

Infective endocarditis prophylaxis in orthodontics A literature review

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بعد التهاب صمام القلب والأنسجة المبطنة لعضلة القلب من الأمراض النادرة ، ولكن المضار الناتجة عن وصول البكتيريا إلى الدم عن طريق الأسنان خطيرة وخاصة في المرضى المعرضين للإصابة بهذا الالتهاب .

وبالرغم من أن هناك نظام متبع للوقاية من التهاب الصمام والأنسجة المبطنة لعضلة القلب أثناء علاج الأسنان ، لا يزال هناك خلط واختلاف حول العلاجات السنية الخاصة بتقسيم الأسنان والتي تستدعي الوقاية من هذا المرض. الهدف من هذا البحث هو مراجعة الأبحاث السابقة ووضع نظام مناسب يدل أطباء تقويم الأسنان على العلاجات التقويمية التي تستدعي الوقاية من التهاب الصمام والأنسجة المبطنة لعضلة القلب في المرضى الأكثر عرضة للإصابة بهذا الالتهاب.

Infective endocarditis (I.E.) is a rare but serious complication of dentally induced bacteraemia in susceptible patients. While there is a suggested protocol of prophylactic measures against dentally induced infective endocarditis, there are still uncertainties as to which orthodontic procedures warrant these measures. The aim of this paper was to review the literature and draw up a suitable protocol to guide orthodontists dealing with patients susceptible to infective endocarditis.

Introduction

Infective Endocarditis (I.E.) is a rare but serious disease which includes acute and subacute bacterial endocarditis and non bacterial endocarditis from virus, fungi and other agents.¹ The disease remains a therapeutic challenge with an overall mortality of 20%.²

The inability to eradicate infective endocarditis by prevention or early treatment may be due to the following:^{3,4}

1. nature of infecting organism has changed over the years
2. physician, the dentist and the public are insufficiently aware of the need for preventive measures in infective endocarditis
3. diagnosis may be difficult when delayed
4. emergence of special risk groups
 - (a) increase in number of narcotic users
 - (a) cardiac surgery patients
 - (a) patients with lowered resistance to infection who require intravascular catheters

Fifty percent of infective endocarditis is due to *Streptococcus viridans* which is commonly found in the oral cavity.¹ Patients predisposed are those with susceptible congenital or acquired cardiac malformations likely to experience predictable procedure related bacteraemia.⁴ Dental procedures known to cause bacteraemia have been investigated and guidelines have been drawn for the prevention of infective endocarditis.⁵

However, there is little documentation as to which orthodontic procedures would require infective endocarditis prophylaxis. Orthodontic treatment is now in great demand for preadolescent and adult patients. Coupled with the fact that more susceptible patients are now seeking orthodontic treatment as comprehensive or adjunctive treatment to other dental specialties, it is imperative for proper guidelines to be drawn up for the orthodontists regarding infective endocarditis prophylaxis.

This article aims to review the literature with the purpose of drawing up practical guidelines for the orthodontist regarding patients susceptible to infective endocarditis.

Pathogenesis of infective endocarditis

The pathogenesis of infective endocarditis is as follows:⁶

1. Susceptible site at the endocardial surface
Damage of the endocardial surface either by congenital cardiac malformations as in Tetralogy of Fallot or acquired from childhood episode of rheumatic fever would render that site susceptible to thrombotic formation.
2. Formation of a non infective thrombotic vegetation
The localized damaged endocardial surface initiates the repair process which involves adherence of platelets and fibrin. This in turn leads to the formation of a non infective thrombotic vegetation on that affected

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surface.

3. Portal of entry into the bloodstream establishing bacteraemia

Trauma at any site would introduce bacteria into the bloodstream resulting in a transient bacteraemia. It is not the level of bacteraemia but rather the frequency of the episodes that is important.

4. Adherence of microorganisms to the established non infective thrombotic vegetation

From the bacteraemia, the microorganisms will adhere to the existing non infective thrombotic vegetation on the endocardial surface. The presence of these microorganisms stimulates further immune response leading to further deposition of platelets and fibrin.

5. Development of clinical features of infective endocarditis

Within this infective vegetation on the endocardial surface, the microorganisms multiply. Due to the relatively high velocity of blood flow against the endocardial surface, some of these infective thrombotic vegetations are dislodged into the bloodstream which leads to systemic consequences of infective endocarditis.

Signs and symptoms of infective endocarditis⁶

1. Fever and chills
2. Night sweats
3. Weight loss
4. Embolic phenomena and metastatic infection
5. Arthralgia (joint pains) and myalgia (muscular pains)

Laboratory investigations^{7,8}

The commonest laboratory investigation is the conventional blood culture that uses a broth culture medium to allow growth of the microorganism from the blood sample. This investigation only gives a positive or negative result.

Recently, the technique of lysis filtration has been used. Not only does this method qualify the presence or absence of the microorganism, it also quantifies the intensity of the bacteria by assessing the colony forming units (CFU) per ml of

blood.

Correlation between infective endocarditis and orthodontic procedures

In a survey of 1038 orthodontists, Hobson and Clark⁹ found 8 cases of infective endocarditis diagnosed during or post treatment involving fixed and removable appliances. While this number may seem small yet the fatality of this disease makes it essential to elucidate which orthodontic procedures put patients at risk.

Oral Hygiene

In the absence of clinical procedures, conditions which may precipitate bacteraemia are poor oral hygiene, periodontal infection and periapical infection.¹⁰ Toothbrushing in the presence of inflammation and plaque causes bacteraemia but the level of bacteraemia reduces when the oral hygiene is good.¹¹ If orthodontic appliances are fitted in the presence of gingival inflammation there may be an increase in the bacteraemic episodes.¹² It has been reported that cleaning and polishing teeth has been associated with infective endocarditis.¹³ It would be prudent to institute antibiotic prophylaxis for susceptible patients before carrying out this procedure.

Impression taking

Stankewitz and coworkers¹⁴ demonstrated that taking alginate impressions may cause bleeding but not bacteraemia. However, it must be pointed out that if impressions are taken in the presence of gingival inflammation there is a potential risk of inducing bacteraemia.

Band placement

In a recent study,¹⁵ bacteraemia was detected in 10% of blood samples taken during orthodontic band placement. This percentage is understandable given the fact that during band placement the band margins are frequently subgingival.

Appliance adjustment

With regard to adjustment of fixed or removable appliances, the American Heart Association does not recommend antibiotic prophylaxis.¹⁰ However, it has been demonstrated that the number of micro-organisms in a bacteraemia is influenced by the degree of trauma.¹⁶ Hence the orthodontist must take care not to inflict mucosal trauma during adjustment. It also means that care must be taken to prevent any mucosal trauma from the appliance itself such as sharp edges from ligature wires, cleats, excess archwire protruding through the buccal molar

tubes.

Mucoperiosteal surgery

Any surgical procedure may warrant antibiotic prophylaxis in susceptible patients.^{5,10} In the case of an impacted tooth that has been surgically exposed, the exposure site does not require any further antibiotic prophylaxis.¹² It has also been recommended that antibiotic prophylaxis is not required for traction of the impacted tooth following excisional exposure or replaced flap technique.¹²

Cumulative bacteraemia

The concept of cumulative bacteraemia deals with the additive effect of episodes of bacteraemia per patient rather than the singular effect of an episode of bacteraemia.⁸ The clinical use of lysis filtration technique has enabled quantification of cumulative bacteraemia by calculating cumulative exposure. Cumulative exposure is derived by the following formula:⁸

$$CE = P \times I \times T \times F$$

where

CE : cumulative exposure

P : % prevalence of bacteria

I : intensity of bacteria in CFU per ml of blood

T : duration of bacteraemia

F : frequency of dentogingival manipulative procedure per year

Roberts and coworkers⁸ calculated that placing tooth separators gave the highest score of cumulative exposure.

Orthodontic patients are unique in that they are seen and treated over a period of more than a year. Therefore it is not only a single episode of bacteraemia that these patients encounter but rather a cumulative exposure.

The premise for the management of these susceptible patients is based on the fact that each orthodontic dentogingival manipulative procedure that causes bacteraemia be identified and the appropriate precautions taken. The protocol that has been drawn up is based on the various current recommendations in the literature.

Management of orthodontic patients at risk from infective endocarditis^{8,12}

The management of susceptible patients at risk would involve the following scheme:

1. Assessment of patient and patient's medical history
2. Preventive measures which induce antibiotic prophylaxis

3. Identifying orthodontic procedures requiring antibiotic prophylaxis
4. Instructions to patients

Cardiac assessment

The primary aim is to identify patients at risk based on the patient's medical history outlining a cardiac condition. Once identified these patients can then be categorized into high, moderate or negligible risk.^{5,10}

High risk cardiac conditions^{5,10}

1. Prosthetic heart valves
2. Previous bacterial endocarditis
3. Cyanotic congenital heart disease (Tetralogy of Fallot)
4. Surgery constituted systemic pulmonary shunts

In these cases, the patient's cardiologist must be consulted to assess risk. If the risk is considerably high, then orthodontic treatment is contraindicated.¹²

Moderate risk cardiac condition^{5,10}

1. Acquired valvular dysfunction (rheumatic heart disease).
2. Hypertrophic cardiomyopathy.
3. Mitral valve prolapse with valvular regurgitation

These patients can generally undergo orthodontic treatment with appropriate antibiotic prophylaxis (Table 1).¹² Indicated procedures for the prophylaxis of dental induced infective endocarditis.

No penicillin allergy	Allergy to penicillin
Local or no anaesthetic Amoxycillin 3g orally 1 hour preoperatively	Clindamycin 600mg orally 1 hour preoperatively
General anaesthetic Amoxycillin 3g and probenidic 1g or Amoxycillin 3g orally 4 hours preoperatively and amoxycillin 3g postoperatively or Amoxycillin 1g IV at induction and 500mg orally 6 hours later	These patients are classified as "Special risk"

Negligible risk cardiac conditions^{5,10}

1. Isolated secundum atrial septal defect
2. Surgical repair of atrial septal defect, ventricular septal defect or patent ductus arteriosus
3. Previous coronary artery bypass graft surgery

4. Mitral valve prolapse without valvular dysfunction
5. Innocent heart murmurs
6. Previous rheumatic fever without valvular dysfunction
7. Cardiac pacemakers

It has been recommended by the American Heart Association¹⁰ (AHA) that antibiotic prophylaxis is not required for this category. The rationale for this recommendation is that the development of infective endocarditis in these patients is not higher than in the general population. Patients who give a history of heart murmur should be investigated to determine if the murmur is innocent.¹²

Special risk patients⁵

The following patients with endocardial disease have been considered as 'special risk' by the British Society of Antimicrobial Chemotherapy (BSAC) and they are these with:

1. a previous history of infective endocarditis
2. a cardiac condition requiring a general anesthesia and
 - a. have a prosthetic heart valve or
 - b. are allergic to penicillin or have had penicillin more than once in the previous month

These patients would require an antibiotic regimen as outlined in Table 2.

No penicillin allergy	Allergic to penicillin
Amoxicillin 1g IV and gentamycin 120mg IV, preoperatively induction and amoxicillin 500mg orally 6 hours later	Teicoplanin 400mg IV and gentamycin 120mg IV preoperatively or at induction or Clindamycin 300mg IV given over 10 min in 50 ml of diluent preoperatively or at induction and 150 mg (oral or IV) 6 hrs later or Vancomycin 1 g slow IV infusion (over not less than 100 min) followed by gentamycin 120 mg IV preoperatively or at induction

Preventive measures

Oral hygiene measures

Maintenance of good oral hygiene and

prevention of oral disease are critical for these susceptible patients before and during orthodontic treatment.¹⁷ Oral hygiene procedures should be given to the patient such as toothbrushing and interdental flossing. Oral hygiene status must be monitored by the orthodontist and where possible by the hygienist too.

A daily oral rinse of 0.2% (w/v) chlorhexidine solution is effective in reducing the bacteraemic level.¹⁸ Fortunately, repeated use of this disinfectant does not result in resistance to it by the bacteria.¹⁹ It is therefore recommended that these patients should have a chlorhexidine oral rinse prior to every orthodontic adjustment in addition to the daily rinse.¹²

Antibiotic prophylaxis

Patients who are currently on penicillin medication should be given an alternative antibiotic for indicated orthodontic procedures.¹⁰

The antibiotic prophylaxis for infective endocarditis as recommended by the British Society of Antimicrobial Chemotherapy⁵ (BSAC) and the American Heart Association¹⁰ (AHA) is outlined in Table 1 (adult regimen), Table 2 (special risk patients' regimen) and Table 3 (child regimen).

Patients not at special risk may receive amoxicillin twice in one month.¹² However, a third dose of amoxicillin can only be given after a period of one month. A second dose of clindamycin can only be given at least 2 weeks after the first dose.

Antibiotic	Age	Dosage
Amoxicillin or Clindamycin	Under 10 years Under 5 years	Half adult dose Quarter adult dose
Vancomycin	Under 10 years	20 mg/kg
Gentamycin	Under 14 years Under 10 years	6 mg/kg or 2 mg/kg if with Teicoplanin 2 mg/kg
Teicoplanin	Under 14 years	6 mg/kg

Orthodontic procedures requiring antibiotic prophylaxis^{8,9,12}

1. Impression taking in the presence of gingival inflammation
2. Placing separators
3. Cleaning and polishing and banding teeth
4. Fitting of banded expanders
5. Surgical exposure of teeth

6. Mucosal trauma during archwire placement
7. Removal of fixed appliances and impression taking immediately after debonding and debanding

With the advances in orthodontic bonding materials, it has been suggested that bonding of all teeth be done in one visit.¹⁵ This eliminates the need for separator placement and subsequent banding and subjecting the patient to 2 doses of antibiotic prophylaxis within 1 to 2 weeks period.

Instructions to patients

1. Proper oral hygiene instruction should be taught to the patient. Daily oral rinse with 0.2% chlorhexidine must be carried out.¹⁵
2. If on the next visit an orthodontic procedure warrants antibiotic prophylaxis, the patient should be instructed to take the dose at least one hour before the appointment.¹⁰
3. The patient should be instructed on the use of orthodontic white wax to be applied over any uncomfortable part of the fixed appliance to prevent mucosal trauma.
4. In all risk categories, the patient must be instructed to report back immediately any unexplained illness after an orthodontic procedure.²⁰ It has been shown that the likelihood of infective endocarditis occurring is within the 1st thirty days of the procedure.²¹

Efficacy of antibiotic prophylaxis

Despite the use of antibiotic prophylaxis the incidence of infective endocarditis has remained unchanged and the risk of it occurring in high risk patients still remains high.^{22,23} This may be partly attributed to the increasing number in penicillin resistant oral streptococci which have emerged due to reduced sensitivity to the drug.²⁴

A recent study in United States concluded that antibiotic prophylaxis in patients with mitral valve prolapse with murmurs is reasonably cost effective.²⁵ In outlining the efficacy of antibiotic prophylaxis in infective endocarditis, the American Heart Association (AHA):⁴ states "The recommendations are based on vitro studies, clinical experience and data from experimental animals. Due to the nature of the morbidity and mortality of infective endocarditis, the prevention of even a few cases makes the effort worthwhile."

Conclusions

Infective endocarditis associated with orthodontic treatment is indeed quite rare. There are no clinical trials to prove the efficacy of either antibiotic prophylaxis or clinical precautions. However, with the increasing number of susceptible patients seeking orthodontic treatment, it is the obligation of the orthodontist to be aware of the current protocol based on the few scientific studies and the recommendations of the AHA and BSAC.

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