THE PREVENTION OF TOTAL HIP AND KNEE ARTHROPLASTY PERIPROSTHETIC JOINT INFECTION IN PATIENTS UNDERGOING DENTAL PROCEDURES

Evidence-Based Clinical Practice Guideline

Adopted by:
The American Academy of Orthopaedic Surgeons Board of Directors
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Adopted by:
The American Association of Hip and Knee Surgeons Board of Directors

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Disclaimer

This clinical practice guideline (CPG) was developed by a physician volunteer clinical practice guideline development group based on a formal systematic review of the available scientific and clinical information and accepted approaches to treatment and/or diagnosis. This clinical practice guideline is not intended to be a fixed protocol, as some patients may require more or less treatment or different means of diagnosis. Clinical patients may not necessarily be the same as those found in a clinical trial. Patient care and treatment should always be based on a clinician's independent medical judgment, given the individual patient's specific clinical circumstances.

Disclosure Requirement

In accordance with AAOS policy, all individuals whose names appear as authors or contributors to the clinical practice guideline filed a disclosure statement as part of the submission process. All panel members provided full disclosure of potential conflicts of interest prior to voting on the recommendations contained within this clinical practice guideline.

Funding Source

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FDA Clearance

Some drugs or medical devices referenced or described in this clinical practice guideline may not have been cleared by the Food and Drug Administration (FDA) or may have been cleared for a specific use only. The FDA has stated that it is the responsibility of the physician to determine the FDA clearance status of each drug or device he or she wishes to use in clinical practice.

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View data summaries via the CPG eAppendix 2

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View background material via the CPG eAppendix 1
View data summaries via the CPG eAppendix 2

Contents

View background material via the CPG eAppendix 1
View data summaries via the CPG eAppendix 2

View background material via the CPG eAppendix 1
View data summaries via the CPG eAppendix 2

SUMMARY OF OPTIONS

Options are formed when there is little or no evidence on a topic. This is defined as low quality evidence or a single moderate quality study (i.e., a limited strength option), no evidence or only conflicting evidence (i.e., a consensus option), or statements resulting in a limited or consensus strength following Evidence to Decision Framework upgrading and/or downgrading.

Prophylactic Systemic Antibiotic Use Before Dental Procedure (Hip/Knee Patients)

Routine use of a systemic prophylactic antibiotic prior to a dental procedure in patients with a hip or knee replacement may not reduce the risk of a subsequent periprosthetic joint infection.

Quality of Evidence: Low

Strength of Option: Limited 

Evidence from two or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention. Also, higher strength evidence can be downgraded to limited due to major concerns addressed in the EtD Framework.

Dental Screening Prior To Hip or Knee Arthroplasty

Implementation of a dental screening in patients before a hip or knee replacement may not reduce the risk of subsequent periprosthetic joint infection.

Quality of Evidence: Low

Strength of Option: Limited 

Evidence from two or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention. Also, higher strength evidence can be downgraded to limited due to major concerns addressed in the EtD Framework.

Antiseptic/Antimicrobial Treatment

In the absence of reliable evidence, it is the opinion of the workgroup that the use of an oral topical antiseptic wash is not necessary before a dental procedure in patients with a hip or knee replacement.

Quality of Evidence: Consensus

Strength of Option: Consensus 

There is no supporting evidence, or limited level evidence was downgraded due to major concerns addressed in the EtD framework. In the absence of sufficient evidence, the guideline work group is making a recommendation based on their clinical opinion.

View background material via the CPG eAppendix 1
View data summaries via the CPG eAppendix 2

Delay Vs. No Delay of Arthroplasty After a Dental Procedure

In the absence of reliable evidence, it is the opinion of the workgroup that the decision to delay a hip or knee replacement surgery is based on the risk of transient bacteremia, the occurrence of an invasive surgical procedure, or treatment of an active dental infection. Please see Table 3.

Quality of Evidence: Consensus
Strength of Option: Consensus ★☆☆☆
There is no supporting evidence, or limited level evidence was downgraded due to major concerns addressed in the EtD framework. In the absence of sufficient evidence, the guideline work group is making a recommendation based on their clinical opinion.

Delay Vs. No Delay of Dental Procedure After a Hip/Knee Arthroplasty

In the absence of reliable evidence, it is the opinion of the workgroup that the decision to delay a dental procedure after hip or knee replacement surgery is based on the risk of transient bacteremia, the occurrence of an invasive surgical procedure, or treatment of an active dental infection. Please see Table 3.

Quality of Evidence: Consensus
Strength of Option: Consensus ★☆☆☆
There is no supporting evidence, or limited level evidence was downgraded due to major concerns addressed in the EtD framework. In the absence of sufficient evidence, the guideline work group is making a recommendation based on their clinical opinion.

View background material via the CPG eAppendix 1
View data summaries via the CPG eAppendix 2

DEVELOPMENT GROUP ROSTER

VOTING MEMBERS

Yale Fillingham, MD, FAAOS
Co-Chair, American Academy of Orthopaedic Surgeons, American Association of Hip and Knee Surgeons

Charles Hannon, MD, FAAOS
Co-Chair, American Association of Hip and Knee Surgeons

David Jevsevar, MD, MBA, FAAOS
American Academy of Orthopaedic Surgeons

Matthew Grosso, MD
American Association of Hip and Knee Surgeons

Nicholas Bedard, MD
American Association of Hip and Knee Surgeons

Elie Berbari, MD
Infectious Diseases Society of America

Majdi Al-Hassan, MBBS
Infectious Diseases Society of America

Jessica Seidelman, MD
Musculoskeletal Infection Society

Alberto Carli, MD, MSc, FRCSC
Musculoskeletal Infection Society

Michele D'Apuzzo, MD, FAAOS
American Academy of Orthopaedic Surgeons

Thomas Myers, MD, FAAOS
American Academy of Orthopaedic Surgeons

Matthew Dietz, MD, FAAOS
American Academy of Orthopaedic Surgeons

Karl Roberts, MD, FAAOS
American Academy of Orthopaedic Surgeons

Lauren Patton, DDS
American Dental Association

Tara Aghaloo, DDS, MD, PhD
American Dental Association

NON-VOTING MEMBERS

Ajay Srivastava, MD, FAAOS
Oversight Chair, American Academy of Orthopaedic Surgeons

AAOS STAFF

Jayson Murray, MA, MBA
Director, Clinical Quality and Value, AAOS

Kaitlyn Sevarino, MBA, CAE
Director, Clinical Quality and Value, AAOS

Danielle Schulte, MS, MBA
Manager, Clinical Quality and Value, AAOS

Tyler Verity, MSLIS
Medical Librarian, Clinical Quality and Value, AAOS

View background material via the CPG eAppendix 1
View data summaries via the CPG eAppendix 2

Jennifer Rodriguez, MBA
Manager, Clinical Quality and Value, AAOS

Barbara Krause
Quality Improvement Specialist, Clinical Quality and Value, AAOS

FORMER AAOS STAFF

Francisco Casambre, MPH
Anushree Tiwari, MPH

View background material via the CPG eAppendix 1
View data summaries via the CPG eAppendix 2

INTRODUCTION

OVERVIEW

This clinical practice guideline is based on a systematic review of published studies examining the influence of dental care and procedures on outcomes after total joint arthroplasty (TJA) as well as strategies to mitigate potential risks associated with dental care and procedures in patients with a TJA. It provides recommendations that will help practitioners to integrate the current evidence and clinical practice, and it highlights gaps in the literature in need of future research. This guideline is intended to be used by appropriately trained physicians and dentists considering prevention of total hip and knee arthroplasty periprosthetic joint infection in patients undergoing dental procedures. The recommendations are a guide for physicians and dentists that should not be interpreted as a standard of care. It also serves as an information resource for developers and applied users of clinical practice guidelines.

GOALS AND RATIONALE

The purpose of this clinical practice guideline is to evaluate the current best evidence associated with treatment. Evidence-based medicine (EBM) standards advocate for use of empirical evidence by physicians in their clinical decision making. To assist with access to the large resources of information, a systematic review of the literature in publication was conducted between May 2023 and October 2023. It highlights where there is good evidence, where evidence is lacking, and what topics future research will need to target in order to help facilitate evidence-based decision making in the prevention of total hip and knee arthroplasty periprosthetic joint infection in patients undergoing dental procedures. AAOS staff methodologists assisted the physician/clinician work group in evaluating the existing literature so that they could formulate the following recommendations based on a rigorous systematic process. Musculoskeletal care is provided in many different settings and by a variety of providers. We created this guideline as an educational tool to guide qualified physicians and clinicians in making treatment decisions that improve the quality and efficacy of care. This guideline should not be construed as including all possible methods of care or excluding acceptable interventions similarly directed at obtaining favorable outcomes. The final decision to use a specific procedure must be made after assessing all concerns presented by the patient and consideration of locality-specific resources.

INTENDED USERS

This guideline is intended for use by all qualified clinicians, including orthopedic surgeons as well as dental providers, considering prevention of total hip and knee arthroplasty periprosthetic joint infection in patients undergoing dental procedures. It serves as an information resource for medical practitioners. In general, individual practicing physicians and clinicians do not have the resources required to complete a project of comparable scope and duration involving the evaluation of an extensive literature base. In April 2019, the AAOS adopted the use of the GRADE Evidence-to-Decision Framework into its clinical practice guideline development methodology. This Framework enables work group members to incorporate additional factors into the strength of each recommendation and move away from the rigidity of previous AAOS recommendation language stems. The AAOS intends for this guideline to assist treatment providers not only in making shared clinical decisions with their patients, but also in describing to patients and their loved ones why a selected intervention represents the best available course of treatment. This guideline is not intended for use as a benefits determination document. It does not cover allocation of resources, business and ethical considerations, and other factors needed to determine the material value of orthopaedic care. Users of this guideline may also want to consider the appropriate use criteria (AUC) related prevention of orthopaedic

View background material via the CPG eAppendix 1
View data summaries via the CPG eAppendix 2

implant infection in patients undergoing dental procedures.

PATIENT POPULATION

This guideline is intended for use with patients who are scheduled to undergo TJA as well as those who have a TJA and are seeking dental care.

SCOPE

The scope of this guideline includes the role of dental screening, antibiotic prophylaxis, prevention, and timing of dental procedures before and after TJA. The population was limited to patients with total hip (THA) or total knee arthroplasty (TKA) implants due to a paucity of data on the scope topics in patients with other orthopaedic implants.

ETIOLOGY

PJI affects 1-2% of primary THA and TKA. There are several causes of PJI including hematogenous spread, contiguous spread from a local source, or surgical site infection from the index procedure.

INCIDENCE AND PREVALENCE

TKA and THA are two of the most common surgical procedures performed worldwide. In the United States, over 1 million TKAs and THAs are performed each year. It is estimated that by 2060 the number of THA and TKA procedures performed will increase by 659% and 469%, respectively (Shichman, 2023).

BURDEN OF DISEASE

As the number of patients who undergo THA and TKA continue to rise, so too will the number of patients presenting for dental care and procedures with a THA and TKA.

EMOTIONAL AND PHYSICAL IMPACT

Patients who have a PJI have increased pain and physical limitations. PJI is also associated with increased mortality, up to 250% greater than patients who do not have PJI (Villa, 2024). There are also significant emotional impacts of PJI including a higher incidence of mental health disorders, including anxiety, depression, and psychotic disorders (Das, 2024).

POTENTIAL BENEFITS, HARM, AND CONTRAINDICATIONS

There are several benefits and harms when considering dental screening prior to surgery, timing of dental procedures prior to surgery, as well as antibiotic prophylaxis in patients who have a THA or TKA who undergo a dental procedure. The ultimate goal is to limit and prevent PJI after THA or TKA. However, interventions aimed at prevention must be weighed against potential harms including patient inconvenience, patient and societal costs, as well as other adverse clinical events such as the development of *Clostridioides difficile* infection or antibiotic-resistant bacteria with widespread antibiotic use. The ultimate decision on whether a patient should delay a dental procedure before or after TJA, undergo dental screening before TJA, or receive antibiotic prophylaxis should be made through a shared decision-making process understanding the unique risks and benefits for that particular patient.

DIFFERENCES BETWEEN THE PRESENT AND PREVIOUS GUIDELINES

This updated clinical practice guideline replaces the edition that was completed in 2012, "Prevention of Orthopaedic Implant Infection in Patients Undergoing Dental Procedures." This update considered the literature that we previously examined as well as the empirical evidence published since the 2012 guideline. In April 2019, the AAOS adopted the use of the GRADE Evidence-to-Decision Framework into its clinical practice guideline development methodology. This Framework enables work group members to incorporate additional factors into the strength of each recommendation and move away from the rigidity of previous AAOS recommendation language stems. The complete listing of inclusion criteria for this guideline is detailed in the section, "Study Selection Criteria," (eAppendix 1).

View background material via the CPG eAppendix 1
View data summaries via the CPG eAppendix 2

METHODS

The methods used to perform this systematic review were employed to minimize bias and enhance transparency in the selection, appraisal, and analysis of the available evidence. These processes are vital to the development of reliable, transparent, and accurate clinical recommendations. To view the full AAOS clinical practice guideline methodology please visit https://www.aaos.org/quality/research-resources/methodology/.

This clinical practice guideline evaluates the prevention of total hip and knee arthroplasty periprosthetic join infection in patients undergoing dental procedures. The AAOS approach incorporates practicing physicians and dentists (clinical experts) and methodologists who are free of potential conflicts of interest relevant to the topic under study, as recommended by clinical practice guideline development experts.

This clinical practice guideline was prepared by the AAOS/AAKHS Prevention of Total Hip and Knee Arthroplasty Periprosthetic Joint Infection in Patients Undergoing Dental Procedures Guideline physician and dentist development group (clinical experts) with the assistance of the AAOS Clinical Quality and Value (CQV) Department (methodologists). To develop this clinical practice guideline, the clinical practice guideline development group held an introductory meeting on January 29th, 2023 to establish the scope of the clinical practice guideline. As the physician and dentist experts, the clinical practice guideline development group defined the scope of the clinical practice guideline by creating PICO Questions (i.e. population, intervention, comparison, and outcome) that directed the literature search. The AAOS Medical Librarian created and executed the search (see eAppendix 1 for search strategy).

LITERATURE SEARCHES

The systematic review begins with a comprehensive search of the literature. Articles considered were published prior to the start date of the search in a minimum of three electronic databases; PubMed, EMBASE, and the Cochrane Central Register of Controlled Trials. The medical librarian conducts the search using key terms determined from the guideline development group's PICO questions.

A CQV methodologist will review/include only primary literature but will supplement the electronic search with a manual search of the bibliographies of secondary literature sources, such as systematic reviews, as available. The methodologist will then evaluate all recalled articles for possible inclusion based on the study selection criteria and will summarize the evidence for the guideline work group who assist with reconciling possible errors and omissions.

A study attrition diagram is provided that details the numbers of identified abstracts, recalled and selected studies, and excluded studies that were evaluated in the clinical practice guideline. The search strategy used to identify the abstracts is also included in eAppendix 1 of the clinical practice guideline documents.

DEFINING THE QUALITY OF EVIDENCE

The quality of evidence for a recommendation is determined by the quality and quantity of included literature for the statement. Statements with evidence from two or more "High" quality studies are considered to have "High Quality Evidence". Statements with evidence from two or more "Moderate" quality studies, or evidence from a single "High" quality study are considered to have "Moderate Quality Evidence". Statements with evidence from two or more "Low" quality studies or evidence from a single "Moderate" quality study are considered to have "Low Quality Evidence". Statements with evidence from one "Low"

View background material via the CPG eAppendix 1
View data summaries via the CPG eAppendix 2

quality study or no supporting evidence are considered to have “Very Low Quality Evidence” or “Consensus” respectively.

DEFINING THE STRENGTH OF RECOMMENDATION

Judging the quality of evidence is only a steppingstone towards arriving at the strength of a recommendation. The strength of recommendation also takes into account the quality, quantity, and the trade-off between the benefits and harms of a treatment, the magnitude of a treatment’s effect, and whether data exists on critical outcomes.

Strength of recommendation expresses the degree of confidence one can have in a recommendation. As such, the strength expresses how possible it is that a recommendation will be overturned by future evidence. It is very difficult for future evidence to overturn a recommendation that is based on many high quality randomized controlled trials that show a large effect. It is much more likely that future evidence will overturn recommendations derived from a few small retrospective comparative studies. Consequently, recommendations based on the former kind of evidence are given a “strong” strength of recommendation and statements based on the latter kind of evidence are presented as “Options” to the practicing clinician, rather than a directional recommendation, with either a “limited” strength or, in the event of no supporting or only conflicting evidence, a “consensus” strength. For any “consensus” strength option, the decision to include a statement in the clinical practice guideline is at the discretion of the guideline development group.

VOTING ON THE RECOMMENDATIONS

The recommendations and their strength were voted on by the guideline development group members during the final meeting. If disagreement between the guideline development group occurred, there was further discussion to see whether the disagreement(s) could be resolved. Recommendations were approved and adopted in instances where a simple majority (60%) of the guideline development group voted to approve; however, the guideline development group had consensus (100% approval) when voting on every recommendation for this guideline. Any recommendation strength upgrade or downgrade based on the Evidence-to-Decision Framework required a super majority (75%) approval of the work group.

View background material via the CPG eAppendix 1
View data summaries via the CPG eAppendix 2

UNDERSTANDING THE QUALITY OF EVIDENCE AND STRENGTH OF STATEMENT

Table 1. Strength and Quality Descriptions

Statement Strength	Evidence Quality	Statement Description	Strength Visual
Strong	High*	Evidence from two or more "High" quality studies with consistent findings recommending for or against the intervention. Or Rec is upgraded using the EtD framework.	
Moderate	Moderate*	Evidence from two or more "Moderate" quality studies with consistent findings or evidence from a single "High" quality study recommending for or against the intervention. Or Rec is upgraded or downgraded using the EtD framework.	
Limited	Low*	Evidence from two or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention. Or Rec is downgraded using the EtD framework.	
Consensus*	Very Low, or Consensus*	Evidence from one "Low" quality study, no supporting evidence, or Rec is downgraded using the EtD framework. In the absence of sufficient evidence, the guideline work group is making a statement based on their clinical opinion.	

*Unless statement was upgraded or downgraded in strength, using the EtD Framework.

Table 2. Interpreting the Strength of a Recommendation or Option

Strength of Statement	Patient Counseling (Time)	Decision Aids	Impact of Future Research
Strong	Least	Least Important, unless the evidence supports no difference between two alternative interventions	Not likely to change
Moderate	Less	Less Important	Less likely to change
Limited	More	Important	Change possible/anticipated
Consensus	Most	Most Important	Impact unknown

View background material via the CPG eAppendix 1
View data summaries via the CPG eAppendix 2

REVIEW PERIOD

Following the final meeting, the clinical practice guideline draft undergoes a 3-week review period for additional input from external content experts. Written comments are provided on the structured review form. All reviewers are required to disclose their conflicts of interest.

Specialty societies relevant to the topic are solicited for nominations of individual reviewers approximately six weeks before the final meeting. The review period is announced as it approaches, and others interested are able to volunteer to review the draft. The chairs of the guideline work group review the draft of the guideline prior to dissemination.

Some specialty societies (both orthopaedic and non-orthopaedic) ask their evidence-based practice (EBP) committee to provide review of the guideline. The organization is responsible for coordinating the distribution of our materials and consolidating their comments onto one form. The chair of the external EBP committees provides disclosure of their conflicts of interest (COI) and manages the potential conflicts of their members.

The review stage gives external stakeholders an opportunity to provide evidence-based direction for modifications that they believe have been overlooked. Since the draft is subject to revisions until its approval by the AAOS and AAHKS Board of Directors as the final step in the guideline development process, confidentiality of all working drafts is essential.

The clinical practice guideline is also provided to members of the AAOS and AAHKS Board of Directors (BOD), members of the Research and Quality Council (RQC), members of the Board of Councilors (BOC), and members of the Board of Specialty Societies (BOS) and members of the Committee on Evidence-Based Quality and Value (EBQV) for review and comment. The clinical practice guideline is automatically forwarded to the AAHKS BOD and AAOS BOD, RQC, and EBQV so that they may review it and provide comment prior to being asked to approve the document. Based on these bodies, over 200 commentators have the opportunity to provide input into this clinical practice guideline.

The chairs of the guideline work group, the manager of the AAOS CQV unit, and the Director of AAOS CQV draft the initial responses to comments that address methodology. These responses are then reviewed by the co-chairs, who respond to questions concerning clinical practice and techniques. All comments received and the initial drafts of the responses are also reviewed by all members of the guideline development group. All proposed changes to recommendation language as a result of the review period are based on evidence. Final revisions are summarized in a report that is provided alongside the guideline document throughout the remainder of the approval processes and final publication.

The AAOS believes in the importance of demonstrating responsiveness to input received during the review process and welcomes the critiques of external specialty societies. Following final approval of the guideline, all individual responses are posted on our website http://www.aaos.org/quality with a point-by-point reply to each non-editorial comment. Reviewers who wish to remain anonymous notify the AAOS to have their names de-identified; their comments, our responses, and their COI disclosures are still posted.

THE AAOS GUIDELINE APPROVAL PROCESS

This final clinical practice guideline draft must be approved by the AAOS Committee on Evidence Based Quality and Value, and subsequently the AAOS Research and Quality Council, and the AAOS and AAHKS Board of Directors. These decision-making bodies are described in the eAppendix 1. Their charge is to approve or reject its publication by majority vote.

REVISION PLANS

This clinical practice guideline represents a cross-sectional view of current treatment and may become outdated as new evidence becomes available. This clinical practice guideline will be revised in accordance with new evidence, changing practice, rapidly emerging treatment options, and

View background material via the CPG eAppendix 1
View data summaries via the CPG eAppendix 2

new technology. This clinical practice guideline will be updated or withdrawn in five years.

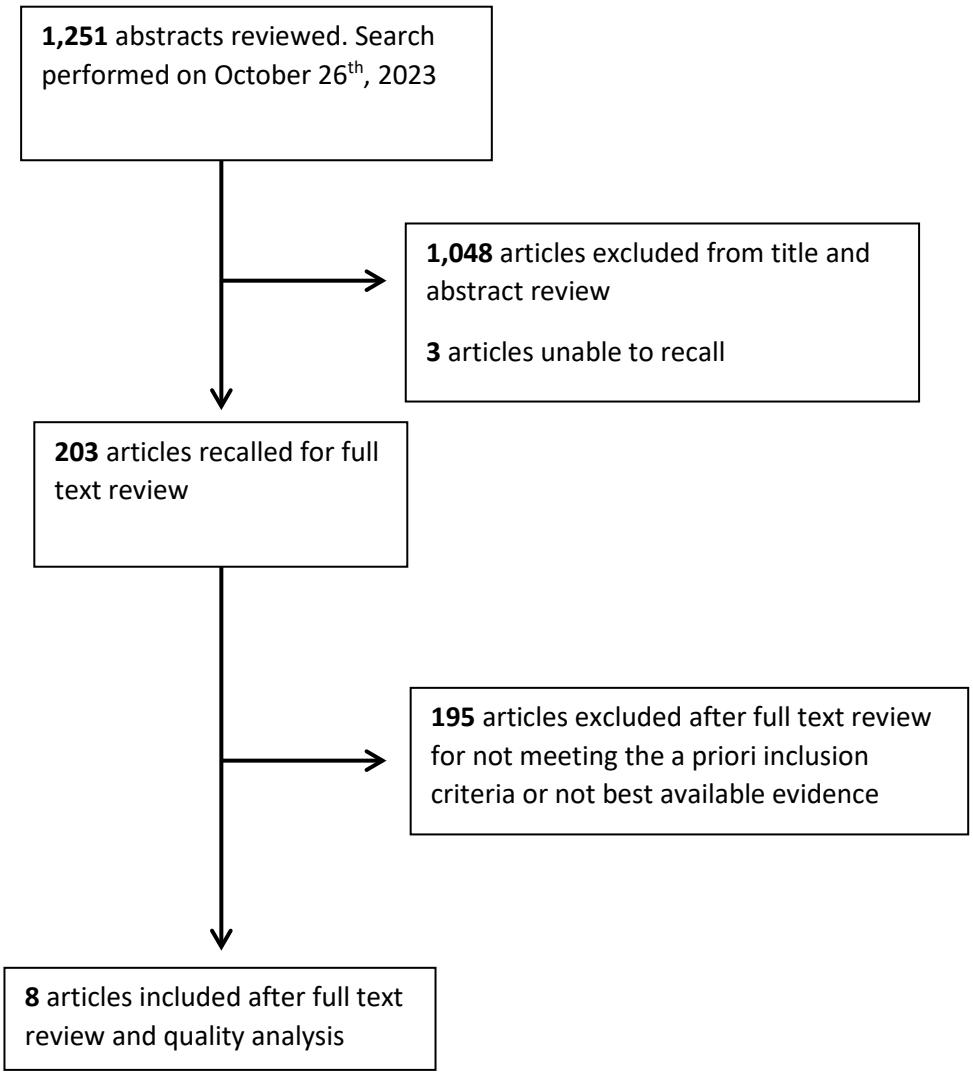
GUIDELINE DISSEMINATION PLANS

The primary purpose of the present document is to provide interested readers with full documentation of the best available evidence for various procedures associated with the topic of this review. Publication of most clinical practice guidelines is announced by an AAOS press release, articles authored by the clinical practice guideline development group and published in the Journal of the American Academy of Orthopaedic Surgeons, and articles published in AAOS *Now*. Most clinical practice guidelines are also distributed at the AAOS Annual Meeting in the Resource Center. The final guideline recommendations and their supporting rationales will be hosted on www.OrthoGuidelines.org.

Selected clinical practice guidelines are disseminated by webinar, the AAOS Learning Management System (LMS), Media Briefings, and by distributing them at relevant Continuing Medical Education (CME) courses and at the AAOS Resource Center.

View background material via the CPG eAppendix 1
View data summaries via the CPG eAppendix 2

Study Attrition Flowchart



View background material via the CPG eAppendix 1
View data summaries via the CPG eAppendix 2

OPTIONS

Low quality evidence, no evidence, or conflicting supporting evidence have resulted in the following statements for patient interventions to be listed as options for the specified condition. Future research may eventually cause these statements to be upgraded to strong or moderate recommendations for treatment.

Prophylactic Systemic Antibiotic Use Before Dental Procedure (Hip/Knee Patients)

Routine use of a systemic prophylactic antibiotic prior to a dental procedure in patients with a hip or knee replacement may not reduce the risk of a subsequent periprosthetic joint infection.

Quality of Evidence: Low

Strength of Option: Limited 

Description: Evidence from one or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention. Also, higher strength evidence can be downgraded to limited due to major concerns addressed in the EtD Framework.

Rationale

Four low quality studies were included (Kao, 2017; Berbari, 2010; Thornhill, 2023; Sax, 2023) as the best available evidence. In 255,568 patients, Kao et al. reported no difference in risk of periprosthetic joint infection (PJI) between total knee arthroplasty (TKA) and total hip arthroplasty (THA) patients who had a dental procedure within 2 years after arthroplasty and those that did not. Of those who had a dental procedure, there was no difference in PJI risk between those that received antibiotics and those that did not. Berbari et al. found no association with low-risk and high-risk dental procedures with TKA and THA PJI in 339 matched patients. In addition, they found that antibiotic prophylaxis prior to dental procedures did not decrease the risk of PJI. In a database analysis of over 1,952,917, Sax et al. similarly found no association between a dental procedure, defined as any procedure involving gingival manipulation, and risk of PJI. In addition, comparing patients who undergo a dental procedure, the rates of PJI and revision were not different between patients who received antibiotic prophylaxis and those who did not.

Benefits/Harms of Implementation

Periprosthetic joint infection is a devastating complication after TJA associated with increased morbidity and mortality. While the data reviewed does not support this, it is possible that rates of PJI after dental procedures may increase without antibiotic prophylaxis. Importantly, however, rates of PJI are reported as low as 1%. The direct societal cost of providing antibiotic prophylaxis prior to dental procedures in patients with TJA is significant, and it is expected that wider adoption of the recommendation will decrease these societal costs. In addition, antibiotic prophylaxis may promote the selection of antibiotic-resistant bacteria and increase the risk of *Clostridioides difficile* infection. Thus, limiting the use of dental antibiotic prophylaxis in TJA may lead to significant cost savings, reduce the risk of developing antibiotic resistance, and incidence of *Clostridioides difficile* infection.

Outcome Importance

Antibiotic prophylaxis prior to dental procedures after THA and TKA is a widely utilized practice. For many, this recommendation will be a shift in practice, which may limit wide acceptability. Some stakeholders may have

View background material via the CPG eAppendix 1
View data summaries via the CPG eAppendix 2

concerns regarding the risks of not providing antibiotic prophylaxis in higher risk patients such as revision TJA patients, patients with prior PJI, or patients with certain medical comorbidities. Importantly, the evidence in this recommendation is mostly derived from patients with primary arthroplasty, particularly THA and TKA. The number of patients with revision arthroplasty and other high-risk populations was too small in the studies included to draw meaningful conclusions. However, it could be argued that the predominance of staphylococci and relative infrequency of viridans group streptococci and other mouth bacterial flora as a causative microbiologic etiology of PJI makes antibiotic prophylaxis prior to dental procedures less intuitive as a prevention strategy even in high-risk populations.

Cost Effectiveness/Resource Utilization

It is estimated that the annual cost of dental antibiotic prophylaxis for patients undergoing TJA in the United States is $59 million, which will only continue to increase as the rates of arthroplasty increase (Thornhill, 2022). Implementing this recommendation could result in significant cost savings for the healthcare system. Moreover, it would reduce antibiotic usage and support antibiotic stewardship, along with its associated benefits.

Acceptability

Periprosthetic joint infections are among the most common causes of failure after TJA. As the number of patients undergoing THA and TKA increases annually, the number of PJIs will increase as well as the costs and secondary adverse effects of antibiotic prophylaxis prior to dental procedures. With increased emphasis on value-based care, this recommendation will reduce costs to the healthcare system without impacting the risk of PJI. In addition, antimicrobial stewardship will prevent the selection of antibiotic-resistant bacteria and protect patients from adverse events associated with unnecessary antibiotic use. A recent large case-control study demonstrated that clindamycin and amoxicillin-clavulanate, commonly used antibiotics for dental prophylaxis, are associated with some of the highest risks of *C. difficile* infection among all the examined oral antibiotics (Miller, 2023).

Feasibility

Fortunately, adopting the guidelines is not resource-intensive or reliant on special needs. Therefore, it would be highly feasible to implement the guidelines with greater clinician acceptance.

Future Research

There is a need for higher-quality evidence, investigations into specific patient subgroups, and economic analyses. Future studies should aim to address the existing gaps in evidence, particularly regarding the efficacy of prophylaxis in high-risk groups (e.g. immunosuppressed and revision TJA) and the cost-benefit analysis of such practices. In particular, future research should focus on patients with revision or megaprostheses as well as patients with medical comorbidities that already place them at a heightened risk of infection (e.g. immunocompromised). Additionally, exploring patient-centered outcomes and preferences could enrich the evidence base and inform more nuanced recommendations.

View background material via the CPG eAppendix 1
View data summaries via the CPG eAppendix 2

Implementation of a dental screening in patients before a hip or knee replacement may not reduce the risk of subsequent periprosthetic joint infection.

Quality of Evidence: Low

Strength of Option: Limited 

Description: Evidence from one or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study recommending for or against the intervention. Also, higher strength evidence can be downgraded to limited due to major concerns addressed in the EtD Framework.

Rationale

The literature regarding oral health maintenance prior to elective total joint arthroplasty (TJA) included 4 low quality studies presented in 3 groups (dental clearance, dental evaluation, and dental screening) based on study design.

Two studies have evaluated the effect of mandating formal preoperative dental clearance (performed by a dentist) prior to TJA (Kwan, 2023; Lampley, 2014). Kwan *et al.* propensity score matched 8,654 patients who had been referred for preoperative dental clearance to 8,654 patients who were not referred based on age, gender, and body mass index (Kwan, 2023). The authors identified no difference between groups in the rate of postoperative prosthetic joint infection (PJI) nor in the bacteriological makeup of infectious organisms in patients undergoing TJA. Furthermore, Lampley *et al.* compared postoperative infection rates of 365 TJA patients who had received dental clearance to a retrospective cohort of 218 hip fracture patients treated with hip arthroplasty who did not have clearance (Lampley, 2014). Although 8.8% of patients who underwent dental clearance had periodontal disease that required treatment preoperatively, the authors found no significant difference in the rate of early postoperative PJI between the cleared versus uncleared groups (1.7% versus 2.5%, p=0.512). Based on the published data the four patients in the hip fracture cohort reported as having a PJI do not appear to meet the 2011 Musculoskeletal Infection Society Criteria as detailed in the methods. However, eliminating these four reported PJIs in the hip fracture cohort would continue to show no benefit for dental clearance.

Fenske *et al.* performed a retrospective analysis on 777 elective arthroplasty patients comparing early (< 4 weeks from TJA) PJI rates in patients who were not screened, screened by their orthopedic surgeon, or were screened by a dentist (Fenske, 2023). Although the authors found no significant difference in postoperative PJI rates among non-screened versus screened (1.6% versus 1%), infection rates were significantly lower in those patients screened by a dentist compared to an orthopedic surgeon (0% versus 2.3%, p=0.021) with all infections occurring in patients screened by the orthopaedic surgeon. A significantly higher rate of patients screened by dentists underwent a dental procedure prior to their TJA compared to patients screened by orthopaedic surgeons (23.6% vs. 0%, p=0.001).

Finally, a single study looked at the prevalence of PJI in patients with and without a documented dental evaluation prior to undergoing primary TJA. Over four-years, Sonn *et al.* retrospectively analyzed a consecutive cohort of patients undergoing 2457 elective arthroplasty procedures, finding that 79.1% had a documented dental evaluation, 15.0% had no documented dental evaluation, and 5.9% were edentulous (Sonn, 2019). An extraction of at least one tooth prior to surgery was identified as necessary in 11.5% of dental evaluations. While the authors do not document the time between dental evaluation and surgery, the median time between extraction

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and surgery was 52 days (IQR, 25-99; range 1-853). Overall, dental evaluation was not associated with a decreased risk of PJI. While the authors found that patients who required a dental extraction trended towards having a higher rate of postoperative complications (adjusted hazard ratio 1.24, p=0.57), they also noted these patients were more likely to exhibit features of immune suppression and diabetes.

Benefits/Harms of Implementation

Clinicians should encourage patients to maintain good dental health and can recommend a formal preoperative assessment by a trained dental practitioner when 1) a history of poor dental hygiene is disclosed, 2) patients exhibit comorbidities such as poorly controlled diabetes, malnutrition, smoking, or immunosuppression that could put them at risk of dental pathology, and 3) when both the cost and feasibility of a dental consultation are appropriate to the patient. The final decision to require formal dental consultation should be a shared decision between the provider and the patient.

Outcome Importance

Periprosthetic joint infection is a devastating complication after TJA associated with increased morbidity and mortality. Fortunately, rates of PJI are reported as low as 1%. It is unclear whether implementation of dental screening may identify patients at high risk and further mitigate the risk of PJI.

Cost Effectiveness/Resource Utilization

Implementing a mandatory dental screening could add significant costs for the patient beyond the screening, as patients who undergo a dental screening are more likely to need a dental procedure before proceeding to TJA. As such, this recommendation reduces cost and limits resource utilization. However, the decision should be made with the patient after discussing the potential risks and benefits of a dental screening due to the potential cost associated with the dental screening.

Acceptability

Given the individual biases based on clinician experience and training, it might be difficult to accomplish widespread acceptance of the current recommendation.

Feasibility

While the encouragement of good oral hygiene should always be supported, the decision to implement a dental screening program prior to TJA in the setting of the United States should be not taken lightly. Recent data reveals that approximately 68.5 million American adults (27% of the population) lack dental insurance (Carequest, 2023), a number that is nearly three times the percentage of those without health insurance. This discrepancy highlights the considerable challenge in ensuring equitable access to dental care, a challenge that continues to afflict specific minority populations over others (Fellows, 2022). Due to the lack of ample evidence to support mandatory clearance, screening, or evaluation by a dental professional prior to TJA, we do not recommend this practice. Mandating dental clearance may inadvertently decrease access to TJA care for certain patient populations. Consensus opinion supports optimization of dental hygiene prior to elective TJA.

Future Research

Four studies have attempted to identify approaches to dental clearance, screening, and evaluation that can improve oral health and decrease potentially infectious foci prior to TJA in patients with teeth with mixed findings. The retrospective nature of the study designs, lack of adequate cohort matching, and minimal details in the dental clearance evaluation and subsequent treatment needs/recommendations are limitations of the literature on this topic. Future studies on this topic should consider taking these limitations into account.

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Antiseptic/Antimicrobial Treatment

In the absence of reliable evidence, it is the opinion of the workgroup that the use of an oral topical antiseptic wash is not necessary before a dental procedure in patients with a hip or knee replacement.

Quality of Evidence: Consensus
Strength of Option: Consensus ★☆☆☆

Description: There is no supporting evidence, or limited level evidence was downgraded due to major concerns addressed in the EtD framework. In the absence of reliable evidence, the guideline work group is making a recommendation based on their clinical opinion.

Rationale

The literature review did not identify any studies meeting inclusion criteria that evaluated topical antiseptic wash prior to a dental procedure for patients with a hip or knee replacement. The consensus recommendation stems from low quality data that has evaluated the impact of chlorhexidine mouthwash prophylaxis on bacteremia following dental procedures (Brown, 1998; Duvall, 2013; Lockhart, 1996; Maharaj, 2012; Tuna, 2012). The results of these studies indicate that chlorhexidine wash prophylaxis does not significantly reduce the level of bacteriemia following dental procedures. As a result, oral topical antiseptic wash is not recommended before a dental procedure in patients with a hip or knee replacement for the purpose of reducing the risk of periprosthetic joint infection (PJI).

Benefits/Harms of Implementation

Given that the data does not support the use of chlorhexidine washes, there is limited harm of implementing this recommendation. Potential benefits are the reduced patient and societal costs by not utilizing this practice.

Outcome Importance

Periprosthetic joint infection is a devastating complication after total joint arthroplasty associated with increased morbidity and mortality. Fortunately, rates of PJI are reported as low as 1%. The prevention of PJI is important but interventions should be implemented when evidence exists to guide the clinician.

Cost Effectiveness/Resource Utilization

This recommendation does not support the use of chlorhexidine wash, which will improve cost-effectiveness and resource utilization.

Acceptability

Because of the lack of demonstrated harm and historical practices of oral, topical antiseptic washes, clinicians might be less willing to accept the guidelines and change practice.

Feasibility

Fortunately, adopting the guidelines is not resource-intensive or reliant on special needs. Therefore, it would be highly feasible to implement the guidelines with greater clinician acceptance.

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View data summaries via the CPG eAppendix 2

Future Research

Continued research with larger studies to examine the effectiveness of oral topical antiseptic wash prior to dental procedures on PJI risk for patient with a hip or knee arthroplasty are necessary to provide better understanding regarding the use of an oral topical antiseptic wash.

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Delay Vs. No Delay of Arthroplasty After a Dental Procedure

In the absence of reliable evidence, it is the opinion of the workgroup that the decision to delay a hip or knee replacement surgery is based on the risk of transient bacteremia, the occurrence of an invasive surgical procedure, or treatment of an active dental infection. Please see Table 3.

Quality of Evidence: Consensus
Strength of Option: Consensus ★☆☆☆

Description: There is no supporting evidence, or limited level evidence was downgraded due to major concerns addressed in the EtD framework. In the absence of reliable evidence, the guideline work group is making a recommendation based on their clinical opinion.

Rationale

Non-invasive dental procedures which induce bacteremia do so transiently, with pathogen clearance occurring within hours, or at the longest, within a day following the procedure (Lockhart, 2008). Therefore, noninvasive dental procedures and minimally invasive dental care procedures can be performed safely up until the day before elective total joint arthroplasty (TJA) surgery. Conversely, oral surgical procedures and dental extractions involve prolonged healing stages, which can last for up to three weeks. Therefore, when feasible, oral surgical and extraction procedures should be completed at least 3 weeks in advance of elective TJA surgery. Table 3 lists specific recommendations on how long to wait after the different types of dental procedures before proceeding with a TJA.

The mouth has a high cellular turnover rate, with gingival healing (as from scaling and root planing) being completed within 3 days. However, oral surgical procedures often produce wounds which heal by primary or secondary intent. Typical epithelialization from a dental extraction takes 2 weeks, with the healing process consisting of 3 phases: inflammatory (days 3-5), proliferation (up to 14 days), and remodeling (6 weeks) (Haj Yahya, 2021). In diabetics, epithelialization can be delayed up to 3 weeks, especially in the context of a dental extraction (Ruggiero, 2024). Although there is no universally accepted scale for oral mucosal wound healing, the most reassuring feature of oral wound healing is the presence of wound epithelialization (Rodriquez, 2024). Upon completion of epithelialization, bacteremia levels from routine chewing return to baseline levels. Thus, it is recommended that elective TJA be delayed 3 weeks, the average time of epithelization, after oral surgical and extraction procedures.

When active dental infections are present, management can be lengthy and involve oral or intravenous antibiotics. Furthermore, extraction of an infected tooth or treatment by endodontic therapy (root canal therapy) in conjunction with antibiotic therapy is often needed to resolve severe oral infections. Due to the possibility of infection persistence, elective TJA surgery should be postponed until dental and antibiotic treatment has concluded with subsequent verification that the oral infection has been eradicated.

Benefits/Harms of Implementation

The dental and orthopedic team needs to weigh the benefits/harms individually for each patient, considering the patient's values and preferences. In general, there is limited harm in delaying elective arthroplasty for the maximum noted 3-week period.

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Outcome Importance

Periprosthetic joint infection is recognized as a devastating complication after TJA associated with increased morbidity and mortality. This consensus opinion tries to weigh concerns for balancing transient bacteremia from dental procedures and infection risk potential for the planned joint replacement.

Cost Effectiveness/Resource Utilization

There is limited evidence to support cost-effectiveness. However, this opinion does not accelerate resource utilization but rather considers delay and timing of delay in resource utilization.

Acceptability

This consensus opinion aims to give guidance that can be considered by healthcare team members to maximize access to dental healthcare while minimizing any potential risk of transient bacteremia seeding a planned TJA in the perioperative period.

Feasibility

After the dissemination of the clinical practice guideline, there should be limited obstacles to widespread adoption. Communication between dentists and orthopedic surgeons is essential for care coordination.

Future Research

As limited research was available, investigations documenting dental treatment and type (grouped by hematogenous bacteremia potential) undertaken at specific time points prior to TJA surgery, then correlated with PJI outcomes, would be of benefit.

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Table 3: Suggested Time Intervals Needed Between Dental Procedures and TJA Surgery

Dental Procedure Group*	Considerations	Minimum Time Before TJA	Minimum Time After TJA
Dental examination without probing dental radiograph or cone beam CT imaging, denture adjustment procedures, clear orthodontic aligner (invisible braces) adjustment procedures, occlusal guard or bite splint adjustment	Not considered invasive dental procedures. No possibility of manipulation of gingiva.	Same day	Same day
Oral hygiene procedures including dental cleaning, dental prophylaxis using a rubber cup and handpiece [without scaling] or periodontal probing (without SRP)		1 day	3 months
Orthodontic procedures including banding or debanding orthodontic fixes or removable appliances, archwire adjustment, orthodontic mini-implant removal, orthodontic separate placement		1 day	3 months
Other non-invasive procedures including suture removal, anesthetic injection, crown and bridge placement, dental restorative procedures, rubber dam clamp or matrix band wedge between teeth, impression taking, endodontic treatment (root canal therapy).	Impressions may be taken digitally (no risk) or with intraoral impression material use in a tray (minimal risk)	1 day	3 months
Scaling and/or root planing (SRP) with manual (hand instruments) or ultrasonic scaler		1 week	3 months
Dental Extractions including single, multiple, impacted third molar	With or without bone graft or platelet-rich fibrin material for socket augmentation	3 weeks	3 months
Oral Surgery (including dental implant surgery, periodontal surgery, cleft palate surgery, piezoelectric surgery, osteosynthesis plate removal)		3 weeks	3 months
Treatment of Active Dental Infection	Antibiotics and oral surgery (e.g. extraction) or endodontic treatment (e.g. root canal therapy)	3 weeks after resolution of active infection	Same day

Note:
*(Martins, 2023)
#Minimum Time Pre TJA is based on dental-procedure induced bacteremia and related procedure healing time. Most transient bacteremia in healthy mouth resolves in several hours but studies indicate longest times for extractions and scaling procedures and 2 hours is the farthest time point assessed in most studies (Martins, 2023).
§Minimum Time Post TJA is based on joint healing required for stability prior to dental-procedure induced bacteremia.

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Delay vs. No Delay of Dental Procedure After a Hip/Knee Arthroplasty

In the absence of reliable evidence, it is the opinion of the workgroup that the decision to delay a dental procedure after hip or knee replacement surgery is based on the risk of transient bacteremia, the occurrence of an invasive surgical procedure, or treatment of an active dental infection (see table 3).

Quality of Evidence: Consensus
Strength of Option: Consensus ★☆☆☆

Description: There is no supporting evidence, or limited level evidence was downgraded due to major concerns addressed in the EtD framework. In the absence of reliable evidence, the guideline work group is making a recommendation based on their clinical opinion.

Rationale

Orthopedic surgeons consider delaying dental care following total joint arthroplasty (TJA) surgery due to three concerns: 1) dental procedures produce transient bacteremia that could potentially seed the newly placed highly perfused joint replacement, 2) more invasive dental procedures lead to higher bacterial loads and potentially increased infection risk, and 3) joint replacements and the surrounding tissues are more susceptible to hematogenous infection acutely after surgery. There is no reliable clinical evidence to confirm the first two concerns. For the third concern, indirect clinical evidence and animal studies suggest that the surgical site may have increased hematogenous seeding risk for up to three months postoperatively (Honkanen, 2019). As a result, a consensus recommendation was made that consideration should be given to delaying a dental procedure for up to 3 months after a TJA based on the type of dental procedure performed. Table 3 lists specific recommendations on how long to wait after TJA before proceeding with the different types of dental procedures.

Is there a link between dental-related transient bacteremia and joint replacement infection in the early postoperative period?

Thornhill et al. (2022) linked medical and dental datasets of the National Health Service in the United Kingdom to evaluate the incidence of invasive dental procedures (IDPs) in a 3-month period prior to 9427 late periprosthetic joint infection (PJI) hospital admissions and the prior 12-month period for IDPs of extractions, scaling and endodontic care. The incidence of IDPs was significantly lower in the three months prior to PJI admission. Causal organisms were identified in 4338 (46%); among those, the majority were staphylococcus, and only 9% were oral streptococci, which authors believe to have been an overestimation due to lack of ICD-10 code specificity. Subsequently, Thornhill et al. (2023) using U.S. commercial and publicly funded health insurance claims data and a similar case-crossover study design of IDPs in the three months immediately before a PJI referred to as the case period compared with the preceding 12-month period (control) for 2,344 PJI hospital admissions attempted to answer the question of an association between IDPs and PJIs. They found no significant positive association between IDPs (1,821, of which 18.3% had antibiotic coverage) and subsequent PJI. These analyses suggest a lack of causal association between IDPs and PJIs. However, neither of these studies examined the association of IDPs and the incidence of PJI within the first few months following joint replacement surgery – a period that may present elevated risk due to increased joint perfusion. Regardless of whether a dental procedure is performed, the first three months after a joint replacement carry the highest risk for developing a PJI. Consequently, it is prudent to avoid any procedures, including dental procedures, that could theoretically or actually further elevate the risk of PIJ during this already critical time.

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Is it known which dental procedures are more likely to lead to bacteremia?

In a recent systematic review including 25 randomized controlled trials and 64 nonrandomized controlled trials, Martins et al. (2023) in evaluating bacteremia before and after IDPs, defined as involving manipulation of dental or mucosal tissues around the teeth, found that the highest incidence was from dental extractions (62%-66%), periodontal scaling and root planing (SRP; 44%-36%), and oral health procedures (27%-28%) defined as dental prophylaxis (cleaning) and dental probing without SRP. They confirmed peak bacteremia occurred within 5 minutes of the end of the IDP and decreased over time with all but scaling and surgical procedures resolving by the 2-hour time point assessment. Methods are insufficient to reliably determine bacterial load magnitude in circulation; however, one quantitative real-time PCR and anaerobic/aerobic blood culture-based study suggests the magnitude of bacteremia is higher after dental extractions than supra gingival scaling procedures (Reis, 2018). Martins et al. (2023), in this systematic review, also noted that activities of daily living result in transient bacteremia, particularly in individuals with poor oral hygiene, with a frequency of 16% for dental flossing and chewing and 8%-26% for toothbrushing. Duration may be impacted by the patient's immune system and ability to clear transient bacteremia.

Is a joint replacement site at increased risk for hematogenous seeding early after surgery?

The supposition that human arthroplasty surgical sites are more at risk for hematogenous seeding arises indirectly from evidence confirming that there is increased blood flow to the joint and its surrounding tissues within the first three months following surgery. Gavish et al (2023) published a systematic review and meta-analysis quantifying the skin temperature (ST) following total knee arthroplasty. Of the 318 patients included in the review encompassing ten studies, the authors found that ST was greatest during the first 2-weeks post-surgery (an average increase of 2.8°C), remained above preoperative temperature at 3-months (increase of 1.4°C) and then eventually decreased to 0.9 °C and 0.6 °C at six and 12-months respectively. Increased blood flow has also been described using advanced imaging in radiology. Hofmann et al. (1990) demonstrated in 59 knee replacements that periprosthetic tissues had significantly increased signal uptake on bone scans both within the immediate postoperative period and in the subsequent three months, regardless of fixation type. These signals take up to 2 years to normalize following hip replacement and five years following knee replacement (Glaudemans, 2013), reflecting the extended duration of soft tissue and bone healing that occurs following surgery.

Although direct evidence for increased hematogenous seeding risk immediately following human arthroplasty surgery is lacking, in-vivo animal modeling does appear to confirm this clinical concern. Both Blomgren et al. (1980) and Southwood et al. (1985) independently observed that rabbits that received arthroplasty implants were specifically susceptible to surgical site infections from low-dose bloodstream bacterial inoculations only within the first three to four weeks following surgery. Although more contemporary animal investigations have also been able to establish hematogenous infections with postoperative bacterial inoculations (Shiels, 2015; Wang, 2017), these have been at singular intervals, and a temporal relationship has not been studied.

Benefits/Harms of Implementation

Benefits/harms need to be weighed individually for each patient by the dental and orthopedic team, considering the patient's values and preferences. More acute dental infections arising early in the TJA surgery period require management, while elective procedures might best be delayed for 3 months, during which the patient is engaged in rehabilitation of the joint with more limited mobility and pain. In general, there are limited harms from delay of elective dental procedures for the maximum noted 3-month period.

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View data summaries via the CPG eAppendix 2

Outcome Importance

Periprosthetic joint infection is recognized as a devastating complication after total joint arthroplasty associated with increased morbidity and mortality. This consensus opinion tries to weigh concerns for balancing infection in the mouth and infection risk potential for the new joint during the early phase post-arthroplasty.

Cost Effectiveness/Resource Utilization

There is limited evidence to support cost effectiveness; however, this opinion does not accelerate resource utilization but rather considers delay and timing of delay in resource utilization.

Acceptability

This consensus opinion aims to give guidance that can be considered by the health care team members to maximize access to dental healthcare while minimizing any potential risk of transient bacteremia seeding a new joint replacement in the early prosthetic joint healing phase.

Feasibility

After dissemination of the clinical practice guideline, there should be limited obstacles to wider spread adoption. Communication between dentists and orthopedic surgeons is essential for care coordination. For dental management of acute dental infection immediately after TJA while the patient is still in the hospital, this may assume the hospital or surgical facility has access to a dentist/oral and maxillofacial surgeon who will provide care in the hospital setting. If dental care is to be provided by a community dentist/oral and maxillofacial surgeon after hospital discharge, this may warrant additional time delay in scheduling definitive dental invasive intervention to resolve dental infection while the patient is maintained on intravenous antibiotics.

Future Research

As limited research was available, investigations documenting dental treatment and type (grouped by hematogenous bacteremia potential) undertaken at specific time points after TJA in the early healing phase, then correlated with PJI outcomes, would be of benefit.

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View data summaries via the CPG eAppendix 2

APPENDICES

Appendix I: References

Introduction and Rationale References

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View data summaries via the CPG eAppendix 2

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