We report prosthetic knee arthritis due to *Granulicatella adiacens*, a micro-organism present in the oral flora, usually described in endocarditis but rarely in prosthetic joint infection. This patient had undergone a dental extraction without antibiotic prophylaxis one month before, and an aseptic loosening of the prosthesis had been diagnosed previously. If antimicrobial prophylaxis against infective endocarditis for dental procedures is well established, such an approach is still controversial for joint prosthesis and should be considered in some conditions.

**Case report**

A 55-year-old diabetic man was admitted to hospital in July 2009 for a right knee pain. He had a right knee injury in 1988 caused by a road traffic accident that required tibial osteotomy. A total right knee prosthesis was implanted in 1999 for malunion and the patient healed without any septic complication. Since 2008, the patient had reported progressive knee pain and decrease in joint mobility. In March 2009, aseptic loosening of the prosthesis was diagnosed on radiological, microbiological and clinical data. The arthro-computed tomography scan showed osteolysis and loosening of the total knee prosthesis, and knee puncture showed a leukocyte count of 660 cells ml$^{-1}$ with negative culture (Fig. 1a). In June 2009, the patient had a dental extraction for a dental abscess, without antibiotic prophylaxis. One month later, the patient had an increasing right knee pain associated with increased volume of the right knee, without fever. On admission, laboratory findings showed an increased level of CRP (142 mg l$^{-1}$) associated with a blood cell count of 24 6 10$^9$ l$^{-1}$. A prosthesis infection was suspected, and a two-step surgery was decided upon. On 23 July, the prosthesis was removed, synovectomy and curettage were performed, and a spacer was implanted. Direct examination of knee fluid and three synovial biopsies, after Gram staining, demonstrated numerous polynuclear neutrophils and Gram-positive cocci in chains. Tissues were homogenized in a mini bead-beater (MM200 Retsch, Germany) and cultivated on blood and chocolate agar plates and brain heart infusion broth (Oxoid). Cultures on chocolate agar plates incubated aerobically yielded alpha haemolytic colonies. Gram staining of the colonies showed Gram-positive cocci in chains (Fig. 1b). The GenBank/EMBL/DDBJ accession number for the 16S rRNA gene sequence of *Granulicatella adiacens* is D50540.

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**Introduction**

Joint replacement prosthesis has become a common procedure in orthopaedic surgery. The most feared complication is infection. The infection rate due to intraoperative contamination has decreased thanks to antibiotic prophylaxis and aseptic conditions. However, the absolute number of patients with device-associated infection is increasing, because of the growing number of arthroplasties performed and longevity of patients, which is associated with a risk of secondary contamination, particularly from haematogenous dissemination (Zimmerli & Ochsner, 2003). Dental infections and poor oral care are two of the main causes of arthroplasty infection, after the skin and urinary tract routes of entry (Maderazo et al., 1988). However, there is no formal evidence confirming the relationship between oral or dental care and arthroplasty infection (Berbari et al., 2010; Legout et al., 2012; Skaar et al., 2011).

Here we describe a case report of prosthetic knee arthritis occurring after dental treatment and due to *Granulicatella adiacens*, a nutritional variant of *Streptococcus* belonging to the oral flora.
2), but the micro-organism could not be identified reliably by phenotypic methods. Identification of the isolate was achieved by 16S rRNA gene amplification as previously described (Jacquier et al., 2010). The sequence of the corresponding amplicon was submitted to the NCBI database (accession number D50540) and showed 99.9% identity with *G. adiacens*. Antibiotic susceptibility of the isolate was tested using the disc diffusion method and MICs.

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**Fig. 2.** (a) Alpha-haemolytic colonies of *G. adiacens* on chocolate plate agar. (b) Gram-stain of *G. adiacens* cells.

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**Fig. 1.** (a) Arthro-computed tomography scan. Loosening of the total right knee prosthesis is shown by the arrows. (b) Timeline of the patient’s treatment.
were determined using the E-test method, according to the EUCAST guidelines (http://www.eucast.org). The isolate was susceptible to beta-lactams, macrolides, rifampicin, aminoglycosides and glycopeptides, and resistant to sulfamethoxazole/trimethoprim. The MIC measurement displayed low values for amoxicillin (MIC <0.016 mg l⁻¹) and rifampicin (MIC <0.002 mg l⁻¹), and moderate activity for levofloxacin (MIC=0.5 mg l⁻¹). Antimicrobial therapy combining amoxicillin 2 g three times per day and rifampicin 600 mg two times per day was initially administered intravenously for the first two weeks and by the oral route for the three following months (until October 2009). One month after the end of antimicrobial chemotherapy, a total knee prosthesis was reimplanted in November 2009. Cultures performed on knee fluid and five biopsies remained sterile. Two years later, the patient remains clinically well without any inflammatory syndrome (Fig. 1b).

Discussion

Joint prosthesis infections after dental procedures are mainly due to Gram-positive cocci (more than 70% of cases), particularly Staphylococcus spp. and various species of streptococci (Bauer et al., 2007). G. adiacens, a low virulence bacterium, belongs to the nutritionally variant streptococci and is present in the oral flora. Standard media must be supplemented with pyridoxal or other nutritional agents to achieve successful laboratory isolation of this microorganism (Ruoff, 1991). Moreover, weak metabolic activity and/or biochemical variability could lead to misidentification with conventional phenotypic methods. The rate of infections due to G. adiacens is probably underestimated because of difficulties encountered in both culturing and identification. G. adiacens has mostly been identified in bloodstream and endovascular infections, such as infective endocarditis (Chang et al., 2008; Senn et al., 2006), and rarely in osteoarticular infections; it has been reported in vertebral osteomyelitis (Heath et al., 1998) and septic arthritis (Bauer et al., 2007; Hepburn et al., 2003; Riede et al., 2004; Rosenthal et al., 2002). To date, only one study has underlined the relationship between oral care and arthroplasty infection due to G. adiacens (Bauer et al., 2007).

Recommendations concerning antibiotic prophylaxis during dental treatment for patients with valvulopathy or cardiac valve prosthesis are well defined to prevent infective endocarditis. Antibiotic prophylaxis during dental treatment for patients with joint prosthetics is, however, controversial. In 2003, the American Dental Association and the American Academy of Orthopaedic Surgeons (AAOS) established recommendations on antibiotic prophylaxis during dental procedures with high incidence of bacteremia (American Dental Association & AAOS, 2003). These recommendations limited antibiotic prophylaxis to patients with joint replacement less than two years previously, inflammatory arthropathies, immunosuppression (denutrition, HIV, diabetes, malignancy), previous joint infection or haemophilia. Conversely, in 2009 AAOS recommended extending antibiotic prophylaxis to all total joint replacement patients prior to any invasive procedure that may cause bacteremia (AAOS, 2010). However, this position is controversial (Little et al., 2010; Marek & Ernst, 2009; Napeñas et al., 2009) and is still a point of concern. Indeed, opponents of extended indications of antibiotic prophylaxis argue that bacteremia due to chronic poor oral hygiene could be riskier than episodes due to a single dental procedure (Lockhart et al., 2008); and that the risk of antibiotic side-effects could be more important than the benefit of preventing bacteremia following dental procedures.

In our case report, a patient with prosthetic loosening had dental treatment without antibiotic prophylaxis and developed a secondary prosthetic infection. The long interval between the patient's dental extraction and suspicion of infection could be explained by the species' low virulence, and we cannot exclude the possibility that the patient waited before seeking treatment. In cases of prosthetic loosening, many wear particles generate an inflammatory reaction, and the particles may saturate the macrophages and limit their ability to respond to bacterial invasion (Maderazo et al., 1988). In our case, the patient was probably more susceptible to infection due to this local immunosuppression and diabetes.

Overall, the mode of contamination remains unclear: either the silently chronic bacteremia due to the poor oral conditions was responsible for the knee infection, or this infection was directly linked to dental treatment. Even if this infection occurred after a dental extraction, no formal evidence could validate this assumption, underlining the complexity of the antibiotic prophylaxis debate.

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