

Prevention of Orthopaedic Implant Infection in Patients Undergoing Dental Procedures

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Abstract

The Prevention of Orthopaedic Implant Infection in Patients Undergoing Dental Procedures evidence-based clinical practice guideline was codeveloped by the American Academy of Orthopaedic Surgeons (AAOS) and the American Dental Association. This guideline replaces the previous AAOS Information Statement, "Antibiotic Prophylaxis in Bacteremia in Patients With Joint Replacement," published in 2009. Based on the best current evidence and a systematic review of published studies, three recommendations have been created to guide clinical practice in the prevention of orthopaedic implant infections in patients undergoing dental procedures. The first recommendation is graded as Limited; this recommendation proposes that the practitioner consider changing the long-standing practice of routinely prescribing prophylactic antibiotic for patients with orthopaedic implants who undergo dental procedures. The second, graded as Inconclusive, addresses the use of oral topical antimicrobials in the prevention of periprosthetic joint infections. The third recommendation, a Consensus statement, addresses the maintenance of good oral hygiene.

Overview and Rationale

This clinical practice guideline was approved by the American Academy of Orthopaedic Surgeons (AAOS) Board of Directors in December 2012 and by the American Dental Association (ADA) Council on Scientific Affairs in November 2012. The purpose of this clinical practice guideline is to help improve prevention and treatment based on the current best evidence.

The recommendations in this guideline are not intended to be a fixed protocol; and as with all evidence-based recommendations, practitioners must also rely on their clinical judgment as well as their patients' preferences and

values when making treatment decisions.

This clinical practice guideline was developed using a rigorous, standardized process, beginning with a systematic review of the available literature published from 1960 through July 2011 related to the prevention of orthopaedic implant infection in patients undergoing dental procedures. The systematic review demonstrates where there is good evidence, where evidence is lacking, and what topics future research could target to improve the prevention of orthopaedic implant infection in patients undergoing dental procedures.

The AAOS and ADA created this guideline as an educational tool to guide qualified physicians and dentists through a series of treatment de-

cisions in an effort to improve the quality and effectiveness of care. This guideline should not be construed as including all proper methods of care or as excluding methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding any specific procedure or treatment must be made in light of all circumstances presented by the patient and the

needs and resources particular to the locality or institution.

Potential Harms, Benefits, and Contraindications

The goal of prevention of orthopaedic implant infection in patients undergoing dental procedures is avoidance of serious complications resulting from

orthopaedic implant infection. Most treatments are associated with some known risks. In addition, contraindications vary widely based on the treatment administered. Therefore, discussion of available treatments applicable to the individual patient relies on mutual communication between the patient, dentist, and physician, weighing the potential risks and benefits for that patient.

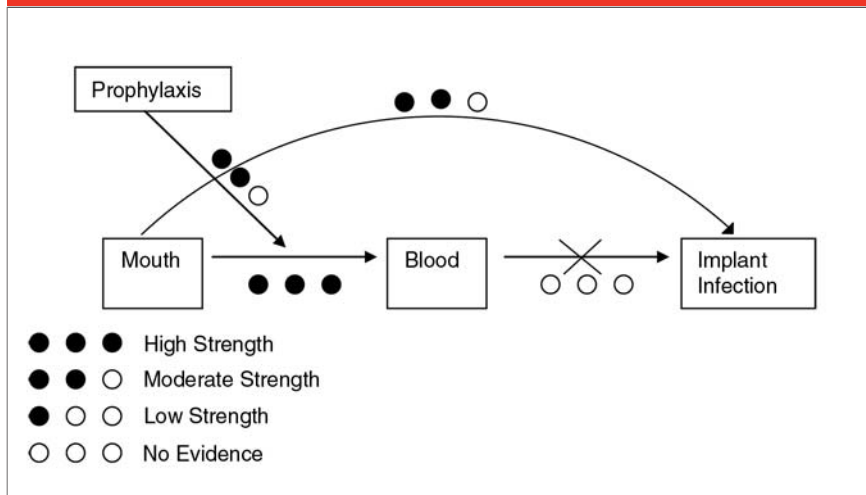
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This clinical practice guideline was approved by the American Academy of Orthopaedic Surgeons on December 7, 2012.

The complete evidence-based guideline, American Academy of Orthopaedic Surgeons and the American Dental Association *Prevention of Orthopaedic Implant Infection in Patients Undergoing Dental Procedures Clinical Practice Guideline*, includes all tables, figures, and appendices, and is available at <http://www.aaos.org/guidelines>.

Figure 1



Overview of the evidence. Just one study (represented by the arching arrow) was identified in the literature search as providing direct evidence of moderate strength and considered for the guideline. The results of this study show that dental procedures are not risk factors for subsequent implant infection and furthermore that antibiotic prophylaxis does not reduce the risk of subsequent infection.

Background

In 2010, more than 302,000 hip replacements and 658,000 knee replacements were performed in the United States. Based on the studies reviewed for this guideline, the mean rate of hip, knee, and spine implant infections was 2%; management typically requires further surgery and prolonged antibiotic treatment.¹⁻¹³ Causes included entry of microbes into the wound during surgery, hematogenous spread, recurrence of sepsis in a previously infected joint, and contiguous spread of infection from a local source.¹⁴

In light of the significant morbidity associated with orthopaedic implant infections, preventing such infections in patients undergoing dental procedures is highly desirable. However, prophylactic antibiotics also entail risks to individual patients and, if widely used, are plausible contributors to the growing problem of bacterial resistance resulting from antibiotic overuse.

Methods

The guideline was developed based on a rigorous, standardized process commensurate with Institute of Medicine standards.^{15,16} The AAOS-ADA work group held an introductory meeting on November 20 and 21, 2010, to establish the scope of the guideline and the search terms for the systematic review. At the introductory meeting, the work group constructed preliminary recommendations which specified “[what] should be done in [whom], [when], [where], and [how often or how long].” The preliminary recommendations functioned as research questions for the systematic review, not as final recommendations or conclusions. Upon completing the systematic review, the work group participated in a 2-day recommendation meeting on October 15 and 16, 2011, at which time the final recommendations and rationales were edited, written, and voted on. The lan-

guage and grade of each recommendation was directly influenced by the best available evidence. Economical and adverse outcomes were not formally considered in creating these recommendations, per AAOS policy. This guideline was created with the best available evidence as it relates to antibiotic prophylaxis, dental procedures, and orthopaedic implant infections.

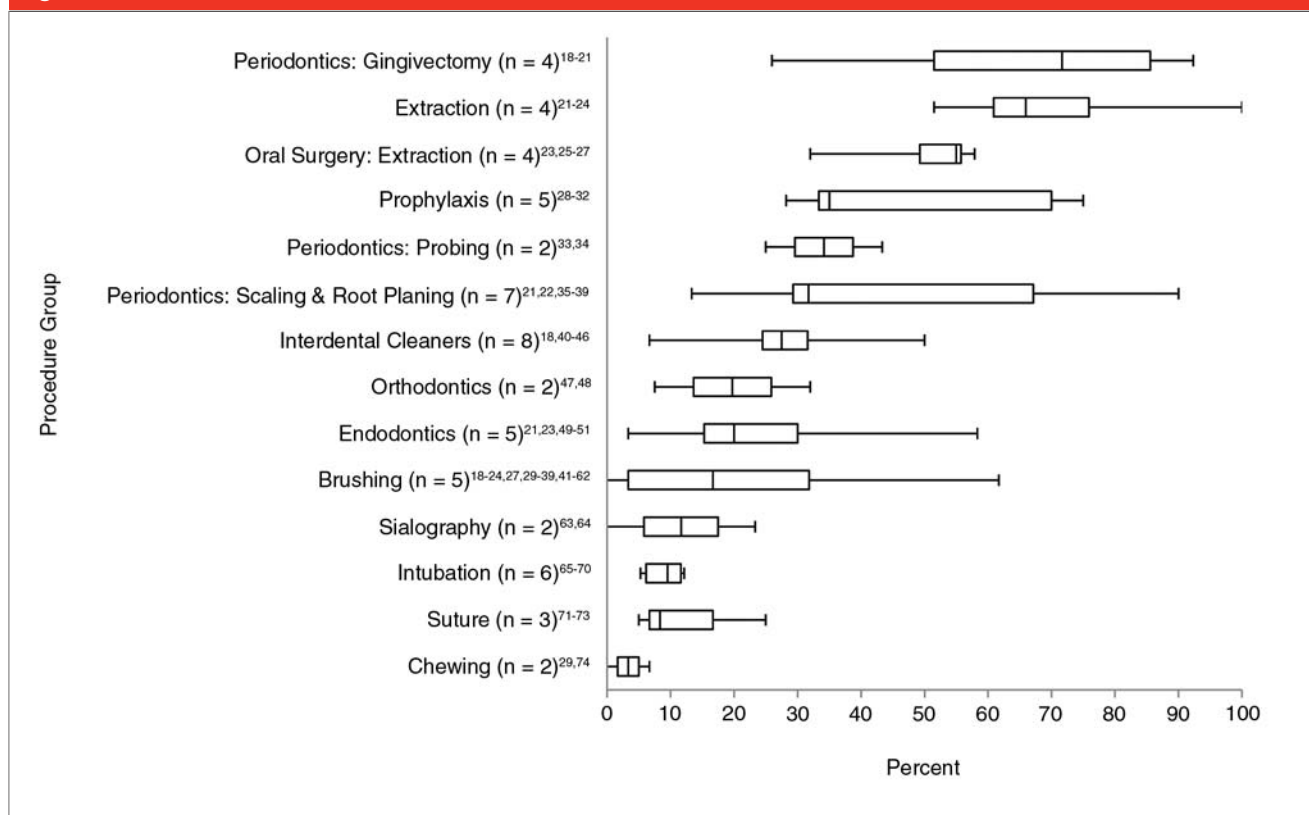
Forty-seven outside organizations were solicited to provide peer reviewers for this guideline. The draft was sent to the 17 review organizations that responded to the solicitation. The disposition of all non-editorial peer review comments was documented and accompanied this guideline through the public commentary and the AAOS/ADA guideline approval process. The full guideline, along with all supporting documentation and workgroup disclosures, is available on the AAOS Website, www.aaos.org/guidelines

Results

The best available evidence published in studies that met the inclusion criteria was considered for this guideline. The following is a summary of this evidence. As illustrated in Figure 1, the quality of evidence that explains the proposed association between dental procedures and orthopaedic implant infection varies. Only one study that provided direct evidence of moderate strength was identified by the literature search and considered for this guideline. The results of this study show that dental procedures are not risk factors for subsequent implant infection and, furthermore, that antibiotic prophylaxis does not reduce the risk of subsequent infection.¹⁷

However, a multitude of indirect evidence was included in this guideline that investigates particular com-

Figure 2



Incidence of bacteremia by procedure group. n = the number of studies pooled

ponents of this complex mechanism. Multiple high-strength studies link oral procedures to bacteremia, a surrogate measure of risk for orthopaedic implant infection. Some low-strength studies investigate potential risk factors for these bacteremias. In addition, multiple moderate-strength studies suggest that prophylaxis decreases the incidence of post-dental procedure bacteremia. But no studies explain the microbiological relationship between bacteremia and orthopaedic implant infection.

Rates of bacteremia after dental procedures varied significantly by and within dental procedure group. Median incidence rates range from approximately 5% for chewing to upwards of 65% for simple tooth extraction and gingivectomy (Figure 2). As expected, the more invasive oral procedures produced the highest me-

dian incidence of bacteremia, but common daily habits such as flossing (ie, interdental cleaners), tooth brushing, and even chewing resulted in bacteremia in some cases.

Instances of bacteremia following dental procedures may be modified by individual risk factors. While the strength of the evidence is low, several prognostic studies have addressed a multitude of patient characteristics as potential risk factors for developing bacteremia from dental procedures. These low-strength studies report on oral health indicators and general patient characteristics such as age and sex. The results, which are often contradictory, vary across and within procedure groups (see the full guideline for details).^{18,25,26,28-30,33,34,40,52-59,65,75-79} No conclusions about risk factors could be drawn from these studies.

We recognize the diversity of opinion concerning the clinical importance of bacteremia as a surrogate outcome for orthopaedic implant infection, and understand the clinician's concern and rationale for wanting to prevent bacteremia. Therefore, we conducted two independent network meta-analyses on the efficacy of antibiotic and topical antimicrobial prophylaxis for bacteremia post simple tooth extraction. Other studies exist that investigate different dental procedures, but the most robust data reside in tooth extraction studies. Several studies of moderate strength were included in these analyses. These studies investigated the effect of many different antibiotic drugs and topical antimicrobials. Twenty-one antibiotic studies^{22,31,53,57,60,80-95} and 13 topical oral antimicrobial studies^{22,55,96-106}

Table 1**Number Needed to Treat (NNT) to Prevent Bacteremia Post Tooth Extraction: Antibiotics^a**

Treatment	NNT
Amoxicillin	1.8
Penicillin	2.5
Erythromycin	5.0
Clindamycin	3.0
Josamycin	14.0
Moxifloxacin	1.9
Cefaclor	9.3
IV tetracycline	1.5
IV cefuroxime	2.1
IM teicoplanin	2.2
Topical amoxicillin	4.0
Antiseptic rinse	3.2
IM penicillin or IV erythromycin or oral or IV amoxicillin	3.7

IM = intramuscular, IV = intravenous

^a The table represents a conversion of odds ratio from a forest plot of indirect (network) comparisons of antibiotics versus placebo/no treatment**Table 2****Number Needed to Treat (NNT) to Prevent Bacteremia Post Tooth Extraction: Topical Antimicrobials^a**

Treatment	NNT
Saline rinse	70.0
Chlorhexidine rinse	2.5
Povidone-iodine rinse	2.3
Chloramine-T rinse/brush	2.5
Lugol solution rinse	11.7
Hydrogen peroxide rinse	3.9
Sodium perborate-ascorbic acid rinse	2.5
Phenolated rinse	2.8
Placebo rinse	N/A
Operative field isolation	1.8
Isolation + iodine rinse	1.8
Isolation + chlorhexidine rinse	1.5

N/A = not applicable

^a The table represents a conversion of odds ratio from a forest plot of indirect (network) comparisons of topical antimicrobials versus no treatment

were included in our network meta-analyses. The majority of the results from the individual studies and the overall effect of these prophylactic agents according to our analyses were favorable and clinically meaningful (Tables 1 and 2).

While there was no direct evidence to explain the proposed association between bacteremia and orthopaedic implant infection, we summarized the microbiological information pertaining to cases and rates of bacteremia and implant infection, when available, based on our included literature. According to orthopaedic implant cohort studies,¹⁻¹³ approximately 53% of organisms responsible for the infections were *Staphylococcus* species. The overall rate of infection was approximately 1.5%. Of the studies that distinguished early from late infections,^{1,4,5,8-11,13} we were able to calculate rates of 0.4% and 0.9%, respectively. According to

orthopaedic implant infection case series,^{17,107-122} approximately 64% of the infections were *Staphylococcus* species. Of the studies that distinguished early from late infections, 36.7% were early and 63.3% were late.^{17,107-111,113-117,120} Dental-related bacteremia varied greatly by procedure and study, as did the organism responsible for the bacteremia.^{19,22-}

24,28,29,33,35,37-42,44-48,50,51,62,64,65,67-73,89,91,93,

123-139 No clear association between the organisms found in the prosthetic implant infections and bacteremia exists. However, the majority of the organisms found in implant infections are *Staphylococcus*, and the majority of the organisms found as the cause of bacteremias are *Streptococcus*.

Considering all of the above information in accordance with AAOS clinical practice guideline protocol, the workgroup created the following recommendations:

Recommendations**Recommendation 1**

The practitioner might consider discontinuing the practice of routinely prescribing prophylactic antibiotics for patients with hip and knee prosthetic joint implants undergoing dental procedures.

Grade of Recommendation: Limited

A Limited recommendation means the quality of the supporting evidence that exists is unconvincing or that well-conducted studies show little clear advantage to one approach versus another.

Practitioners should be cautious in deciding whether to follow a recommendation classified as Limited and should exercise judgment and be alert to emerging publications that report evidence. Patient preference should have a substantial influencing role.

Recommendation 2

We are unable to recommend for or against the use of topical oral antimicrobials in patients with prosthetic joint implants or other orthopaedic implants undergoing dental procedures.

Grade of Recommendation: Inconclusive

An Inconclusive recommendation means that there is a lack of compelling evidence resulting in an unclear balance between benefits and potential harm.

Practitioners should feel little constraint in deciding whether to follow a recommendation labeled as Inconclusive and should exercise judgment and be alert to future publications that clarify existing evidence for determining balance of benefits versus potential harm. Patient preference should have a substantial influencing role.

Recommendation 3

In the absence of reliable evidence linking poor oral health to prosthetic joint infection, it is the opinion of the work group that patients with prosthetic joint implants or other orthopaedic implants maintain appropriate oral hygiene.

Grade of Recommendation: Consensus

A Consensus recommendation means that expert opinion supports the guideline recommendation even though there is no available empirical evidence that meets the inclusion criteria.

Practitioners should be flexible in deciding whether to follow a recommendation classified as Consensus, although they may set boundaries on alternatives. Patient preference should have a substantial influencing role.

Discussion

Direct support for recommendation 1 comes from a single well-conducted case-control study. Study enrollment consisted of 339 patients with prosthetic hip or knee infections (cases) and 339 patients with hip or knee arthroplasties without infection (controls) hospitalized on an orthopaedic service during the same time period. The comparison between these groups was for differences in dental visits (exposure) in terms of high- and low-risk dental procedures, with and without antibiotic prophylaxis. Results reported as odds ratios with 95% CI demonstrate no statistically significant differences between groups. Neither dental procedures nor antibiotic prophylaxis before dental procedures were associated with risk of prosthetic hip or knee infections. The authors performed a sample size calculation and withdrawals were low, thus minimizing attrition bias. The prospective nature of this study minimized recall bias. Additionally, blinding of the treatment group to those assessing outcomes limits detection bias. Although

this one study of direct evidence was of moderate strength, it did have limitations. The authors conducted covariate analysis on some subgroups of higher risk patients. The number of patients in these subgroups, however, was relatively small, and there are insufficient data to suggest that these patients are at higher risk of experiencing hematogenous infections.

Indirect evidence was also considered for recommendation 1. There is high-strength evidence that demonstrates the occurrence of bacteremia with dental procedures. Historically, there has been a suggestion that bacteremias can cause hematogenous seeding of total joint implants, both in the early postoperative period and for many years following implantation. Two years post joint arthroplasty was previously considered the critical period for prophylaxis. In addition, bacteremias may occur during normal daily activities, such as chewing and tooth brushing. It is likely that these daily activities induce many more bacteremias than do dental procedure-associated bacteremias. While evidence supports a strong association between certain dental procedures and bacteremia, there is no evidence to demonstrate a direct link between dental procedure-associated bacteremia and infection of prosthetic joints or other orthopaedic implants. Multiple studies of moderate- and high-strength evidence suggest that antibiotic prophylaxis decreases the risk of dental procedure-associated bacteremias. However, dental-procedure-associated bacteremia is a surrogate outcome for prosthetic joint infection. There is no evidence that these bacteremias are related to prosthetic joint infections. Surrogate outcomes may or may not relate to a clinically relevant patient outcome. A positive surrogate outcome (eg, reduced bacteremias), however, could mask a negative patient-centered outcome

(eg, implant infection).

Recommendation 1 is limited to patients with hip and knee prostheses because the single study of direct evidence included only patients with these types of orthopaedic implants. There is no direct evidence that met our inclusion criteria for patients with other types of orthopaedic implants.

Evidence for recommendation 2 is sparse. There was no direct evidence to support or refute the use of prophylaxis (topical antimicrobials) before dental procedures. The same indirect evidence discussed above relating to dental procedures and bacteremia was considered for recommendation 2. There is conflicting evidence regarding the effect of antimicrobial mouth rinse on the incidence of bacteremia post dental procedures. One high-strength study reports no difference in the incidence of bacteremia following antimicrobial mouth rinsing in patients undergoing dental extractions. Conversely, numerous studies suggest that topical antimicrobial prophylaxis decreases the incidence of dental procedure-associated bacteremia. However, there is no evidence that application of antimicrobial mouth rinses before dental procedures prevents infection of prosthetic joints or other orthopaedic implants. Due to the lack of direct evidence, the contradictory nature of the indirect evidence pertaining to topical oral antimicrobials, and continued concern with surrogate outcomes, recommendation 2 is Inconclusive. The work group is unable to recommend for or against the use of topical oral antimicrobials.

Recommendation 3 is an opinion statement due to the lack of evidence relating oral hygiene measures to prosthetic joint or other orthopaedic implant infections. Oral hygiene measures are low cost, provide potential benefit, are consistent with current practice, and are in accor-

dance with good oral health. There is evidence of the relationship of oral microflora to bacteremia. This bacteremia may be associated with poor oral hygiene. This implies that improvement of oral hygiene (or maintenance of good oral hygiene) may be beneficial in reducing bacteremia.

These recommendations are not intended to stand alone. Treatment decisions should be made in light of all circumstances presented by the patient. Treatments and procedures applicable to the individual patient rely on mutual communication between patient, physician, dentist, and other healthcare practitioners in accordance with evidence-based medicine applicability. (See the full guideline at http://www.aaos.org/research/guidelines/PUDP/dental_guideline.asp)

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