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Case Report

Implant Failure Caused by Galvanic Corrosion

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Abstract

A patient presented with sensitivity and pus exudation around Tooth #19 three years after placement and restoration of a dental implant. Clinical and radiographic examination indicated suppuration and necrosis of the bone surrounding the implant. Antibiotic therapy initially provided relief of symptoms but they returned after a period of 3 months and were found to have progressed at a subsequent 4-week follow-up. A more aggressive treatment was initiated, involving reflection of a flap, removal of granulation tissue, sanitization of the implant surface with hypochlorite solution, placement of cadaveric bone and flap closure. This treatment alleviated symptoms for about 14 months but these returned thereafter and radiologic examination indicated severe suppuration. Removal of the implant was deemed necessary. After implant removal and sanitization of the cavity, cadaveric bone was placed and the site closed. Within two weeks, osteogenesis was observed without suppuration or other deleterious effects. The cause of implant failure was attributed to galvanic corrosion between the implant and the silver-palladium restoration.

Keywords: *Implant; Galvanic Corrosion; Cadaveric Bone; Osteogenesis*

Introduction

The factors influencing the success or failure of implants have been reviewed in the literature [1-4] and, most commonly, the causes of failure include poor bone quality, bacterial colonization of the implant, smoking and ingestion of antidepressants as well as poor clinical practice. Late-stage implant failure, however, is uncommon and the case reported here is ascribed to galvanic corrosion.

Galvanic corrosion occurs when two or more dissimilar metals or alloys with different standard electrode potentials come into contact in the presence of an electrolyte, this process establishing what is known as a galvanic cell [5,6]. The more electronegative metal will function as the anode and undergo oxidation or corrosion while the more electropositive metal functions as the cathode, and is protected. A common example of this is galvanized iron where corrosion of the zinc anode protects the iron cathode. Galvanic cells may also arise with a single metal or alloy due to differential aeration and differential pH effects [5,6]. Galvanic cells are the electrochemical basis for batteries and, when established, release ions into their electrolytic environment as well as generate electrical currents. Galvanic corrosion effects within the oral cavity have been discussed in the literature [7-11] and have been reported to cause patient discomfort [12] as well as causing the inhibited healing of a mandibular fracture [13].

Clinical Report

A healthy well-nourished 75 y.o. male with good oral hygiene presented with sensitivity, discomfort and exudation of pus in the region of an implant replacing tooth #19. The implant, a MIS7 (11.5 x 6.5 mm) [ref. no. MS7-11600, Lot. No. W09830024] was placed on 6/5/11 by a periodontist in Baltimore, MD and was restored with a Pd-Ag screw-retained cast crown. Clinical and radiographic examination about 2 years after implant placement and restoration indicated infection around the implant (Figure 1). Antibiotic therapy (Amoxicillin, 250 mg tid for 10 days) alleviated symptoms.

Figure 1: *Radiograph of Tooth #19 when patient first presented.*

Complaints by the patient and re-examination of the implant site after 3 months indicated the return of symptoms and bone necrosis (Figure 2). Careful periodontal scaling and deep cleaning was performed but a follow-up examination after a further 4 weeks indicated that the peri-implantitis appeared to have progressed (Figure 3).

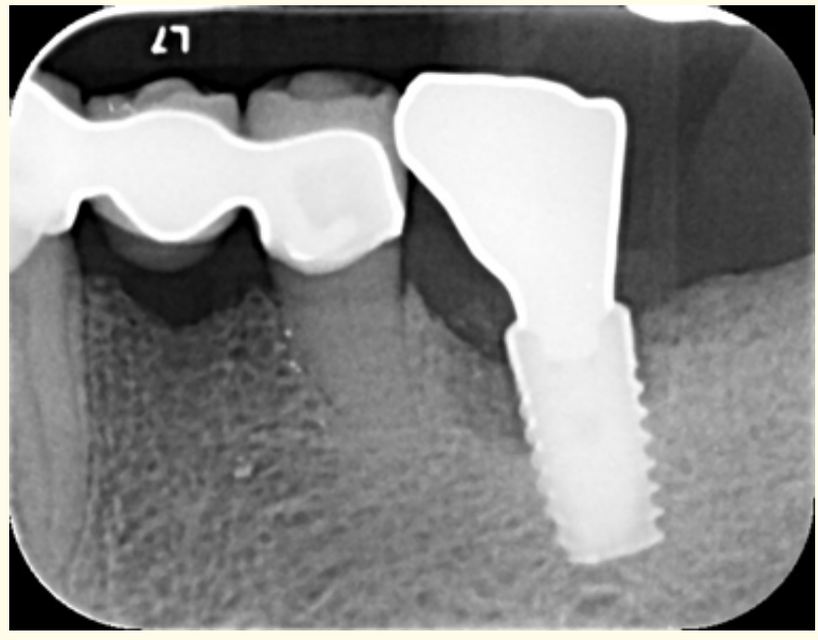

Figure 2: *Post-antibiotic treatment at 3 months.*

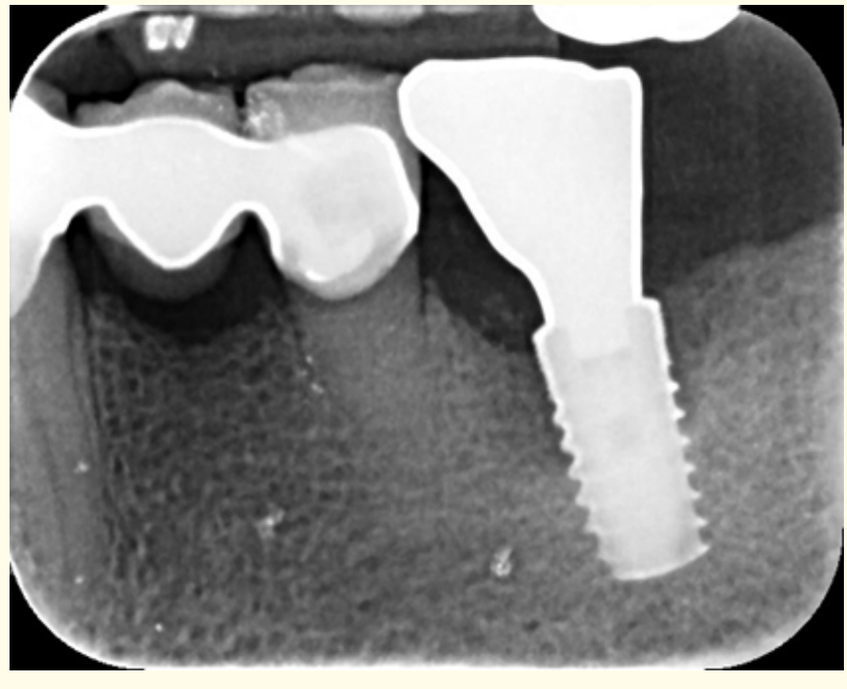

Figure 3: *Radiograph taken 4 months after antibiotic therapy.*

At this stage, it was decided to initiate more aggressive surgical intervention and a flap was reflected and all granulation tissue removed from around the superior portion of the implant. Thereafter, the exposed implant surface was sanitized with 5% hypochlorite solution and, after careful irrigation of the surgical site, dental allograft particulate (cadaveric bone 250 - 1000 μm) was placed around

the exposed implant and flap closure was performed (Figure 4). Post-surgical follow-up at 4 months (Figure 5), indicated resolution of the peri-implantitis and the patient reported relief of symptoms.

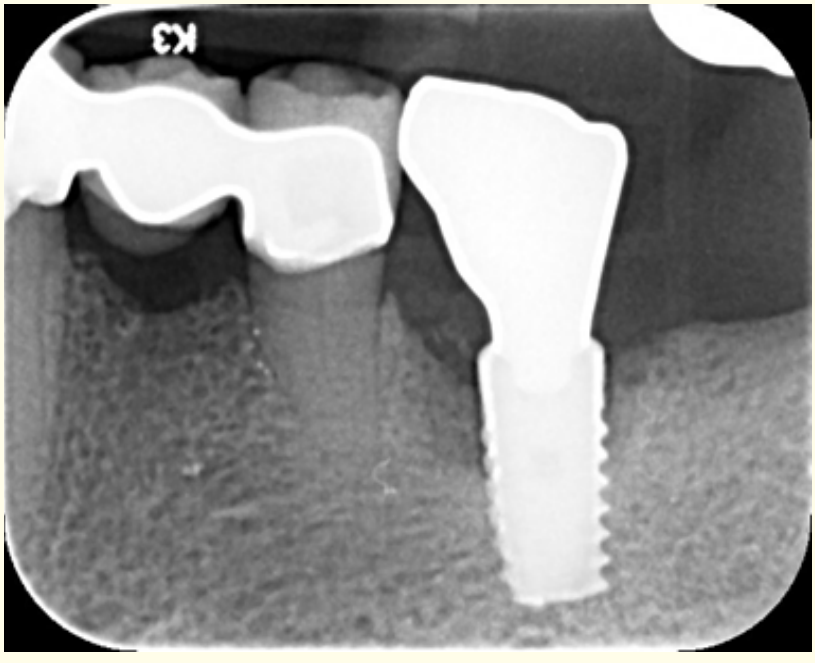

Figure 4: *Post-surgical radiograph.*

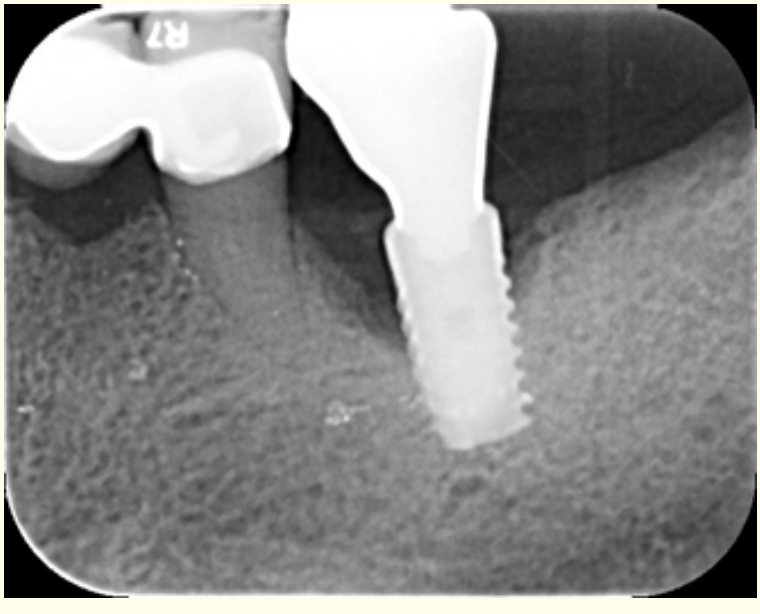

Figure 5: *Radiograph taken 4 months post-surgery.*

Patient recall and examination at 9 months' post-surgery (Figure 6), indicated some osteogenesis but the patient reported that whereas sensitivity had greatly diminished, he did experience intermittent suppuration around the implant site.

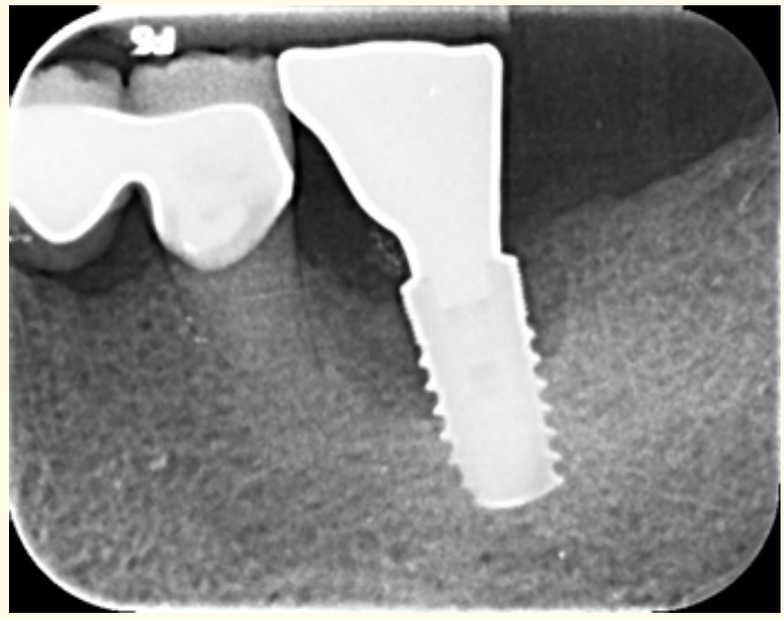

Figure 6: *Radiograph at 9 months' post-surgery.*

Patient recall and examination at 14 months after surgery (Figure 7), showed severe peri-implantitis, suppuration and bone necrosis. At this stage, it was decided to extract the implant, place cadaveric bone (PuraGraft MX-250-200) in the surgical site and allow healing to progress.

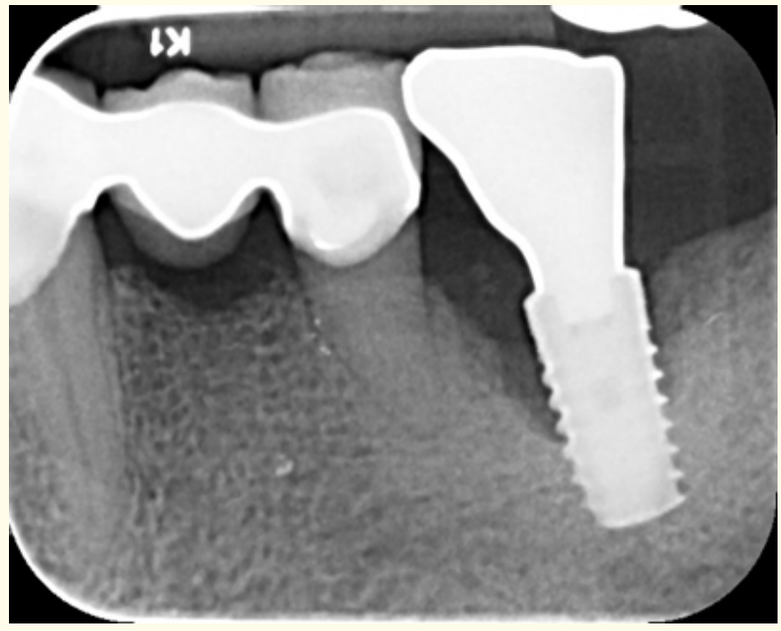

Figure 7: *Radiograph taken 14 months after surgery.*

At two months' post-implant extraction (Figure 8), radiographic examination showed satisfactory healing and osteogenesis within the created socket. Based upon the patient comments, continuous clinical examinations and radiographic monitoring, the evidence clearly indicates that satisfactory osteogenesis was possible with this patient following extraction of the implant.

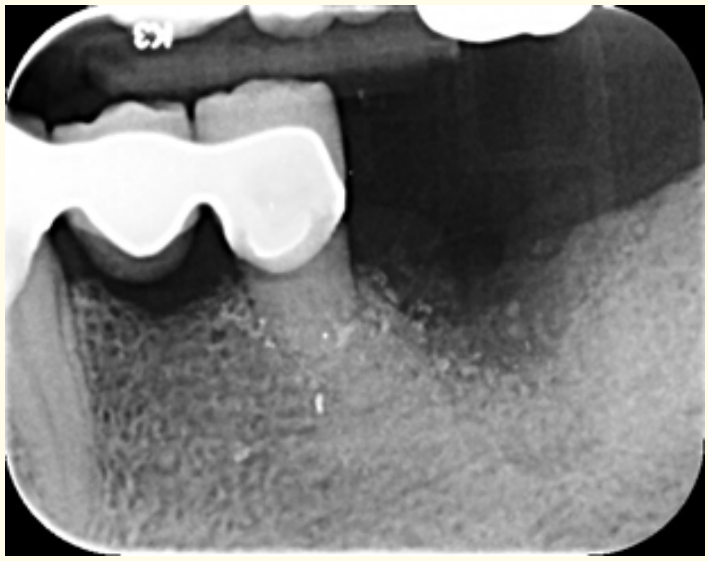

Figure 8: *Two months following implant extraction.*

Careful evaluation and occlusal analysis of the patient indicated that he suffered from a poor maxillary-mandibular relationship, a retrusive mandible and a poor centric relationship. Since the patient also exhibited Class 2 mobility of other implants within the mouth, bruxism and unbalanced stress during mastication possibly contributed to the implant failure.

Discussion and Conclusions

The symptoms presented by the patient suggested peri-implantitis and this initial diagnosis was supported by physical and radiologic examination are were alleviated by antibiotic therapy. When the symptoms returned and with exacerbated suppuration, the conclusion was that bacterial infection might still be present within the implant site. Conventional periodontal therapy, however, only provided temporary relief of symptoms and even undertaking the recommended aggressive periodontal therapy recommended for peri-implantitis (REF NEEDED) did not eliminate the problems.

Alleviation of all symptoms only occurred after removal the implant and its restoration. It was at this stage that expert opinion was sought and it was concluded that galvanic corrosion between the titanium implant and the Ag-Pd restoration was the cause of the problems reported here. This situation has been predicted in the literature [2-12] but there do not appear to be any clinical reports of implant failure due to galvanic corrosion although hindered healing of a mandibular fracture has been reported [13].

It is not clear at this stage why galvanic corrosion might cause bone necrosis and delayed healing together with the manifestations of bacterial infection. It is possible, however, the electrochemical environment associated with galvanic and other types of corrosion reaction might encourage the proliferation of bacteria, a situation that is known to occur with orthopedic implants [14-16]. It has been postulated

that dissolution of metal ions and particles within the oral environment can trigger or contribute to the development of peri-implantitis at later stages [17] and the case presented here appears to support this postulate.

The patient's poor occlusal balance and malocclusion and lack of a centric relation likely contributed to the implant failure. These problems were addressed by construction of a custom bite guard built into centric relation, not centric occlusion, and ongoing treatment should alleviate the ongoing unbalanced stress during night-time bruxism and mastication.

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