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Original Research

Bacteremic capacity of a minimally invasive flapless accelerated orthodontic technique

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ABSTRACT

Objective: The aim of present prospective cohort study was to investigate prevalence of bacteremia after a minimally invasive flapless accelerated orthodontic technique.
Material and Methods: The sample consisted of 30 orthodontic patients (18 female, 12 male; mean age: 19.57 ± 0.5 years). All patients had Class I malocclusion and had fixed orthodontic appliance treatment. The flapless technique was performed with a reinforced scalpel on the labial aspect of the mandibular incisors to separate the interproximal cortices transmucosally. Using aseptic technique, two blood samples of 20 mL were collected before and 30 to 60 seconds after the flapless technique. The blood was aseptically inoculated into culture bottles and incubated at 35°C for 2 weeks. Medium alterations showing bacterial growth were investigated by using Gram staining. The bacteria were identified by VITEK 2 (bioMérieux, Marcy l'Etoile, France) automated microbiology identification system. The result was analyzed statistically using the McNemar test, with $P < 0.05$ indicating statistical significance. The intensity of bacteremia was expressed as colony-forming units per milliliter.
Results: No significant difference between the preoperative and postoperative samples were determined with respect to bacteremia ($P = 0.335$). Only *Streptococcus oralis* was detected in two postoperative samples.
Conclusion: A minimally invasive flapless accelerated orthodontic technique is not related to transitory bacteremia, as *Streptococcus oralis* was detected in only two postoperative samples.

1. Introduction

Blood is normally a sterile environment. Presence of bacteria in the bloodstream is always abnormal, and is known as bacteremia [1]. Bacteremia can result following dental extractions [2], tooth brushing [3], chewing [4], debonding of bonded maxillary expansion appliance [5], orthodontic stripping [6], removal of orthodontic mini-implants [7], banding and debanding [8], gold chain adjustment [9], and removal of fixed orthodontic appliances [10]. However, research regarding the latest orthodontic procedure–related bacteremia has been sparse, as is the case for the minimally invasive flapless accelerated orthodontic techniques.

In the patients with underlying cardiac conditions associated with the highest risk of adverse outcome from infective endocarditis, guidelines from the American Heart Association state that antibiotic prophylaxis is recommended for all dental procedures that involve dento-gingival manipulation and perforations of the oral mucosa [11].

One of the common deterrents to orthodontic therapy is the amount of time that a patient needs to commit; thus, there has been a continuous search for techniques to accelerate the rate of orthodontic tooth movement [12]. At present, there are various techniques to accelerate the rate of orthodontic tooth movement, namely, surgically facilitated orthodontics [13], combination of interradicular corticotomy and supra-apical osteotomy technique [14,15], periodontal ligament distraction [16], undermining of interseptal bone [17], the corticotomy-facilitated technique [18], dentoalveolar distraction osteogenesis [19], micro-osteoperforation [20], and piezopuncturing [21].

Many efforts have been made to develop methods with minimal surgical intervention that could speed up the rate of orthodontic tooth movement by increasing alveolar bone turnover rate by means of a regional acceleratory phenomenon. One of the methods

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being used is corticision, which has the potential to speed up the rate of tooth movement. Corticision involves transmucosal cortical incision without causing surgical trauma and without the need for flaps or bone grafting [22]. There are two methods of creating transmucosal cortical incisions: piezotome-assisted corticision and reinforced scalpel–assisted corticision [23–25].

A flapless technique is less invasive, but it involves piercing of gingiva to secure the necessary bone injury to the alveolar bone. Therefore, the objective of present study was to investigate bacteremic capacity of minimally invasive flapless accelerated orthodontic technique in a sample of orthodontic patients. To our knowledge, this is the first report of a study on bacteremia after corticision technique, as an adjunct to orthodontic treatment.

2. Materials and methods

After obtaining institutional ethical board approval and written informed consent from the patients, 30 orthodontic patients were enrolled in this prospective cohort study of 7 months' duration: September 1, 2016, to April 1, 2017. Before this study, a power analysis was performed to estimate the sample size. Literature reported 0% to 6.6% difference in the prevalence of bacteremia before and after various orthodontic procedures [6,9,26–28]. Our assumption of a 10% prevalence of bacteremia was taken by averaging the findings of other studies [6,9,26–28]. At an alpha level of 5% and a power of 80%, 24 patients would be enough for detecting at least a 25% difference in the prevalence of bacteremia before and after the technique [29]. We decided to collect samples from 30 patients after considering the possibility of potential losses and sample contamination.

Before fixed orthodontic treatment, patients were referred to a periodontologist, blinded for study, to receive instructions for maintaining good oral hygiene. One expert operator, who did bonding, evaluated the patients' oral hygiene and gave scores for each patient as follows. If the patient had more than five sites with bleeding after brushing, the oral hygiene was labeled as poor (grade 3); if there was a little bleeding, it was moderate (grade 2); and if there were no bleeding sites, the oral hygiene was labeled as good (grade 1). Patients who had oral hygiene grades of 1 were included in this study. Inclusion criteria were as follows: orthodontic patients 18 years or older scheduled to have nonextraction orthodontic treatment with lower incisor crowding >5 as per Little's irregularity index [30], good oral hygiene, and probing depth of less than 3 mm. Patients were instructed to avoid chewing, tooth brushing, and flossing for 4 hours before sample collection. Exclusion criteria were predetermined according to the study of Erverdi et al [26] and are listed in Table 1.

The minimally invasive flapless technique was performed 1 week after placement of the 0.022-inch slot-fixed orthodontic appliance (3M Gemini; 3M Unitek Corporation, Monrovia, CA). After administration of local anesthesia of 2% lidocaine with 1:100,000 epinephrine (Henry Schein, Melville, NY), a reinforced surgical blade (number 15; Feather Safety Razor, Mino, Japan) was used to a depth of approximately 3 mm for separating the interproximal cortices transmucosally. The blade was positioned on the interradicular buccal attached gingiva at an inclination of 90° to the long axis of lower incisors and inserted into the bone marrow without flap reflection by tapping with the surgical mallet, gradually penetrating the overlying gingiva, cortical bone, and cancellous bone. The blade was pulled out without a swing motion. The whole procedure was performed by an experienced specialist.

Rubber seals of the bottles were disinfected and microorganisms of environmental origin were excluded from the analysis. To determine the bacteremic capacity, a peripheral venous blood sample (20 mL) was drawn from an antecubital vein after discarding the first 0.5 mL of blood, with a 20-gauge sterile plastic cannula (HECOS; Shanghai Medicines & Health Products Import and Export, Shanghai, China) and a sterile syringe after a strict aseptic technique of disinfecting the area with alcohol and povidone iodine. The cannula was left in place and closed between the two samplings. The first blood sample was taken before the administration of local anesthesia. The second blood sample was taken 20 minutes after administration of anesthesia, within 30 to 60 seconds after the first cortical incision [31].

Table 1
Exclusion criteria (Erverdi et al [26])

Congenital heart disease
History of rheumatic fever
Aortic or mitral stenosis
Prosthetic heart valves
History of subacute bacterial endocarditis
Hypertrophic cardiomyopathy
Immunosuppression
Diabetes
Bleeding disorder
Pregnancy
Antibiotic usage within the past 3 months
Using antiseptic mouth wash regularly
Restoration adjacent to the gingival margin on the selected molar

The samples were immediately inoculated into two bottles of culture medium containing 0.011 g sodium polyanethole sulfonate, 1.33 g thioglycolate broth, and 45 mL sterile distilled water (Hemoprov III Newprov Ltda, Pinhais, Brazil) and incubated at 35°C, 10% pCO_2 for 2 weeks [27]. Daily visual inspections were carried out to detect any signs of microbial growth. For confirming, cultures were performed on blood agar and blood agar supplemented with 0.0005% hemin (Sigma Chemical Co, St Louis, Mo) and 0.00005% menadione (Sigma) under aerobic and anaerobic conditions, respectively, at 37°C, for up to 7 days [27]. Gram staining was used to distinguish bacterial morphologies. When growth was detected, the bacteria were identified by VITEK 2 (bioMérieux, Marcy l'Etoile, France) automated microbiology identification system.

Blinding was implemented so as experts responsible for the microbial analyses and/or the statistical analysis were not aware of which sample corresponded to the preoperative or the postoperative situation.

2.1. Statistical analysis

A blind statistical analysis was implemented. Data were analyzed using statistical package for the social sciences (SPSS version 21.0; IBM Corporation, Chicago, IL). The result was analyzed statistically, between the preoperative and postoperative samples with respect to bacteremia, using the McNemar test, with $P < 0.05$ indicating statistical significance. The intensity of bacteremia was expressed as the colony-forming units per milliliter. The Shapiro- Wilk test was used for normality, and, as a consequence, the Kruskal-Wallis test for nonparametric one-way analysis of variance.

3. Results

Of 30 patients, 18 were female and 12 were male with mean age of 19.57 ± 0.5 years. Mean lower incisor crowding was 5.7 ± 0.20 mm. Healing was uneventful following the procedure and blood collection. No statistically significant differences were found between the preoperative and postoperative samples with respect