

First report of an acute purulent maxillary sinusitis caused by *Pseudomonas aeruginosa* secondary to dental implant placement in an immunocompetent patient

C. D'Ovidio,¹ A. Carnevale,² G. Pantaleone,³ A. Piattelli⁴ and G. Di Bonaventura⁵

IN BRIEF

- Removal of dental implants should be considered when infection occurs in the case of simultaneous augmentation and implantation.
- *P. aeruginosa* can cause acute purulent maxillary sinusitis secondary to maxillary sinus augmentation.
- Dental facilities require systematic application of reliable methods to prevent or reduce exposure of patients and dental staff to microbial contamination.

PRACTICE

Study design In this case report, we present maxillary *Pseudomonas aeruginosa* sinusitis in an immunocompetent patient who underwent an autologous bone transplant for the insertion of dental implants. **Results** The infection was eradicated after removal of the dental implants and long-term antibiotic therapy. **Conclusion** Despite the infection resolution, severe complications were observed with important legal consequences.

INTRODUCTION

Odontogenic infections are epidemiologically relevant, since they are one of the main causes of consultation in dental practice and primary care. Although these infections affect a large portion of the population, and can produce serious complications if not treated quickly and adequately, few epidemiological and clinical studies have been reported in the literature.¹⁻³

Pseudomonas aeruginosa infection following dental treatment, though not frequent, is well described in the immunocompromised population, including the elderly, organ transplant recipients, HIV-infected patients, cancer patients, and those on immunosuppressive therapy.^{4,5} It is, however, very uncommon in immunocompetent patients.

In this article, we report a case of an acute purulent maxillary sinusitis, sustained by *P. aeruginosa*, secondary to a bone regeneration procedure using autologous bone

for dental implants insertion, in a patient without any known immunodeficiencies.

CASE REPORT

A 52-year-old man, with no previous medical history, presented at the Maxillo-Facial Surgical Division of Torrette Hospital of Ancona for the insertion of two implants, after a right maxillary sinus augmentation procedure. The autologous bone, used in the sinus augmentation procedure, was retrieved from the chin area using a low-speed (600-50,000 rpm) straight handpiece for implant cooling the drill with a sterile physiological saline solution.

The block (6 × 1 cm) was inserted into the cavity of the right maxillary sinus floor, through repositioning the Schneider membrane in a cervical sense, with Caldwell-Luc method, and was set to the sinus floor with two plants. Immediately after surgery, there was no perforation of the Schneider membrane and there was a perfect primary stability.

Although the patient received antibiotic prophylaxis with amoxicillin 2 g/day (Velamox 1 g, Mediolanum Farmaceutici S.p.A.), and was treated with chlorhexidine before and after surgery, two days after the surgical procedure he referred the presence of severe pain and swelling with local wound dehiscence in the mandibular area and, three days later, also in the maxillary area. The patient was then admitted to another hospital

for a second maxillary sinus Caldwell-Luc revision, showing the dissemination of the infection to the ethmoid; therefore, the plants and bone graft were removed.

Cultures obtained from pus and gingival swab both revealed *P. aeruginosa* infection. Based on susceptibility test results, an antibiotic therapy was started with imipenem 500 mg/day (Tienam 500 mg, Merck Sharp & Dohme, Italy) and maintained for one year.

Then, two other Caldwell-Luc surgeries were necessary because of the presence of an oro-antral fistula. Dehiscence of the wound caused by infection persisted in the chin area also, resulting in pulpal necrosis of six teeth (33, 32, 31, 41, 42 and 43) that underwent endodontic treatment. Repeated surgery – necessary for the persistence of infection – made it clear that lowering of the right orbital floor was necessary. Despite the successful antibiotic treatment, a follow-up examination revealed the following consequences secondary to the *P. aeruginosa* post-surgical superinfection and multiple surgical treatments: a) lowering of the right orbital floor (Fig. 1a); b) pulpal necrosis of six teeth (Fig. 1b); iii) hypoesthesia of the maxillary and mandibular branch of the right trigeminal nerve.

DISCUSSION

In this paper we report for the first time, to the best of our knowledge, a case of

¹⁻³Department of Medicine and Aging Science, Section of Legal Medicine, 'G. d'Annunzio' University of Chieti-Pescara, Italy; ⁴Dental School, 'G. d'Annunzio' University of Chieti-Pescara, Italy; ⁵Department of Biomedical Sciences, Center of Excellence for Aging, 'G. D'Annunzio' University Foundation, Chieti, Italy
*Correspondence to: Cristian D'Ovidio
Email: cridov@yahoo.it

Refereed Paper

Accepted 21 July 2011

DOI: 10.1038/sj.bdj.2011.723

©British Dental Journal 2011; 211: 205-207

acute purulent maxillary sinusitis by *P. aeruginosa* secondary to dental implant placement in the augmented sinus of an immunocompetent patient.

The source of infection in this patient cannot be determined with certainty. However, since the presence of *P. aeruginosa* in the oral cavity is infrequent, it is plausible to hypothesise the infection derived from lack of aseptic conditions.

The majority of dental procedures use relatively large quantities of water for irrigation, cooling of instruments and oral rinsing. Numerous studies have shown that the problem of bacterial contamination of dental unit water lines (DUWLs) is widespread.^{6–10} Microbial DUWLs contamination generally arises from municipal water piped into the dental unit, working hand-pieces of a unit, suck-back of patient saliva into the line, and the biofilm formed inside DUWLs. In particular, biofilms – sessile microbial communities exhibiting greater resistance to surfactants, biocides and antibiotics than their planktonic counterpart¹⁰ – can constantly release bacteria,¹¹ thus providing a reservoir for continuous high-level contamination of DUWLs.^{6, 12, 13}

P. aeruginosa is the most frequent contaminant of DUWLs, being isolated in up to 50% of samples of dental unit water at concentrations of up to 2×10^5 CFU/ml.^{13–16} This microorganism is able to thrive in low nutrient environments such as distilled water, often exhibits resistance to antibiotics and disinfectants such as chlorhexidine and iodophors,¹⁷ and it is able to form biofilms in DUWLs, where it not only survives but proliferates waiting for susceptible hosts.^{18–20}

P. aeruginosa is a medically important pathogenic bacteria, causing a broad spectrum of diseases, especially in immunocompromised individuals.^{4,5} A prospective study showed that *P. aeruginosa* isolates recovered from the turbine waterlines caused gingival abscesses only in two immunocompromised patients, while a transient colonisation of the oral cavity of 78 healthy patients did not provoke any adverse health consequences.⁴

Although the infective dose for colonisation in healthy individuals ($>1.5 \times 10^6$ cfu/ml) is rarely encountered in DUWLs,²¹ it could be plausible that previous antibiotic treatment made the present patient more susceptible, thus lowering the required *P. aeruginosa* infectious dose.

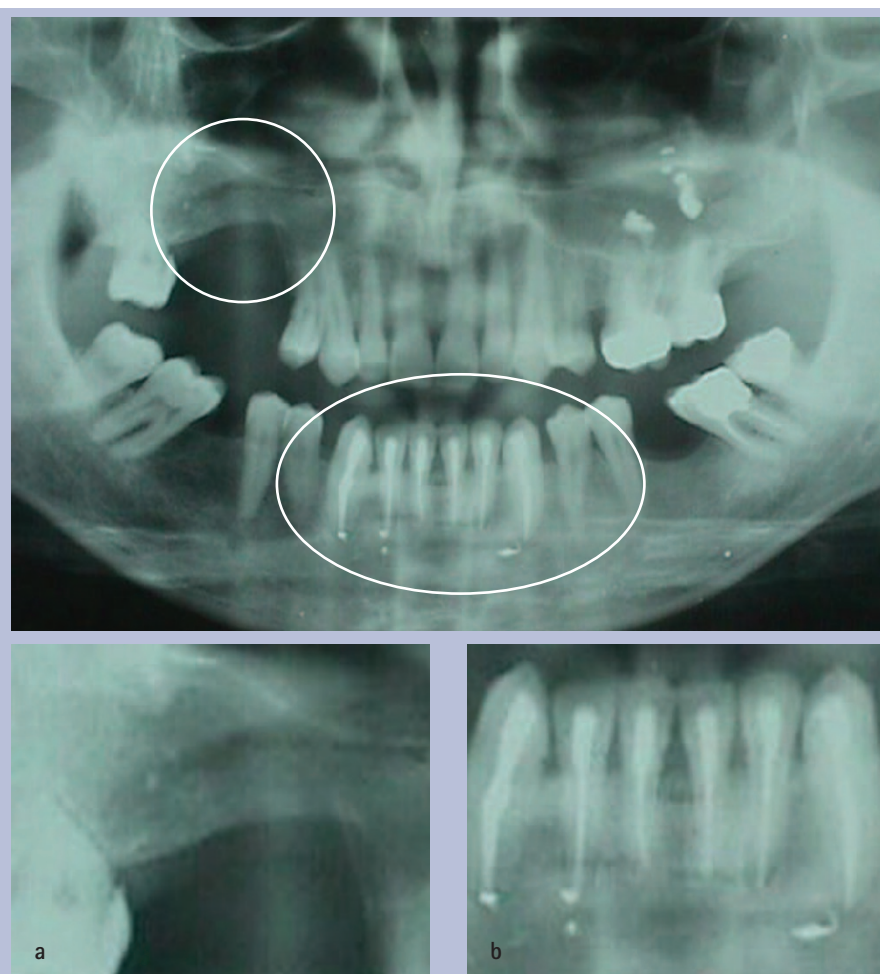


Fig. 1 Post-operative panoramic radiograph showing detail of the after effects associated with acute purulent maxillary sinusitis by *Pseudomonas aeruginosa*, secondary to autologous bone transplant for dental implants: a) lowering of the right orbital floor; b) pulpal necrosis of six dental elements (positions 43–42–41–31–32–33)

Infected sinuses should be treated immediately because infection of the grafted sinuses can spread quickly to the adjacent areas resulting in serious complications like brain abscess, infraorbital abscess, and orbital cellulitis.²²

In our case, since the drill was certainly cooled with a sterile physiological saline solution, the presence of *P. aeruginosa* in the oral cavity is infrequent and because the infection also developed in the chin area where the bone harvesting for grafting was made, it is plausible to hypothesise that the *P. aeruginosa* infection derived from a lack of aseptic conditions.

Moreover, empiric broad-spectrum antibiotic therapy instituted following implants removal failed to eradicate the infection, probably because of the intrinsic multi-drugs resistance of *P. aeruginosa*.⁵ However, antibiotic therapy with imipenem designed on the basis of *in vitro* antibiotic susceptibility tests led to successful

infection eradication. The ability shown by *P. aeruginosa* to grow as highly antibiotic-resistant biofilm communities on the mucosa of patients with chronic sinusitis²³ could provide a plausible explanation for the very long-term (one year) antibiotic therapy needed before achieving infection eradication. Our case further suggests that removal of dental implants should be considered when the infection occurs in the case of simultaneous augmentation and implantation.

CONCLUSION

We believe that the following features in our case deserve emphasis: i) this is the first reported case of acute purulent maxillary sinusitis caused by *P. aeruginosa* secondary to maxillary sinus augmentation using autologous bone in a patient with no evidence of immunodeficiency disorders; ii) there is need for bacterial culture to confirm the pathologic agent

and to evaluate its antibiotic susceptibility before designing an appropriate antibiotic therapy; iii) dental facilities need a systematic application of reliable and effective methods to prevent or reduce exposure of patients and dental staff to these opportunistic and pathogenic bacteria, in order to avoid any dental professional liability.

- Mardinger O, Nissan J, Chaushu G. Sinus floor augmentation with simultaneous implant placement in the severely atrophic maxilla: technical problems and complications. *J Periodontol* 2007; **78**: 1872–1877.
- Zijdeveld S A, van den Bergh J P, Schulten E A, den Bruggenkate C M. Anatomical and surgical findings and complications in 100 consecutive maxillary sinus floor elevation procedures. *J Oral Maxillofac Surg* 2008; **66**: 1426–1438.
- Hong S B, Kim J S, Shin S I, Han J Y, Herr Y, Chung J H. Clinical treatment of postoperative infection following sinus augmentation. *J Periodontol Implant Sci* 2010; **40**: 144–149.
- Martin M V. The significance of the bacterial contamination of dental unit water systems. *Br Dent J* 1987; **163**: 152–154.
- Driscoll J A, Brody S L, Kollef M H. The epidemiology, pathogenesis and treatment of *Pseudomonas aeruginosa* infections. *Drugs* 2007; **67**: 351–368.
- Putnins E E, Di Giovanni D, Bhullar A S. Dental unit waterline contamination and its possible implications during periodontal surgery. *J Periodontol* 2001; **72**: 393–400.
- Szymańska J. Dental bioaerosols as an occupational hazard in a dentist's workplace. *Ann Agric Environ Med* 2007; **14**: 203–207.
- Dutil S, Veillette M, Mériaux A, Lazure L, Barbeau J, Duchaine C. Aerosolization of mycobacteria and legionellae during dental treatment: low exposure despite dental unit contamination. *Environ Microbiol* 2007; **9**: 2836–2843.
- Al-Saif K M, Assery M, Nahas M A. Microbial contamination of dental unit water systems in Saudi Arabia. *Saudi Dent J* 2007; **19**: 110–114.
- Coleman D C, O'Donnell M J, Shore A C, Russell R J. Biofilm problems in dental unit water systems and its practical control. *J Appl Microbiol* 2009; **106**: 1424–1437.
- Fiehn N E, Larsen T. The effect of drying dental unit waterline biofilms on the bacterial load of dental unit water. *Int Dent J* 2002; **52**: 251–254.
- Shearer B G. Biofilm and the dental office. *J Am Dent Assoc* 1996; **127**: 181–189.
- Whitehouse R L S, Peters E, Lizotte J, Lilge C. Influence of biofilms on microbial contamination in dental unit water. *J Dent* 1991; **19**: 290–295.
- Uzel A, Cogulu D, Oncak O. Microbiological evaluation and antibiotic susceptibility of dental unit water systems in general dental practice. *Int J Dent Hyg* 2008; **6**: 43–47.
- Tambekar D H, Gulhane P B, Goyal K S, Gulhane S R. Prevalence of *Pseudomonas aeruginosa* in dental unit water-lines. *Res J Microbiol* 2007; **2**: 983–987.
- Al-Hiyasat A S, Ma'ayeh S Y, Hindiye M Y, Khader Y S. The presence of *Pseudomonas aeruginosa* in the dental unit waterline systems of teaching clinics. *Int J Dent Hyg* 2007; **5**: 36–44.
- Kumar S, Atray D, Paiwal D, Balasubramanyam G, Duraiswamy P, Kulkarni S. Dental unit waterlines: source of contamination and cross-infection. *J Hosp Infect* 2010; **74**: 99–111.
- Walker J T, Bradshaw D J, Bennet A M. Microbial biofilm formation and contamination of the dental unit in general dental practice. *Appl Environ Microbiol* 2000; **66**: 3363–3367.
- Mavridou A, Kamma J, Mandilara G, Delaportas P, Komioti F. Microbial risk assessment of dental unit water systems in general dental practice in Greece. *Water Sci Technol* 2006; **54**: 269–273.
- Gawande P V, LoVetri K, Yakandawala N *et al.* Antibiofilm activity of sodium bicarbonate, sodium metaperiodate and SDS combination against dental unit waterline-associated bacteria and yeast. *J Appl Microbiol* 2008; **105**: 986–992.
- Pankhurst C L, Coulter W A. Do contaminated dental unit waterlines pose a risk of infection? *J Dent* 2007; **35**: 712–720.
- Misch C E. *Contemporary implant dentistry*. 3rd ed. St. Louis: Mosby/Elsevier, 2008.
- Oncel S, Pinar E, Sener G, Calli C, Karagoz U. Evaluation of bacterial biofilms in chronic rhinosinusitis. *J Otolaryngol Head Neck Surg* 2010; **39**: 52–55.