



# A Review of Dental Imaging and Treatment Protocol Prior to Open Heart Valve Surgery: An Evidence-Based Approach

Solmaz Valizadeh<sup>1</sup>, Mehdi Hosseinzadeh<sup>1,\*</sup>

<sup>1</sup> Department of Oral and Maxillofacial Radiology, School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, Iran

\* **Corresponding Author:** Department of Oral and Maxillofacial Radiology, School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, Iran. Email: meahdi.hosseinzadeh@gmail.com

**Received:** 17 June, 2024; **Revised:** 30 June, 2024; **Accepted:** 11 July, 2024

## Abstract

**Context:** Open heart valve surgery is associated with a significant risk of infective endocarditis (IE), often linked to oral infections. Despite existing guidelines recommending dental evaluations before surgery, there is no standardized protocol for dental imaging and treatment in this high-risk population. This study aims to present the first evidence-based protocol for dental imaging and treatment to systematically identify and address oral infections, thereby reducing perioperative risks and improving outcomes.

**Evidence Acquisition:** A comprehensive review of current literature on the relationship between oral infections and infective endocarditis was conducted. Existing guidelines from the American Heart Association (AHA) and European Society of Cardiology (ESC) were analyzed. Imaging modalities were integrated into the proposed protocol for preoperative dental evaluation. A risk-based classification system for common dental conditions and antibiotic prophylaxis was developed.

**Results:** The protocol utilizes imaging techniques to detect oral infections and conditions that could lead to bacteremia, such as dental caries, periodontal disease, and impacted teeth. It also introduces a risk-based approach for managing dental conditions, prioritizing treatments based on urgency, and recommending appropriate antibiotic prophylaxis. This interdisciplinary approach enhances collaboration between dental and cardiac care teams.

**Conclusions:** This study introduces a novel dental imaging and treatment protocol for patients undergoing open heart valve surgery, significantly reducing the risk of infective endocarditis. By addressing oral health systematically before surgery, this protocol improves surgical outcomes and sets a new standard of care for cardiac patients. Future research should validate its effectiveness across diverse healthcare settings and evaluate its long-term impact on patient outcomes.

**Keywords:** Infective Endocarditis, Open Heart Valve Surgery, Dental Imaging, Antibiotic Prophylaxis, Cardiac Surgery

## 1. Context

Infective endocarditis (IE) is a major concern for patients undergoing open heart valve surgery, especially in those with preexisting dental infections. Infective endocarditis is often associated with bacteremia from oral pathogens, particularly *Streptococcus viridians*, which can spread to heart valves and lead to severe complications (1). The American Heart Association (AHA) (2) and European Society of Cardiology (ESC) (3) guidelines stress the importance of dental evaluations before cardiac surgery. Current guidelines focus on general principles but fail to provide specific recommendations for imaging modalities, treatment prioritization, and antibiotic prophylaxis (2, 4).

This study proposes the first evidence-based dental imaging and treatment protocol specifically designed for patients undergoing open heart valve surgery. The protocol aims to prevent perioperative complications by detecting and managing oral infections, prioritizing treatment, and incorporating antibiotic prophylaxis. By utilizing imaging and offering targeted recommendations for dental care, this protocol sets a new standard for preoperative management of cardiac patients.

## 2. Evidence Acquisition

A comprehensive review of existing literature on the association between oral infections and infective endocarditis was conducted. Current guidelines from

the AHA and ESC stress the importance of dental evaluations, but do not provide specific protocols for imaging, treatment prioritization, and antibiotic prophylaxis. The study reviewed imaging modalities used in dental diagnostics, including panoramic radiographs, periapical radiographs, bitewing radiographs, and cone beam computed tomography (CBCT).

Additionally, we developed a risk-based classification system for common dental conditions associated with IE. This classification system categorizes conditions as high, moderate, or low risk, determining the necessary course of action for treatment and the requirement for antibiotic therapy before surgery.

### 3. Results

This study presents a detailed protocol integrating advanced dental imaging techniques with a risk-based classification system for dental conditions.

Untreated oral infections can lead to bacteremia during invasive dental procedures or even routine daily activities, such as chewing or brushing (5). This transient bacteremia poses a significant risk for patients with compromised cardiac health, particularly those with prosthetic valves or prior history of IE (3).

The most common oral health conditions associated with IE include:

- Dental caries: If untreated, these can progress to pulpitis and periapical abscesses (6).
- Periodontal disease: Chronic periodontal inflammation can lead to persistent bacteremia (4).
- Impacted or partially erupted teeth: These are prone to infection due to bacterial entrapment (2).

Identifying and addressing these conditions before cardiac surgery is essential to minimizing risks and ensuring optimal patient outcomes (3).

Dental imaging plays a crucial role in detecting infections or conditions that could lead to bacteremia and subsequently increase the risk of infective endocarditis. Comprehensive dental imaging helps identify sources of infection, such as untreated caries, abscesses, and periodontal disease, enabling timely intervention before surgery (7). The following imaging modalities are recommended:

#### 3.1. Panoramic Radiographs

- Provide a wide field view of the teeth, jaws, and maxillary sinuses.
- Help detect dental caries, root pathology, impacted teeth, and other abnormalities that could serve as

infection sources.

- Recommended as an initial imaging study to assess the overall oral health of the patient.

#### 3.2. Periapical Radiographs

- Focused on specific areas to reveal localized infections at the root tips or surrounding bone.
- Essential for diagnosing periapical abscesses, pulpitis, and other dental infections.

#### 3.3. Bitewing Radiographs

- Primarily used to detect interproximal caries and evaluate alveolar bone loss due to periodontal disease.
- Recommended in patients with suspected or known proximal caries or early periodontal disease.

#### 3.4. Cone Beam Computed Tomography

- Provides 3D imaging for complex cases where conventional imaging may not provide sufficient detail.
- Useful for impacted teeth, jaw lesions, and cases where surgical planning for tooth extraction or endodontic therapy is required.

By incorporating these imaging modalities, dental professionals can comprehensively assess the patient's oral health status and address any potential infection sources that could contribute to IE.

The following table categorizes common dental conditions according to their description, recommended treatments, rationale, and the necessity for antibiotic therapy prior to surgery (Table 1).

Antibiotic prophylaxis is essential for patients with high-risk dental conditions to prevent bacteremia during invasive dental procedures. The AHA guidelines suggest the following antibiotic regimens:

#### 3.5. Standard Regimen

- Amoxicillin 2 g orally, 1 hour before the procedure.

#### 3.6. Penicillin Allergies

- Clindamycin 600 mg orally, 1 hour before the procedure.
- Azithromycin 500 mg orally, 1 hour before the procedure.
- Cephalexin 2 g orally, 1 hour before the procedure.

#### 3.7. Timing and Implementation of Dental Treatment

##### 3.7.1. Timing of Dental Clearance

**Table 1.** Overview of Common Dental Conditions, Their Treatments, and Considerations for Antibiotic Therapy Prior to Surgery

Dental Condition	Description	Recommended Treatment	Rationale	Antibiotic Therapy Before Surgery
Dental caries	Localized decay in enamel or dentin.	Restoration (filling or crown)	Prevents progression to pulpitis or abscess formation.	Not required unless associated with acute infection or cellulitis.
Pulpitis	Inflammation of the dental pulp, often due to deep caries.	Root canal therapy (RCT) or extraction (if tooth is non-restorable).	Eliminates potential source of infection and prevents abscess formation.	Not required unless symptoms of infection (e.g., fever, swelling).
Periapical abscess	Infection at the root tip or surrounding bone.	Root canal therapy if salvageable; otherwise, extraction.	Prevents systemic dissemination of infection, including bacteremia.	Required if abscess is draining or systemic signs of infection exist.
Periodontal disease	Gingival inflammation or bone loss due to plaque or calculus.	Scaling and root planning; extraction for advanced cases.	Reduces bacterial load and resolves chronic inflammation, which can be a source of bacteremia.	Required if periodontal pockets > 6 mm are associated with infection.
Impacted teeth	Partially or fully impacted teeth prone to pericoronitis or infection.	Extraction if symptomatic or signs of inflammation are present.	Prevents recurrent infections, which may lead to bacteremia during postoperative recovery.	Required if pericoronitis or adjacent infection is present.
Non-restorable teeth	Teeth with advanced decay or structural damage.	Extraction	Eliminates potential foci of infection, which could become a source of bacteremia.	Not required unless signs of acute infection are present.
Soft tissue infections	Oral infections such as cellulitis or abscesses.	Antibiotics for acute infection, followed by definitive treatment.	Controls systemic spread of infection and resolves acute oral infections that may lead to bacteremia.	Always required prior to definitive dental treatment.

- Dental clearance should ideally be completed 2 - 4 weeks before surgery to allow for adequate healing of any treated dental conditions.

- Emergency dental treatments (e.g., abscess drainage) should be completed no later than 7 days before surgery, in close coordination with the cardiac surgery team.

### 3.8. Risk-Based Prioritization

- High-risk conditions: These require immediate intervention (e.g., abscesses, advanced periodontitis, symptomatic impacted teeth).

- Moderate-risk conditions: Conditions such as caries or mild periodontal disease should be addressed before surgery but without urgency.

- Low-risk conditions: Asymptomatic dental conditions can be safely managed after surgery if necessary.

### 3.9. Postoperative Dental Care

#### 3.9.1. Early Postoperative Period

- Avoid elective dental procedures during the first 6 months post-surgery to allow stabilization of prosthetic valves.

- Maintain rigorous oral hygiene to prevent gingival inflammation and infection.

#### 3.10. Long-Term Maintenance

- Regular dental checkups every 3 - 6 months to monitor oral health.

- Continued emphasis on preventive care, including fluoride treatments and antimicrobial mouth rinses.

## 4. Conclusions

The proposed dental imaging and treatment protocol represents a significant advancement in preoperative care for patients undergoing open heart valve surgery. By addressing oral health systematically, this approach reduces the risk of infective endocarditis, improves surgical outcomes, and establishes a new standard of care for cardiac patients. Future research should focus on validating the protocol's effectiveness across diverse healthcare settings and evaluating its impact on long-term patient outcomes.

## Footnotes

**Authors' Contribution:** Study concept and design: S. V. and M. H.; Analysis and interpretation of data: S. V. and M. H.; Drafting of the manuscript: S.V. and M. H.; Critical revision of the manuscript for important intellectual content: S. V. and M. H.

**Conflict of Interests Statement:** The authors declared no conflict of interests.

**Data Availability:** The dataset presented in the study is available on request from the corresponding author during submission or after publication.

**Funding/Support:** This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## References

1. Sheppard MN. Infective endocarditis. *Diagnostic Histopathology*. 2022;**28**(4):199-208. <https://doi.org/10.1016/j.mpdhp.2022.01.003>.
2. Wilson W, Taubert KA, Gewitz M, Lockhart PB, Baddour LM, Levison M, et al. Prevention of infective endocarditis: guidelines from the American Heart Association: a guideline from the American Heart Association Rheumatic Fever, Endocarditis, and Kawasaki Disease Committee, Council on Cardiovascular Disease in the Young, and the Council on Clinical Cardiology, Council on Cardiovascular Surgery and Anesthesia, and the Quality of Care and Outcomes Research Interdisciplinary Working Group. *Circulation*. 2007;**116**(15):1736-54. [PubMed ID: [17446442](https://pubmed.ncbi.nlm.nih.gov/17446442/)]. <https://doi.org/10.1161/CIRCULATIONAHA.106.183095>.
3. Habib G, Lancellotti P, Antunes MJ, Bongiorni MG, Casalta JP, Del Zotti F, et al. 2015 ESC Guidelines for the management of infective endocarditis: The Task Force for the Management of Infective Endocarditis of the European Society of Cardiology (ESC). Endorsed by: European Association for Cardio-Thoracic Surgery (EACTS), the European Association of Nuclear Medicine (EANM). *Eur Heart J*. 2015;**36**(44):3075-128. [PubMed ID: [26320109](https://pubmed.ncbi.nlm.nih.gov/26320109/)]. <https://doi.org/10.1093/eurheartj/ehv319>.
4. Thornhill MH, Gibson TB, Cutler E, Dayer MJ, Chu VH, Lockhart PB, et al. Antibiotic Prophylaxis and Incidence of Endocarditis Before and After the 2007 AHA Recommendations. *J Am Coll Cardiol*. 2018;**72**(20):2443-54. [PubMed ID: [30409564](https://pubmed.ncbi.nlm.nih.gov/30409564/)]. <https://doi.org/10.1016/j.jacc.2018.08.2178>.
5. Chen PC, Tung YC, Wu PW, Wu LS, Lin YS, Chang CJ, et al. Dental Procedures and the Risk of Infective Endocarditis. *Medicine (Baltimore)*. 2015;**94**(43). e1826. [PubMed ID: [26512586](https://pubmed.ncbi.nlm.nih.gov/26512586/)]. [PubMed Central ID: [PMC4985400](https://pubmed.ncbi.nlm.nih.gov/PMC4985400/)]. <https://doi.org/10.1097/MD.0000000000001826>.
6. Catherine M, Otto MD, Co-Chair, Rick AN, Robert O; Blase, et al. Guidelines for the Management of Patients With Valvular Heart Disease: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *AHA/ASA J*. 2020. <https://doi.org/10.1161/CIR.0000000000000092>.
7. Pitts NB, Zero DT, Marsh PD, Ekstrand K, Weintraub JA, Ramos-Gomez F, et al. Dental caries. *Nat Rev Dis Primers*. 2017;**3**:17030. [PubMed ID: [28540937](https://pubmed.ncbi.nlm.nih.gov/28540937/)]. <https://doi.org/10.1038/nrdp.2017.30>.