*Original Article*

# Investigation of Bacteremia Following Orthodontic Debanding

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**Abstract:** The aim of this study was to investigate the prevalence of bacteremia after orthodontic debanding and debonding. The study group comprised 30 patients (10 men, 20 women). All were treated using the Edgewise technique. Patients with acceptable oral hygiene and fixed appliances in both jaws were included in the study group. Blood samples were obtained using a strict aseptic technique before and after removal of bands and brackets. A 6.6% bacteremia prevalence was observed in both preoperative and postoperative blood samples. (*Angle Orthod* 2000;70:11–14.)

**Key Words:** Bacteremia, Orthodontic debanding, Debanding

## INTRODUCTION

A transient bacteremia may follow various dental manipulations including dental prophylactic procedures.[1–8] This bacteremia places patients with predisposing cardiac conditions at risk for infective endocarditis. These predisposing cardiac conditions include most congenital cardiac malformations, previous infective endocarditis, rheumatic and other acquired valvular dysfunctions, hypertrophic cardiomyopathy, mitral valve prolapse with valvular regurgitation, prosthetic cardiac valves, and surgically constructed systemic-pulmonary shunts.[9]

The incidence of bacteremia has been reported for dental procedures such as extraction,[1,2] root scaling,[4,5] endodontic treatment,[7] and toothbrushing.[8] Bacteremia following orthodontic procedures has been investigated in only a few studies. Degling[10] found no microorganisms in the blood stream after orthodontic banding and debanding in 10 patients. In a study of 30 volunteers, McLaughlin et al[11] reported a bacteremia incidence of 10% after banding. A recent study conducted on 40 orthodontic patients found a 7.5% incidence of bacteremia following banding.[12]

Most orthodontic patients are not able to perform effective plaque control and therefore develop mild to moderate gingivitis during treatment with fixed appliances.[13,14] As a result of plaque accumulation and subsequent gingivitis, one would expect a higher incidence of bacteremia after debanding procedures compared with banding procedures.

The 1997 American Heart Association Guidelines state that endocarditis prophylaxis is recommended for the initial placement of orthodontic bands but not brackets.[15] However, 2 earlier surveys of American and British orthodontists have shown that, while many orthodontists prescribed antibiotics before banding and debanding at-risk patients, a significant portion of orthodontists did not think antibiotic therapy was necessary.[16,17] This variation in the handling of at-risk patients may be due to lack of data confirming the need for antibiotic prophylaxis before banding and debanding. More studies are needed to clarify this critical issue. This study investigates the incidence of bacteremia after removal of bands and brackets.

## MATERIALS AND METHODS

The study group consisted of 30 patients (10 males and 20 females) ranging from 18.5 to 29 years of age, with an average age of 22.5 years. All patients were treated using the Edgewise technique, with bands on first molars and direct bonding attachments on the other teeth. Patient inclusion and exclusion criteria are shown in Table 1. The duration of treatment with fixed appliances ranged from 14 to 21 months. All procedures were explained to the patients before the appointment for debanding, and each individual signed an informed consent form. The patients were instructed not to brush their teeth for 2 hours before their debanding appointment. Just before removal of the bands and brackets, an 11-mL blood sample was obtained from an antecubital vein using a 20G sterile plastic cannula (HECOS, Shanghai Medicines & Health Products Import and Export Corporation, Shanghai, China) and a sterile syringe following a strict aseptic technique. Debanding and de-

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**TABLE 1.** Patient Inclusion and Exclusion Criteria

Inclusion criteria
- Fixed appliances in both jaws, ie, bands on first molars and direct bonded brackets on remaining teeth.
- Plaque index ≤2, gingival index ≤1.

Exclusion criteria
- Congenital heart disease.
- History of rheumatic fever.
- Aortic stenosis, mitral stenosis, or both.
- Prosthetic heart valves.
- History of subacute bacterial endocarditis.
- Hypertrophic cardiomyopathy.
- Surgically constructed systemic-pulmonary shunts.
- Vascular and joint prostheses.
- Immunosuppression.
- Diabetes.
- Bleeding disorder.
- Pregnancy.
- Antibiotic usage within the past 3 months.
- Regular use of antiseptic mouthwash.
- Restoration adjacent to gingival margin on selected molar.

bonding procedures were performed with a band remover and bracket-removing pliers (Dentaurum, Pforzheim, Germany). Immediately after removal of all bands and bonded brackets, the valve of the cannula was reopened and a second blood sample of 11 mL was drawn into a new sterile syringe. Appliance removal and blood sampling procedures were completed within 2 minutes.

Ten mL each of preoperative and postoperative blood was aseptically inoculated into blood culture bottles (Signal Blood Culture System, Oxoid Unipath Limited, Hampshire, England) that were connected with a growth indicator device and incubated at 37° for 14 days. Positive results were indicated in the bottles in which the blood and broth mixture had risen above the green locking sleeve of the growth indicator device. Cultures were taken from positive bottles and plated on blood agar and blood agar supplemented with 0.0005% hemin (Sigma Chemical Co, St. Louis, Mo) and 0.00005% menadione (Sigma). These were incubated under aerobic and anaerobic conditions, respectively. Colony morphology, gram-staining procedures, standard microbiologic biochemical testing technique and API 20 strips (bioMérieux, Marcy l'Etoile, France) identified the bacterial colonies. In addition to the Signal blood culture test, the number of bacteria per mL of blood was determined by the pour-plate method that used 20 mL of fastidious anaerobic agar (Oxoid) supplemented with 5% calf serum. Colonies from the pour-plate were counted and identified using this procedure. Preoperative and postoperative microbiologic findings were statistically analyzed using the *t*-test.

## RESULTS

Bacteremia was detected in the preoperative blood samples of 2 patients (6.6%) and postoperative blood samples of 2 others (6.6%) by both Signal blood culture and pour-plate methods (Table 2). *Streptococcus salivarius* and *Streptococcus sanguis* II-2 were identified in the preoperative blood samples, and *Streptococcus sanguis* I-3 and *Streptococcus mitis* I were identified in the postoperative samples. The numbers of *S salivarius* and *S sanguis* II-2 per mL of blood isolated from the preoperative samples were 3 colony forming units (CFU)/mL and 8 CFU/mL, respectively. The numbers of *S sanguis* I-3 and *S mitis* I per mL of blood isolated from the postoperative samples were 12 CFU/mL and 6 CFU/mL, respectively (Table 3). There was no statistically significant difference between the preoperative and postoperative blood samples with respect to percentage of bacteremia ($p > 0.05$). Gingival bleeding was detected in 18 patients during band removal.

**TABLE 2.** Blood Culture Results for Preoperative and Postoperative Samples

| Blood sample | Signal blood culture system | Pour-plate |
|---|---|---|
| Preoperative (n = 30) | 2 | 2 |
| Postoperative (n = 30) | 2 | 2 |

**TABLE 3.** Microorganisms Isolated From Postoperative Blood Samples

| Subject | CFU/mL* | Species |
|---|---|---|
| 3 | 3 | *Streptococcus salivarius* |
| 14 | 8 | *Streptococcus sanguis* II-2 |
| 21 | 12 | *Streptococcus sanguis* I-3 |
| 25 | 6 | *Streptococcus mitis* I |

* CFU/mL, colony-forming unit per milliliter of cultured blood.

## DISCUSSION

Management of patients who are at risk for the development of infective endocarditis is a crucial matter in orthodontics and in all fields of dentistry. A transient bacteremia that occurs after various dental manipulations, including certain orthodontic procedures, may lead to the development of infective endocarditis unless appropriate precautions are taken. Of all the orthodontic procedures, banding and debanding are considered to cause the greatest trauma to the gingival margin.[10] Initial placement of orthodontic bands is included in the list of dental procedures for which antibiotic prophylaxis is recommended by the American Heart Association.[15] However, only a few studies were identified in the literature concerning the incidence of bacteremia due to banding or debanding.[10–12]

Although the sample size was not large (30 patients), it was comparable to previous studies on bacteremia related to orthodontic banding, which had samples ranging from 10 to 40 patients.[10–12] In the study by McLaughlin et al,[11] the sample comprised volunteer dental school students and staff members. In the studies of Degling[10] and Erverdi et al,[12] and in our study, all individuals studied were orthodontic patients.

The subjects selected for the study group had been treated with the same type of fixed appliances (ie, Edgewise mechanics) in both the upper and lower dentitions, with bands on first molars and direct bonding attachments on the remaining teeth. Mean plaque index and gingival index scores[18] of the patients were important criteria for selecting the sample. Subjects with extremely poor oral hygiene and gingival health were excluded.

For optimal detection of bacteremia, blood sampling must be done within 2 minutes after trauma to the gingiva.[19] For this reason, appliance removal and blood sampling procedure were planned to be completed in 2 minutes or less. Care was taken not to traumatize the gingiva while removing the bands; nevertheless, gingival bleeding was observed in 18 patients. Previous studies have shown that gingival bleeding does not necessarily cause bacteremia in every case, and that bacteremia can develop in the absence of bleeding.[11,12]

Blood was collected just after removal of bands and brackets but before cleaning the excess cement and bonding material. Scaling the excess cement is a procedure that is comparable to a dental prophylaxis and can itself be a cause of transient bacteremia. Collecting the blood after cleaning the excess cement and bonding agent could obscure the findings of the study. Since removal of each banded or bonded item can be considered a separate trauma to the gingival margin, it might have been better to limit the study to the removal of a single band. However, as the whole procedure was completed in a very short time (2 minutes), removing all the appliances at once should not have presented a problem.

Blood samples were collected and microbiologically evaluated according to methods that have been substantiated in 2 recent studies on bacteremia after banding.[11,12] In the study by McLaughlin et al,[11] the BacT/Alert system and BACTEC blood culture test were used in addition to the pour-plate method. The Signal blood culture, another modern microbiologic test, was used in the present study. McLaughlin et al[11] stated that because blood culturing techniques have become more sensitive, it is now possible to detect bacteremias in procedures previously considered to be free from risk. The first study on bacteremia due to orthodontic banding was published by Degling[10] in 1972 when microbiologic techniques were not as sensitive as they are today. This may be the reason bacteremia was not detected in that study.

Orthodontic appliances tend to retain bacterial plaque and food debris, resulting in mild to moderate gingivitis in most patients.[13,14] It has been shown that the mean population of bacteria in the oral cavity increases with the placement of orthodontic bands.[20] Under these circumstances, one could speculate that a higher bacteremia prevalence would be recorded at debanding as compared to initial banding. However, excluding Degling's[10] findings, the 6.6% postoperative bacteremia prevalence in our study is lower than the prevalence reported for bacteremia after banding.[11,12] When inserting bands, bacterial deposits on the tooth surface may be pushed into the gingival sulcus by the hydraulic effect of the banding cement, thereby increasing the risk of bacteremia.

In our study, 6.6% of patients had preoperative bacteremia. Although higher than the incidence of preoperative bacteremia reported by McLaughlin et al,[11] this was not an unexpected finding. A recent injury caused by the appliances may have caused this preoperative bacteremia.

The 6.6% incidence of bacteremia following debanding and debonding was lower than the incidences reported for procedures like dental flossing[21] and toothbrushing[8] that patients must perform on a daily basis. Until now, there have been no reports of endocarditis associated with these procedures. In other words, high bacteremia does not always mean high endocarditis risk. In this respect, orthodontic debanding is not considered a major cause of infective endocarditis.

Four cases of endocarditis associated with orthodontic treatment have been reported by Biancaniello et al,[22] Dajani,[23] and Hobson and Clark.[24] Interestingly, none of these cases were associated with banding or debanding, but with minor adjustments for which the guidelines of the American Heart Association do not recommend endocarditis prophylaxis. On the other hand, recent case-control studies do not support the idea that dental treatment is a risk factor for infective endocarditis. A study by Lacassin et al[25] showed that dental extraction was not associated with a higher risk of infective endocarditis, whereas scaling and root canal treatment showed a trend toward a higher risk. Strom et al[26] did not find dental procedures to be a risk factor for endocarditis, even in patients with underlying cardiac valvular abnormalities. They confirmed the importance of preexisting cardiac abnormalities as principle risk factors.

Van der Meer et al[27] suggested a multicausal model as a plausible explanation for the pathogenesis of endocarditis. In such a model, previously existing heart disease, natural dentition, iatrogenic bacteremia, age and sex (the risk of endocarditis increased significantly with age, and men are more often affected than women) are component causes contributing to the development of endocarditis, but none of them are indispensable. Bacteremia, on the other hand, is a necessary cause since without bacteria there can be no bacterial endocarditis. Different combinations of necessary and component causes lead to the development of endocarditis.

The protective efficacy of antibiotic prophylaxis has been noted in a few studies. In a case-control study, Imperiale and Horwitz[28] reported that the protective efficacy of antibiotic prophylaxis was 91%. In a comparison of 2 groups of subjects with prosthetic heart valves, Horstkotte et al[29] found that infective endocarditis occurred only in patients who were not given antibiotic prophylaxis. However, in more recent studies, Van der Meer et al[30] showed a nonsig-

nificant protective efficacy of 49%, while Lacassin et al[25] reported a 46% protective efficacy, which was not significant. According to Strom et al,[26] even if 100% effectiveness was assumed, only a few cases of infective endocarditis could be prevented by antibiotic prophylaxis for dental procedures. Based on these data, the need for antibiotic prophylaxis before debanding can be questioned. Besides banding and debanding, orthodontic treatment can possibly cause transient bacteremia in a number of ways, including wires that become detached during treatment or buccal tubes and brackets that impinge on the buccal mucosa. As these events may not all be preventable, should an orthodontist keep at-risk patients under antibiotic cover for an entire average treatment period of 18 months? These considerations and the partial efficacy of prophylaxis suggest that application of antibiotics may be reserved for the highest risk situations (ie, high-risk cardiac patients undergoing procedures that are very likely to cause bleeding).

## CONCLUSIONS

Management of at-risk patients is a very important matter and further research is necessary. The orthodontist should evaluate the level of risk of the patient and seek consultation with the patient's medical specialist. The risk of adverse reactions to antibiotic prophylaxis, including anaphylaxis and the possible presence of drug-resistant organisms must be taken into consideration. The cost-benefit aspects of antibiotic prophylaxis should be evaluated. In this respect, the orthodontist's own clinical judgment is the most important factor in reaching a final decision. The use of antiseptic mouthwash before orthodontic procedures may reduce the severity of bacteremia.[31] At-risk patients may be asked to use chlorhexidine mouthwash prior to each treatment session. The use of bands and fixed acrylic appliances should be avoided whenever possible. Care should be taken not to leave any sharp edges on the appliance that could injure soft tissues. The best possible oral health should be established and maintained to reduce the risk of bacteremia.

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