REVIEW ARTICLE

Antibiotic prophylaxis to reduce the risk of joint implant contamination during dental surgery seems unnecessary

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Summary
Introduction: Joint implant infection rates range between 0.5% and 3%. Contamination may be hematogenous, originating in oro-dental infection and, as in endocarditis, antibiotic prophylaxis has been recommended to cover oro-dental surgery in immunodepressed patients with joint implants less than 2 years old, despite the lack of any formal proof of efficacy. In this context, the cost and side effects of such prophylaxis raise the question of its real utility.

Materials and methods: A search of Pubmed was performed using the following keywords: prosthetic joint infection, dental procedure, antibiotic prophylaxis, hematogenous infection, dental infection, bacteremia, and endocarditis. Six hundred and fifty articles were retrieved, 68 of which were analyzed in terms of orthopedic prosthetic infection and/or endocarditis and oro-dental prophylaxis, as relevant to the following questions: frequency and intensity of bacteremia of oro-dental origin, frequency of prosthetic joint infection secondary to dental surgery, and objective efficacy of antibiotic prophylaxis in dental surgery in patients with joint implants.

Results: Bacteremia of oro-dental origin is more frequently associated with everyday activities such as mastication than with tooth extraction. Isolated cases of prosthetic contamination from dental infection have been reported, but epidemiological studies in joint implant bearers found that absence of antibiotic prophylaxis during oro-dental surgery did not increase the rate of
prosthetic infection. The analysis was not able to answer the question of the efficacy of dental antibiotic prophylaxis in immunodepressed patients; however, oro-dental hygiene and regular dental treatment reduce the risk of prosthetic infection by 30%.

Discussion and conclusion: The present update is in agreement with the conclusions of ANSM expert group, which advised against antibiotic prophylaxis in oro-dental surgery in implant bearers, regardless of implant duration or comorbidity: the associated costs and risks are disproportional to efficacy.

Level of evidence and type of study: Level V; expert opinion.
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Introduction

Osteo-articular prosthetic infection (OAPI) affects less than 1% of hip replacement bearers and 1% to 2% of knee replacement bearers. It is hematogenous in 30% of cases, usually with a urinary or cutaneous origin [1–5]. There have been reports of OAPI following dental surgery, with a suggested causal relationship [6–16]. In certain at-risk situations, antibiotic prophylaxis covering dental treatment may thus seem indicated to prevent hematogenous prosthetic contamination. In France, amoxicillin is recommended in this context in case of implants less than 2 years old, especially in immunodepressed patients [17–24]. No studies, however, have demonstrated the interest of such prophylaxis, while costs are high and there is a risk of selecting resistant bacteria.

For these reasons, antibiotic prophylaxis is no longer applied, for example, in cardiology; there has been no consequent increase in the incidence of endocarditis [25–27]. It therefore seemed logical to extend the same attitude to bearers of orthopedic implants, especially in the light of the latest AFSSAPS/ANSM (French health authorities) guidelines [28].

The present article provides an update on antibiotic prophylaxis in dental surgery in orthopedic implant bearers, focusing on three points:

• the frequency and intensity of bacteremia of oro-dental origin;
• the frequency of OAPI secondary to dental surgery;
• and the objective efficacy of antibiotic prophylaxis in dental surgery in joint implant bearers.

Materials and methods

A Pubmed search of English and French language articles was conducted using the following keywords:

• ‘prosthetic joint infection’ (1067 articles);
• ‘prosthetic joint infection’ and ‘dental procedure’ (57 articles);
• ‘prosthetic joint infection’ and ‘antibiotic prophylaxis’ (105 articles);
• ‘dental procedure’ and ‘hematogenous infection’ (14 articles);
• ‘dental infection’ and ‘bacteremia’ (646 articles);
• ‘bacteremia’ and ‘joint replacement’ (64 articles);
• and ‘endocarditis’ and ‘antibiotic prophylaxis’ (1053 articles).

Retrospective or prospective studies and case reports specifically focusing on orthopedic implant infection and/or endocarditis secondary to a dental procedure were short-listed (650 articles), and analysis finally used articles addressing the following questions: frequency and intensity of bacteremia of oro-dental origin, frequency of OAPI secondary to dental surgery, and objective efficacy of antibiotic prophylaxis in dental surgery in patients with joint implants. On these criteria, the literature review comprised 68 of the 650 short-listed articles.

Results

Frequency and intensity of bacteremia of oro-dental origin

The incidence of bacteremia during tooth extraction is 100% [29–32]. Intensity peaks within the 30 seconds following extraction at a plateau of 10 to 20 minutes. For everyday activities such as tooth-brushing or mastication, incidence is lower (20% to 58% in tooth-brushing and 17% to 51% in chewing gum), but with longer duration, proportional to that of the activity [33].

Guntheroth [34] estimated the cumulative duration of bacteremia due to daily tooth-brushing and mastication in a subject with healthy teeth at 5370 minutes (3.7 days) per month, whereas tooth extraction led to low-intensity bacteremia of no more than 6 to 30 minutes: i.e., the risk of onset of bacteremia is 154,000-fold greater in everyday activities than in tooth extraction. This accounts for the much higher frequency of spontaneous bacteremia found in subjects with defective oral hygiene than following tooth extraction [8,35].

Does bacteremia really induce bacterial contamination of internal orthopedic implants?

It is difficult to establish the similarity between the dental site bacteria and those of the secondary lesion. The published data are founded on a very approximate analogy between blood-culture isolates and bacteria known to belong to the oro-dental flora. Clinicians are usually faced with the situation of a patient with negative blood culture and OAPI implicating a micro-organism presumed to be of
Oro-dental origin: e.g., Streptococcus sp. (mitis, salivarius, sanguinis, mutans, anginosus, etc.), which is the main bacterial species in oral flora, strictly anaerobic bacteria (Prevotella sp., Fusobacterium sp., Peptostreptococcus sp., etc.) or staphylococcus. Oro-dental flora varies with age, local pH, oro-dental hygiene, associated parodontopathy, tooth decay, saliva quality, etc. [36–44]. Fortunately, proliferation is limited by local defence systems, and the bacteria implicated in hemogenous OAPI are rarely (<1%) of oro-dental origin but rather S. aureus or oro-digestive species (Escherichia coli, Proteus sp., Salmonella sp., Listeria, Streptococcus sp., etc.). Prosthetic contamination secondary to oro-dental surgery is very unusual, even in series without antibiotic prophylaxis [1–3,5–8,11,12,45–51]. Ainscow and Denham [5] reported a higher risk of hemogenous OAPI in case of skin lesion than of dental surgery.

The causal relation between dental procedure duration and prosthetic infection is thus controversial. In a retrospective study of 2973 total hip replacements, LaPorte et al. [6] found 52 late infections, only three of which were associated with dental procedures (6%; 0.1% of hip implants); patients had received no antibiotic prophylaxis, and procedure time exceeded 45 min. In another series [7] of 3490 knee replacements, only seven of the 62 cases of infection observed (11%; 0.2% of knee implants) were related to dental procedures without antibiotic prophylaxis, of a mean 115 minutes duration (range, 75–205 minutes); five of the seven patients showed risk factors (diabetes, rheumatoid arthritis).

Likewise, Ainscow and Denham [5], Skaar et al. [51] and Bauer et al. [52] found no correlation between absence of antibiotic prophylaxis and onset of prosthetic infection. Ainscow and Denham [5] prospectively followed up 1112 patients for 6 years after arthroplasty without antibiotic prophylaxis during dental care: 22 developed OAPI, including three hemogenous cases of cutaneous origin (varicose ulcer), while 224 had had tooth extractions without antibiotic prophylaxis, none of whom developed hemogenous infection [5]; this study involved limitations, inasmuch as OAPI risk factors were analyzed on a questionnaire sent to the patients, weakening the force of the conclusions. Skaar et al. [51] confirmed the findings in a smaller retrospective series.

Does antibiotic prophylaxis reduce the incidence of osteo-articular prosthetic infection

Amoxicillin is the molecule most frequently employed in prevention; administered ahead of oro-dental surgery, it reduced but did not abolish the risk of bacteremia implicating streptococcus or anaerobic bacteria [53–60]. Hall et al. [53] studied the incidence of Streptococcus viridans bacteremia in patients receiving either placebo or 2 g i.v. penicillin or 3 g amoxicillin 1 hour before dental surgery; in blood culture performed before, during and 15 minutes after the procedure, rates of S. viridans bacteremia were comparable (95%, 90% and 85%, respectively). Lockhart et al. [54], in contrast, found a significantly reduced risk of bacteremia with amoxicillin (versus placebo: 84% versus 33%), administered both peroperatively (20% versus 6%) or after tooth extraction (76% versus 15%).

Finally, such antibiotic prophylaxis shows no impact on prosthetic infection rates. Recently, in the only prospective case-control study in the field, Berbari et al. [8] found OAPI risk (in hip and knee implants) to be the same in patients undergoing dental surgery [odds ratio (OR), 0.8; 95% confidence interval (95% CI) (0.4–1.6)] and in controls [OR, 0.6; 95% CI, (0.4–1.1)]. In the same study, antibiotic prophylaxis performed during tooth extraction failed to reduce OAPI risk (in hip and knee implants) [OR, 0.9; 95% CI, (0.5–1.6) versus OR, 1.2; 95% CI, (0.7–2.2) without prophylaxis]; likewise, in a subgroup with implants of less than 1 year of age, OAPI risk following dental surgery was unaffected by antibiotic prophylaxis [8].

Given its doubtful efficacy, amoxicillin or penicillin antibiotic prophylaxis should be reconsidered in terms of cost, side effects and risk of bacterium selection [61–67]. The costs of antibiotic prophylaxis are increasing with the increasing number of joint implant bearers. Jacobson et al. [62] calculated a very low overall risk of OAPI, at 29.3 per 104 dental visits (0.00293%), while the cost of antibiotics to prevent one case of infection directly related to a dental procedure was $480,000 per year in the USA in 1990, if the extra costs incurred by antibiotic-related complications are taken into account. Side effects are mainly digestive (10–60%), allergic (4%) or anaphylactic shock or death (one per million oral amoxicillin prescriptions and 15 per million i.v. penicillin prescriptions), although no such complications have been reported following dental surgery.

Selection for resistance, finally, is a risk incurred by any excessive use of antibiotics, and should as such be taken into account. Limiting the use of certain antibiotics in Streptococcus pneumoniae infection has been shown to restore susceptibility to amoxicillin [68].

Discussion

The present literature review found no proven efficacy of antibiotic prophylaxis covering oro-dental surgery in joint implant bearers. Most studies were retrospective or single case reports; the one prospective case-control study [8] pointed to non-efficacy; statistical power was lacking to assess efficacy in the immunodepression subgroup. Lack of information regarding type of dental procedure and protocol (duration, with or without antibiotics) and lack of long-term follow-up preclude any definite conclusion.

Oro-dental hygiene would seem to be more important for the prevention of OAPI, significantly reducing the frequency of bacteremia. No precise guidelines, however, have as yet been laid down as to the optimal frequency of oro-dental check-ups; one per year would appear reasonable to ensure healthy teeth [8].

It is for these reasons that the AFSSAPS/ANSM in 2011 advised against antibiotic prophylaxis in oro-dental procedures in joint implant bearers, whatever the age of the implant, the patient’s health status or the type of procedure, putting the accent rather on the quality of oro-dental hygiene [28].

The members of the latest consensus conference on the management of OAPI came to no decision, but did advise treating any infection site before joint replacement,
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particularly in the case of possible dental infection sites (decay, parodontopathy and especially dental abscess, etc.) [69].

Conclusion

In the absence of proven efficacy of antibiotic prophylaxis covering oro-dental surgery in joint implant bearers, regardless of immune status, and in the absence of any harmful effect of abstinence, French experts have recommended ceasing such protocols in favor of guidelines for optimizing oro-dental hygiene.

Disclosure of interest

The authors (Laurence Legout and Eric Beltrand) declare that they have no conflicts of interest concerning this article, except for Eric Senneville, who is a consultant for AFSSAPS/ANSM. Henri Migaud is an occasional consultant in research and education for Zimmer and Tornier, receiving royalties from Tornier. Eric Senneville is a speaker for Novartis, Sanofi-Aventis, and receives congress support from Pfizer, MSD.

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