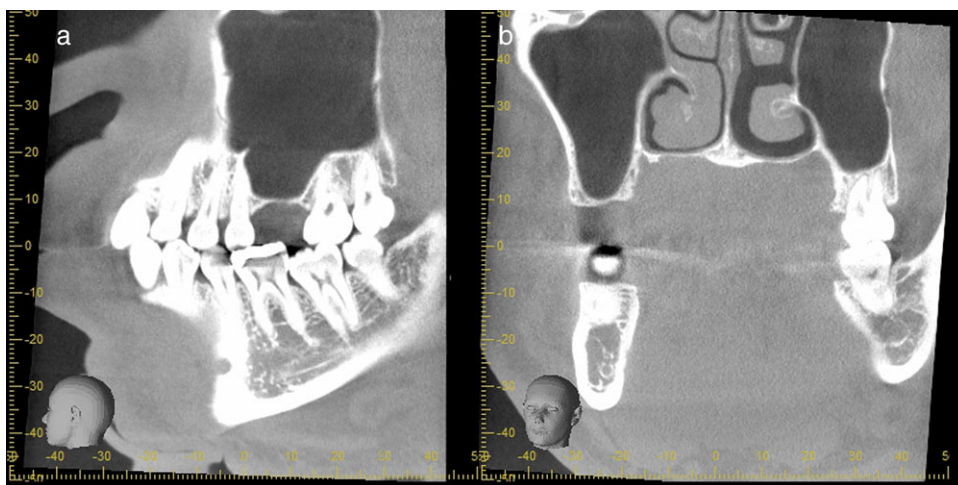


FIGURE 2 Preoperative CBCT image. **2a** Sagittal view. **2b** Coronal view. The maxillary sinuses appear clear bilaterally, and the nasal mucosa on the right side is thickened. The right maxillary sinus is severely pneumatized.

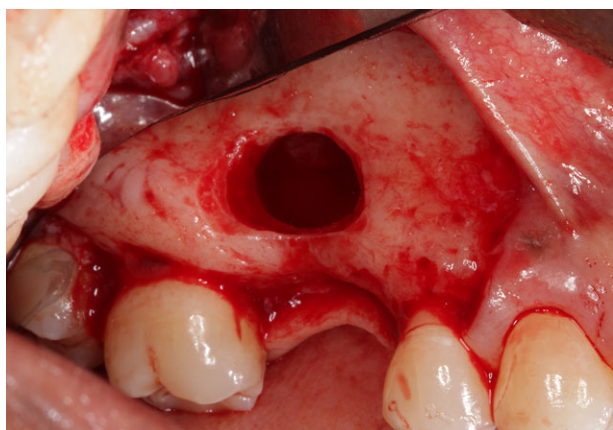


FIGURE 3 Position of lateral window; no damage to Schneiderian membrane detected.

One option for managing sinus graft infection is to selectively remove the infected portion of the graft, thoroughly irrigate the remaining graft, refrain from placing additional biomaterial, and monitor healing over an extended period.² Another approach involves complete bone graft removal and debridement of the sinus without placement of any additional biomaterial.⁸ The present case suggests locally applied tetracycline hydrochloride

(TTC) may be a useful adjunct in the setting of wound infection after sinus elevation and concomitant signs and symptoms of ABRs.

Clinical Presentation

A patient presented December 10, 2015, to Tingay Dental Clinic, Fort Gordon, Georgia, missing tooth #3 (Fig. 1). Cone-beam computed tomography (CBCT) revealed \approx 1 mm bone thickness between the osseous crest and sinus floor (Fig. 2). The Chief Resident (AL) discussed alternative therapies

with the patient, who elected sinus augmentation for subsequent implant placement. A 9×12 mm ovoid window in the lateral wall exposed the Schneiderian membrane, which was gently elevated along the sinus floor and superiorly along the medial wall (Fig. 3). The sinus membrane expanded and contracted with respirations, and no perforation was detected on visual inspection. Thorough irrigation of the surgical site and antrum did not present fluid from the nose, and exhaling while occluding the nose did not produce bubbles in the lateral window. A freeze-dried bone allograft (FDDB)[†] hydrated in normal saline was placed in the sinus, and the surgical access was covered with a bovine pericardium membrane[§] (Fig. 4). The surgical site was closed using nonresorbable sutures,^{||} and healing during the first week proceeded uneventfully. The patient received postoperative analgesics and a 1-week course of amoxicillin (500 mg three times daily). Day 19 post surgery, the patient described nasal congestion with

[†]Oragraft, LifeNet Health, Virginia Beach, VA.

[§]CopiOs, Zimmer Biomet, Warsaw, IN.

^{||}CV-5 Gore-Tex, W.L. Gore and Associates, Newark, DE.



FIGURE 5 Local fluctuant swelling and yellow pustule noted day 23 post surgery.



FIGURE 7 Tetracycline-hydrated FDBA in place after careful debridement and thorough irrigation of the antrum with 90 mL normal saline.

Case Management

The complication was explained to the patient, who consented in writing to complete graft removal, thorough antral lavage, and assessment of the sinus for placing a second graft. On reentry, scant purulence was noted, and the graft material was meticulously debrided to clear the antrum. The antrum was thoroughly flushed with 90 mL normal saline with no fluid flow from the nose. Membrane

perforation was anticipated based on CBCT assessment but not detected intraoperatively despite careful inspection, possibly suggesting membrane repair in response to systemic doxycycline. The intact Schneiderian membrane was fixed in a superior position and did not expand or contract upon respirations. The medial wall of the maxillary sinus was readily visible using loupes and illumination. An amnion-chorion membrane[¶] was trimmed and placed in contact with the inferior aspect of the Schneiderian membrane to protect against a clinically undetectable perforation. FDBA was hydrated in an aqueous TTC solution (50 mg/mL) for 5 minutes, rinsed twice with normal saline, and placed into the sinus (Fig. 7). A collagen membrane[#] was placed over the access lateral window. The site was closed and allowed to heal for 8.5 months. The patient was advised to complete his previously prescribed course of doxycycline.

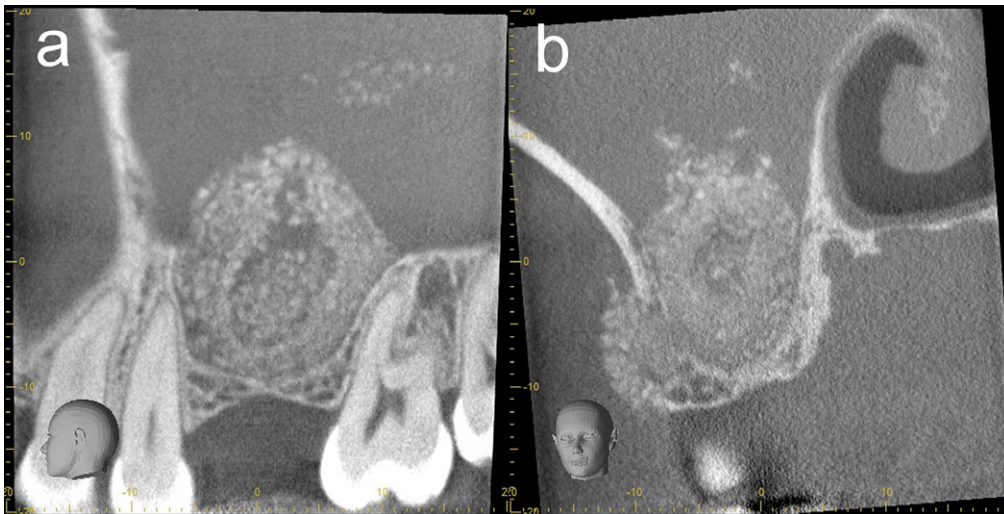


FIGURE 6 CBCT image of sinus graft infection day 23 post surgery. **6a** Sagittal view. **6b** Coronal view. A well-circumscribed radiolucent area within the allograft, expansion of allograft particles beyond the margin of the lateral window, and loose biomaterial particles erupting into the maxillary sinus were noted. Most of the contaminated biomaterial appeared contained and accessible to an oral approach. In a more posterior CBCT slice, the ostium appeared free of obstruction. Mucociliary clearance was expected to eliminate escaped particles. Removal of the contaminated biomaterial particles as soon as possible was a treatment priority.

sinus pressure and was prescribed saline nasal spray and a 14-day course of doxycycline (100 mg twice daily). Day 23 post surgery the patient presented with increased severity of previous symptoms in addition to headache, purulent nasal drainage, and a yellow pustule in the area of tooth #3 (Fig. 5). CBCT evaluation suggested breach of the Schneiderian membrane (Fig. 6). A diagnosis of ABRS secondary to sinus graft infection was made.⁹

[¶]BioXclude, Sinoasis Medical, Golden, CO.

[#]BioMend, Zimmer Biomet.

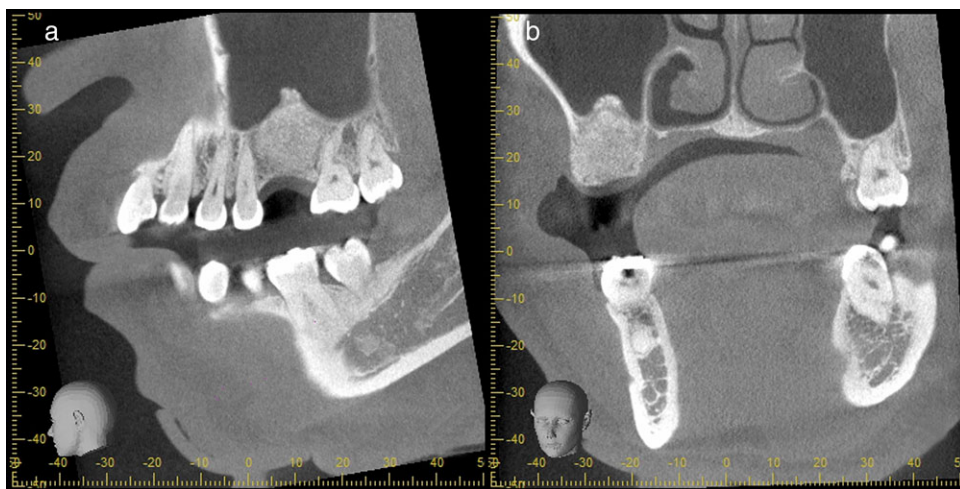


FIGURE 8 CBCT image 8.5 months after second sinus procedure. **8a** Sagittal view. **8b** Coronal view. A dome-shaped radiopacity in the grafted area was covered by a thickened Schneiderian membrane. Discrete radiopacities within the Schneiderian membrane suggest incorporation of graft material from the original procedure.

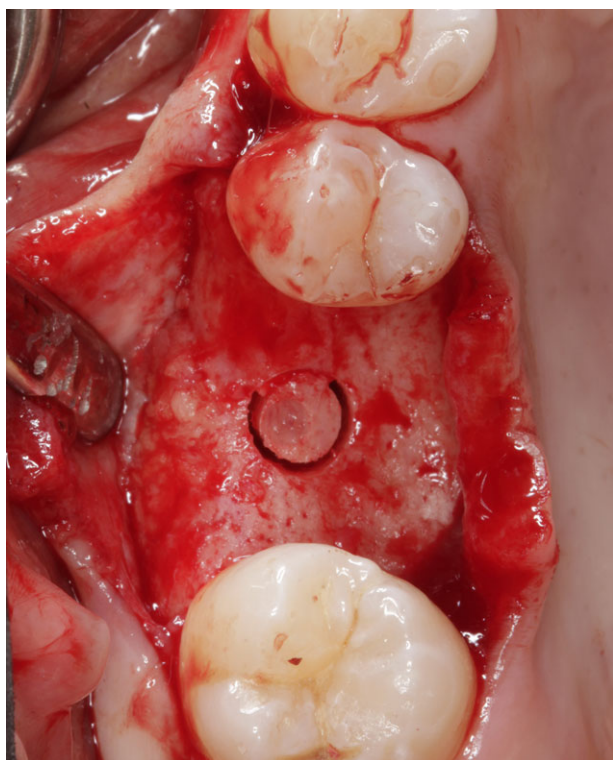


FIGURE 9 Edentulous ridge in tooth #3 area 6 months after tetracycline-hydrated FDBA placement. A \varnothing 4.25-mm bone core biopsy was obtained.

Clinical Outcomes

Symptoms were substantially reduced within 48 hours and virtually absent at 1 week. Upon reentry, a \varnothing 4.25-mm bone core biopsy was obtained to assess composition of the sinus graft, and a \varnothing 6 \times 11.5-mm implant** was placed with 45-Ncm insertion torque (Figs. 8 through 14). Histologic assessment showed a combination of new vital

**Osseotite Certain, Zimmer Biomet.

bone, residual graft particles, and scar-like connective tissue (Fig. 15).

Discussion

Rhinoviruses, influenza and parainfluenza viruses, coronaviruses, and human respiratory syncytial virus account for the majority of nonodontogenic sinus infections; bacterial infection occurs secondarily in only a small proportion of cases.⁹ Viral sinusitis is usually self-limiting, and ABRS is diagnosed clinically when symptoms persist 7 to 10 days or worsen after 5 to 7 days.⁹ The maxillary

sinus microbiota is distinct from that of the oral cavity, and some opportunistic species present in noninflamed sinus aspirates are also associated with acute sinusitis.^{9,10} Empirically, *Haemophilus influenzae*, *Streptococcus pneumoniae*, *Moraxella catarrhalis*, and *Staphylococcus aureus* are the predominant species in ABRS.^{5,9} In 2003, limited evidence supported use of penicillin or amoxicillin as recommended ABRS treatment.¹¹ Since then increasing rates of resistance to β -lactam antibiotics in ABRS-associated bacteria has led to a preference for amoxicillin-clavulanate.^{9,12}

Tetracycline antibiotics bind the 30S ribosomal subunit, inhibiting bacterial protein synthesis. Upon systemic or topical administration, TTC substantively binds mineralized tissue.¹³ In vitro, dentin slabs immersed in a 50-mg/mL solution retained biologically active TTC concentrations over at least 48 hours.¹³ With repeated oral dosing, TTC concentrations in maxillary sinus secretions approach serum concentrations, although saliva

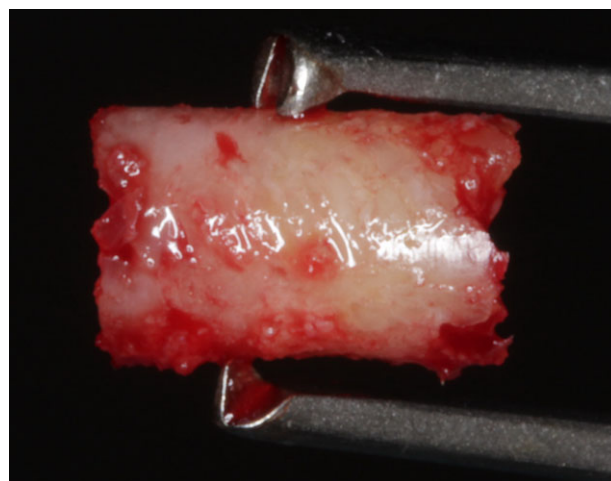


FIGURE 10 Bone core biopsy (\varnothing 4.25 \times 7 mm) obtained during implant placement. Quality of the bone core appeared clinically favorable, and the grafted area retained a faint yellow color attributable to the tetracycline.

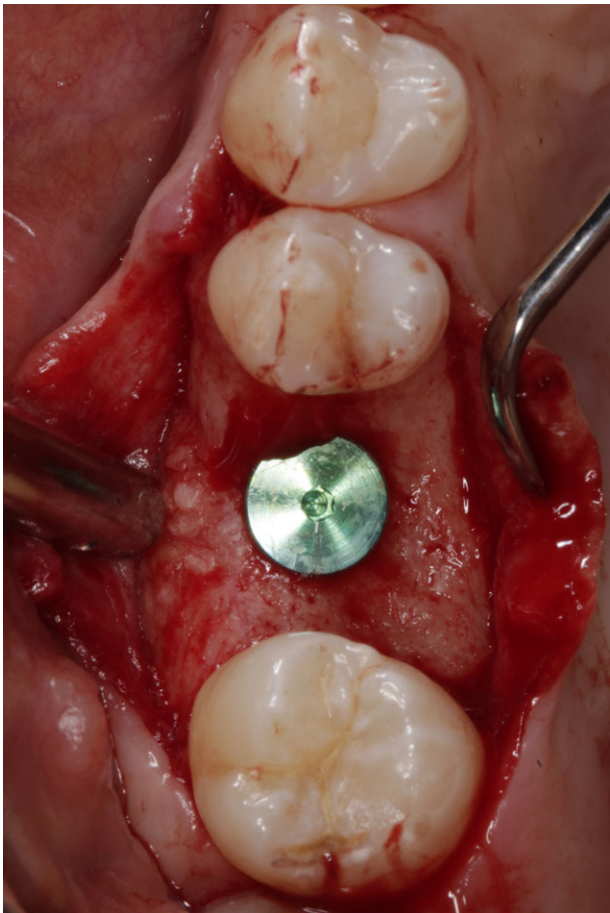


FIGURE 11 Implant in place, tooth #3 area.



FIGURE 12 Periapical radiograph at time of $\phi 6 \times 11.5$ -mm implant placement.

and tear concentrations remain low.¹⁴ Locally applied TTC has been used in an attempt to enhance bone regeneration in ridge preservation/augmentation procedures as well as in the treatment of periodontitis and peri-implantitis.¹⁵⁻¹⁹ TTC is effective against the bacterial species most frequently associated with ABRS. Indeed, systemic doxycycline is recognized as an alternative to amoxicillin-clavulanate as a first-line antibiotic in ABRS treatment.^{9,12} ■



FIGURE 13 Definitive restoration 6 months after implant placement. Peri-implant mucosa appeared healthy.



FIGURE 14 Radiograph 6 months after implant placement demonstrating stable peri-implant bone levels located at approximately the first thread.

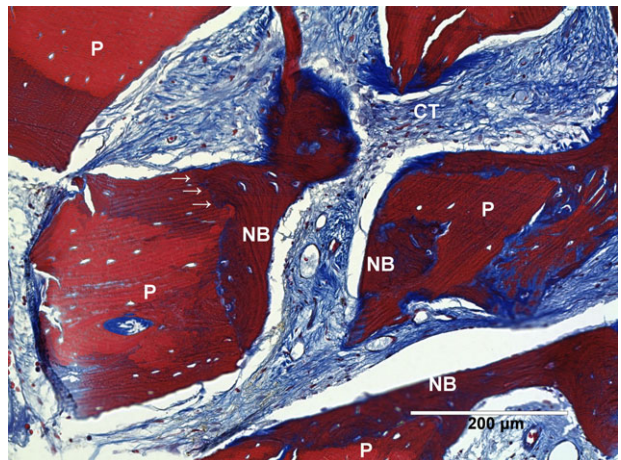


FIGURE 15 Histology of bone core biopsy exhibiting new bone (NB) with viable osteocytes, residual graft particles (P) with empty lacunae, cement lines (arrows) at junctions between new bone and allo-graft particles, and dense, scar-like connective tissue (CT). (Modified Masson trichrome staining; original magnification $\times 20$.)

Summary

Why is this case new information?	<ul style="list-style-type: none"> Locally applied TTC may be particularly useful in sinus elevation procedures given the resident microflora and TTC spectrum of activity.
What are the keys to successful management of this case?	<ul style="list-style-type: none"> A prompt decision to treat or refer with emphasis on removal of infected biomaterial appears essential. Dental specialists may be in the best position to effectively manage sinus graft infection without an untoward impact on implant site development. However, this approach demands close patient monitoring, clinical judgment, and timely referral when necessary.
What are the primary limitations to success in this case?	<ul style="list-style-type: none"> Bacterial resistance to TTC is a limiting factor, with prevalence varying regionally. Data are needed confirming that postoperative sinus infections and community-acquired ABRS exhibit similar microbial profiles. Intuitively, adding biomaterial at reentry surgery may increase risk of persistent or repeat infection. However, data comparing outcomes for reported treatment alternatives do not exist.

Acknowledgments

The authors thank Professor Ulf ME Wikesjö, Department of Periodontics, Oral Biology Laboratory for Applied Periodontal and Craniofacial Regeneration, Augusta University, The Dental College of Georgia, Augusta, Georgia, for his assistance with editing the manuscript. The authors also thank Professor Douglas P. Dickinson, Army Postgraduate Dental School, Uniformed Services University of the Health Sciences, Fort Gordon, Georgia, for his assistance producing the photomicrograph. Finally, the authors recognize CPT Nathan Kosiba, US Army Advanced Education Program in Prosthodontics, Fort Gordon, Georgia, for providing the restorative treatment in this case. The views expressed in this manuscript are those of the authors and do not necessarily reflect the official policy of the Department of Defense, the Department of Army, the Army Medical Department, Uniformed Services University of the Health Sciences, or the US Government. The authors report no conflicts of interest related to this case report.


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