

Management of the American Heart Association's guidelines for orthodontic treatment of patients at risk for infective endocarditis

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Introduction: For over 50 years, the American Heart Association has made recommendations for the prevention of infective endocarditis. The first guidelines were published in 1955; since then, they have been updated 9 times, most recently in 2007. There is still confusion about which orthodontic procedures are most prone to generate bacteremias and lead to infective endocarditis in susceptible patients. The aim of this study was to conduct a survey to determine orthodontists' knowledge, attitudes, and in-office behaviors regarding the American Heart Association's guidelines. **Methods:** A 4-page online survey consisting of 3 sections was sent to members of the American Association of Orthodontists by using a random number generator. The first section consisted of demographic information, the second consisted of questions about the respondents' practice characteristics, and the third included questions about the respondents' knowledge and management of the treatment of patients at risk for infective endocarditis. There were 78 responses. **Results and Conclusions:** Orthodontists are screening for cardiac problems in the patient's medical history but to a lesser extent are requesting written medical clearance from the patient's physician before starting orthodontic treatment. Many of the orthodontists surveyed believed that their knowledge of the American Heart Association's guidelines and management of high-risk patients was in the good-to-excellent range. Orthodontists recommend antibiotic prophylaxis most frequently during band placement and removal. Patients at risk for infective endocarditis are somewhat likely to inquire about possible treatment sequelae associated with previous cardiac problems. (*Am J Orthod Dentofacial Orthop* 2012;142:348-54)

For over 50 years, the American Heart Association has made recommendations for the prevention of infective endocarditis. The first guidelines were published in 1955 and, since then, have been updated 9 times, most recently in 2007. Infective endocarditis is a rare disease that can be life threatening. Despite advances in medicine, morbidity and mortality can result. Although the incidence of endocarditis is hard to measure, most cases are not attributable to invasive dental procedures.¹ It is difficult to conduct

controlled trials to positively establish that antibiotic prophylaxis provides protection against endocarditis during invasive procedures. Also, there is still confusion about which orthodontic procedures might generate bacteremias, which can lead to infective endocarditis in susceptible patients.

The relationship between orthodontics and infective endocarditis has not been fully defined.² Although controversial, it is widely assumed that there are correlations among poor oral hygiene, the severity of periodontal disease, the type of dental procedure, and the frequency, nature, magnitude, and duration of bacteremia.³ However, evidence supports that good oral hygiene with no dental disease will decrease the frequency of bacteremia resulting from daily activities.⁴ Most recent studies have focused on which dental procedures seemed to cause the greatest risk of endocarditis. As shown in Table 1, dental extractions have been reported in the past to have the highest incidence of bacteremia, ranging from 10% to 100%.⁵ However, other studies have shown that other dental procedures such as periodontal surgery, scaling and root planning, dental prophylaxis, rubber dam matrix wedge placement, and endodontic procedures

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Table I. Incidence of bacteremia after oral physiologic function, oral hygiene, and dental procedures

Procedure	Incidence of bacteremia ^{6,7}
Extraction	10%-100%
Periodontal surgery	36%-88%
Periodontal scaling	8%-80%
Dental prophylaxis	0%-40%
Endodontic therapy (manipulation within apex)	0%-20%
Tooth brushing	0%-40%
Irrigating devices	7%-50%
Tooth picks	20%-40%
Chewing	17%-51%
Periodontal disease (patient resting)	11%
Periodontal disease (resting but anaerobic technique)	60%-80%

pose risks for bacteremia similar to those of tooth extractions.⁵

Biancanello and Romero⁶ reported 2 cases in which each child with a history of congenital cardiac defects developed endocarditis within 6 months after adjustment of their orthodontic appliances. Hobson and Clark⁷ reported in a case study that a patient developed endocarditis within 2 weeks after archwire adjustments. In both articles, however, there was no conclusive evidence linking orthodontic treatment to causing infective endocarditis, and the relationship might have been coincidental. In 1995, Hobson and Clark⁸ also surveyed 1038 orthodontists and found only 8 cases of infective endocarditis diagnosed during or after orthodontic treatment. They concluded that the risk for infective endocarditis was minimal. McLaughlin et al⁹ found bacteremia in 10% of blood samples during band placement. On the other hand, Degling¹⁰ found no bacteremia during banding in that study. The American Heart Association's committee concluded that adjustment of orthodontic appliances does not pose a significant risk for bacteremia. Hence, the guidelines do not recommend prophylaxis for routine adjustment of fixed and removable orthodontic appliances.

No current published data have shown which dental procedures can cause greater frequencies of bacteremia, compared with routine daily activities such as mastication, tooth brushing, or flossing. Previous American Heart Association guidelines based the criteria for antibiotic prophylaxis on whether bleeding occurred during a dental procedure. For procedures in which bleeding was expected, prophylaxis was recommended. However, research does not support the claim that bleeding is a reliable indicator for infective endocarditis.⁴ As a result, this led the previous American Heart Association

guidelines to suggest antibiotic prophylaxis for some procedures and not for others.

Previous studies have been controversial on whether antibiotics can prevent or reduce the frequency, magnitude, or duration of bacteremia from dental procedures. Lockhart et al¹¹ reported that antibiotics have been statistically successful in reducing the frequency, nature, or duration of bacteremias from dental procedures, whereas the report by Roberts¹² counters that conclusion. However, the results of the study of Lockhart et al do not indicate that bacteremia was eliminated altogether. Conversely, Hall et al¹³ reported that neither penicillin V nor amoxicillin therapy was effective in reducing the frequency of bacteremia compared with untreated control subjects. In another study, Hall et al¹⁴ found that patients treated with penicillin or ampicillin after dental extractions compared with placebos did have a lower percentage of viridans group streptococci and anaerobes in culture. Ten minutes after the extractions, however, there was no significant difference. No data have shown that a reduction in bacteremia from amoxicillin lowered the risk of infective endocarditis.

Previous American Heart Association guidelines categorized the underlying cardiac conditions in the low, moderate, and high risk categories. These categories were then used to recommend antibiotic prophylaxis for patients in the high and moderate risk categories.¹ The American Heart Association gave several reasons for revising the guidelines.¹⁵ The current guidelines no longer recommend prophylaxis based solely on an increased lifetime risk of acquiring infective endocarditis because it is believed that only a few cases of infective endocarditis can be prevented by antibiotic prophylaxis, even if prophylaxis is 100% effective. It identified patients with underlying conditions, including a prosthetic cardiac valve or a previous episode of infective endocarditis, and some patients with congenital heart disease, as among those with the highest lifetime risk of acquiring bacteremia. As a result of the revisions, fewer patients will be receiving antibiotic prophylaxis.

In a major departure from the former guidelines, which listed certain dental procedures for which antibiotic prophylaxis was recommended, the current guidelines now recommend prophylaxis on any "dental procedures that involve manipulation of gingival tissues or the periapical region of the teeth or perforation of the oral mucosa."¹⁵ These procedures include placement and removal of orthodontic bands but do not include routine anesthetic injections through noninfected tissues, dental radiographs, placement of removable prosthetic or orthodontic appliances, adjustment of orthodontic appliances, placement of orthodontic brackets, shedding of deciduous teeth, and bleeding

Table II. Respondent profiles

	<i>Our study</i>	<i>National reports¹⁶⁻¹⁸</i>
Sex	Men, 47%; women, 53%	Men, 85%; women, 15%
Average years out of residency	14 years	15 years
Median age group	40-49 years	52 years
Average years in practice	14 years	21 years
Average hrs/wk spent in direct patient care	30 hours	31 hours
Average patients treated on a typical day	55 patients	54 patients
Average percentage of adults in practice	22%	20%

from trauma to lips or oral mucosa.¹⁵ This, of course, also includes the placement of temporary anchorage devices. The antibiotic prophylaxis regimen remains unchanged since 1997. It recommends that antibiotic prophylaxis should be administered in a single dose before the procedure. If antibiotics were not administered before the procedure, prophylaxis can still be given up to 2 hours afterward.

The aim of this study was to conduct a survey to determine orthodontists' knowledge, attitudes, and in-office behaviors regarding the American Heart Association's guidelines for the prevention of infective endocarditis.

MATERIAL AND METHODS

To examine orthodontists' knowledge and management of the most recently published American Heart Association guidelines, a 4-page online questionnaire was drafted. Our subjects consisted of members of the American Association of Orthodontists. The respondents' e-mail addresses were generated from the American Association of Orthodontists' membership directory by using a random number generator. All respondents practiced in the United States, and all had to report their primary activity as the practice of orthodontics to be eligible for the study. Three hundred and four surveys were distributed by e-mail to obtain a sample size of 78 respondents, resulting in a response rate of 26.5%. Two additional reminder e-mails were sent 10 days apart to follow up. An introductory letter was attached to each e-mail message describing the details of the survey and asking for participation in the study. The letter briefly described the study, emphasized its purpose and research goals, and the importance of the respondent's participation, and ensured confidentiality.

The questionnaire consisted of 3 sections, totaling 29 questions, and was formatted on Survey Monkey. The first section consisted of questions about the

respondent's characteristics. The second section consisted of the respondent's practice characteristics and history-taking practices. The last section of the questionnaire included questions about knowledge and management of patients at risk for infective endocarditis. All completed questionnaires were assigned an identification number. All responses were entered into a Microsoft Excel spreadsheet (2007; Redmond, Wash). Any comments were also entered into the spreadsheet. All information was transferred to SPSS software (version 17; SPSS, Chicago, Ill). Frequencies and means were calculated for all data. Bivariate correlations, comparisons of means, and paired *t* tests were also used.

RESULTS

The profiles of the respondents in our study and the national reported averages are presented in Table II. The sex ratio in this study was different from those in national reports. The average number of years in practice in our study was 14 years. The rest of the sample profile attributes were similar to national averages.¹⁶⁻¹⁸

The respondents were asked to rate their knowledge of the guidelines published by the American Heart Association for the prevention of infective endocarditis and managing orthodontic treatment for patients at high risk for endocarditis. Practitioners rated their knowledge with the categories of limited, moderate, good, or excellent. When they were asked to self-assess their knowledge of the American Heart Association's guidelines for the prevention of infective endocarditis, 63.0% responded good, and 16.4% responded excellent. When they were asked to self-assess their knowledge of managing orthodontic treatment for patients at risk for endocarditis, 57.5% responded good, and 17.8% responded excellent.

In comparison, the respondents were then objectively examined on their knowledge of the risk assessment aspects of the guidelines. Four cardiac conditions (prosthetic cardiac valves, physiologic heart murmurs, myocardial infarct in the last 6 months, and previous episode of infective endocarditis) were presented, and the practitioners were asked whether they regarded patients with these conditions as having a low, moderate, or high risk for infective endocarditis. The results are shown in Table III. For prosthetic cardiac valves, 59.0% responded with high risk. For physiologic heart murmurs, 70.5% responded with low risk. For myocardial infarct in the last 6 months, 35.6% responded with moderate risk. For previous infective endocarditis, 73.1% responded with high risk.

Virtually all respondents (97.4%) reported that they obtain and review a patient's medical information, which includes questions about cardiac conditions, as

Table III. Risk assessment of cardiac conditions

Cardiac conditions (n = 78)	Low risk	Moderate risk	High risk
Prosthetic cardiac valves	10.3% (n = 8)	30.8% (n = 24)	59.0% (n = 46) correct
Physiologic heart murmurs	70.5% (n = 55) correct	26.9% (n = 21)	2.6% (n = 2)
Myocardial infarct in the last 6 months	25.6% (n = 20)	35.6% (n = 27) correct	37.0% (n = 31)
Previous infective endocarditis	9.0% (n = 7)	17.9% (n = 14)	73.1% (n = 57) correct

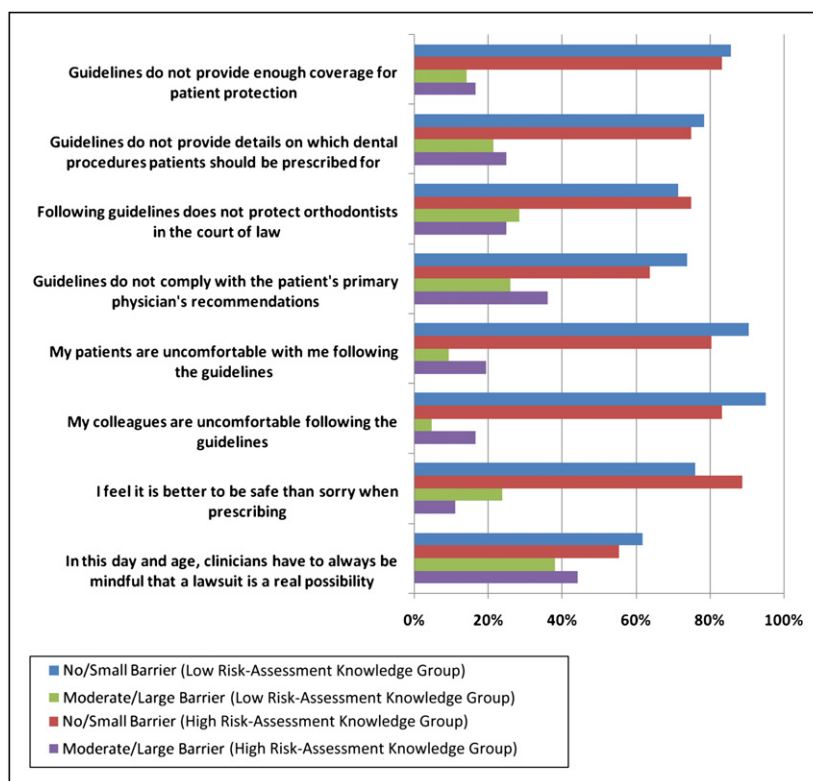


Fig. Barriers to implementing the American Heart Association's guidelines.

part of their medical history. However, only 57.7% of the respondents required medical clearance for patients with a positive history of heart problems. When the respondents were asked to estimate the number of patients they have referred for evaluation of suspected endocarditis, only 7 orthodontists (13.7%) stated that they made referrals in the past year.

Relatively few orthodontists communicated with the patient's primary physician. Of those who require a medical clearance from patients with a history of heart problems, 69.8% responded seldom or never, and 30.2% responded sometimes or often, to how often they communicate with the patient's physician. The last

parameter examined, in terms of the orthodontists' management of infective endocarditis, was the extent to which respondents viewed aspects of the American Heart Association's guidelines as barriers toward implementing them in their private practice. The Figure details the respondents' perceptions of several barriers and whether they regard them as no-to-small barriers or moderate-to-large barriers.

Table IV presents the participants' decisions regarding the need for antibiotic prophylaxis for 7 orthodontic procedures for patients at high risk for infective endocarditis. According to our survey, 98.4% of the orthodontists recommended antibiotics for placement of molar bands,

Table IV. Need for antibiotic prophylaxis and orthodontic procedures

<i>Orthodontic procedures (n = 61)</i>	<i>Orthodontists recommending antibiotic prophylaxis</i>
Taking study impressions*	5% (n = 3)
Placing separators before banding	60.7% (n = 37)
Placing molar bands	98.4% (n = 60)
Bonding brackets	20% (n = 12)
Adjusting orthodontic appliances*	1.7% (n = 1)
Removing molar bands	90.2% (n = 55)
Debonding brackets	62.3% (n = 38)

*n = 60.

90.2% recommended them for removal of molar bands, 62.3% recommended them for debonding of brackets, and 60.7% recommended them for placement of separators before banding. In the study, 73% of the orthodontists use antibiotics in their private practice. Table V lists the most common prescription regimen components that these respondents used in their practices.

DISCUSSION

In this study, there were approximately equal numbers of men and women; this differs from the national averages reported by Keim et al.¹⁶ They found the percentages to be 85% for men and 15% for women. Furthermore, the average years in practice were reported to be fewer than their national average of 21 years. However, the median age group corresponded with their study: 52 years. The number of women entering orthodontic practice has steadily increased from 1990 to 2008 when their study was done. This might also reflect a tendency for younger and more interested orthodontists to respond to this study.

The most prominent inadequacy of knowledge in this study was evident when the respondents were asked about the level of risk related to having had a diagnosis of a myocardial infarct in the last 6 months. Only 35% responded with the correct risk assessment for this cardiac condition—the moderate risk category. Even though these patients might have a lifelong risk of infective endocarditis, the American Heart Association believes that the risk is much greater from a random blood-borne bacterial infection resulting from everyday activities than from a dental or medical procedure.¹⁵

Sadowsky et al¹⁹ analyzed general dentists and their knowledge of the prophylactic regimen as recommended in the American Heart Association's guidelines. From their study, we wanted to use our respondents' level of knowledge regarding risk assessment of cardiac conditions to divide the respondents into 2 groups based on

Table V. Most commonly used prescription components among those using antibiotics in their practices

<i>Prescription regimen (n = 53)</i>	<i>Total percentage (number)</i>
Antimicrobial agent: amoxicillin	81.1% (n = 43)
Preoperative dosage: 2 g	66.0% (n = 35)
Preoperative time: 1 hour	84.9% (n = 45)
Postoperative dosage: no dosage given	75.5% (n = 40)

their answers to several questions. Subjects who gave 2 or fewer correct answers were placed in the low risk-assessment knowledge group, which comprised 53.8% of the respondents. Those with more than 2 correct answers regarding the risks associated with certain cardiac conditions were placed in the high risk-assessment knowledge group, which comprised 46.2% of the respondents. Approximately half of the respondents had high knowledge of the risk levels associated with certain cardiac conditions, and the other half had low knowledge. This might reflect that some practitioners are more familiar with the most recent guidelines, whereas others are not as familiar with the current literature. Table VI shows how the 2 risk-assessment knowledge groups self-assessed their own knowledge (limited/moderate or good/excellent) of the American Heart Association's guidelines and managing orthodontic treatment for patients at risk for infective endocarditis. Interestingly, as shown in Table VI, over 70% of both risk-assessment knowledge groups, whether low or high, regarded their knowledge of the guidelines and management of patients at risk for infective endocarditis to be in the good to excellent range.

Most respondents did screen for cardiac problems. However, as shown in Table VII, only 57.1% of the low risk-assessment knowledge group and 58.3% of the high risk-assessment knowledge group required medical clearance for patients with a positive history of heart problems. The results indicated that orthodontists are screening for cardiac problems in the medical histories of patients who are currently receiving orthodontic treatment or who are about to start. However, they are not following through, to the same extent, with regard to the information reported in the history. When the respondents were asked to estimate the number of patients they have referred for evaluation of suspected endocarditis in the past year, only 4 from the low risk-assessment knowledge group and 3 from the high risk-assessment knowledge group referred patients for evaluation of suspected infective endocarditis. These low numbers of referrals could be because the baseline number of patients at risk for infective endocarditis in an orthodontic office is extremely low. The incidence of infective

Table VI. Knowledge of risk in relation to self-assessed knowledge

<i>Self-assessed knowledge: good or excellent</i>	<i>Total</i>	<i>Lower knowledge of risk % (n = 42)</i>	<i>Higher knowledge of risk % (n = 36)</i>	<i>Fisher exact test</i>
American Heart Association's recommendations	78	73.8% (n = 31)	80.6% (n = 29)	0.593
Managing orthodontic treatment for patients at risk for infective endocarditis	78	71.4% (n = 30)	80.6% (n = 29)	0.432

Table VII. Risk-assessment knowledge in relation to screening for cardiac conditions and communications with physician

	<i>Total</i>	<i>Lower knowledge of risk</i>	<i>Higher knowledge of risk</i>	<i>Fisher exact test</i>
Review cardiac questions in medical history	78	97.6% (n = 41)	97.2% (n = 35)	1.00
Require medical clearance	78	57.1% (n = 24)	58.3% (n = 21)	1.00
If yes to medical clearance, sometimes or often communicate with physician	43	21.7% (n = 5)	40.0% (n = 8)	0.318

endocarditis in a general population has been estimated between 1.7 and 6.2 cases per 100,000 person-years.²⁰

Furthermore, among those who require medical clearance for patients with heart problems, 78.3% of the low risk-assessment knowledge group and 60% of the high risk-assessment knowledge group reported that they do not regularly communicate with the patients' physicians about their cardiac conditions. This pattern of behavior appears consistent with the findings regarding the low numbers of patients required to obtain medical clearance before orthodontic treatment and the low numbers of patients referred for evaluation of suspected endocarditis in the past year.

Most participants indicated that they do not offer prophylaxis for clearly noninvasive procedures (eg, taking study impressions, bonding brackets, and adjusting orthodontic appliances), but they do offer prophylaxis for removing and placing molar bands. However, regarding other procedures (placing separators before banding and debonding brackets), the participants were more diverse in their answers. It seems that, according to some orthodontists, procedures such as placing separators before banding, placing and removing molar bands, and debonding brackets meet the criterion of "manipulation of gingival tissues" and might need antibiotic administration.

Several surveys have been conducted to evaluate how orthodontists prescribe when treating high-risk patients. Hobson and Clark⁸ found that 67% of orthodontists used antibiotic prophylaxis during band fitting and 50% during band removal. Gaidry et al² found that 65% of orthodontists used antibiotic prophylaxis during band fitting and 38% during band removal. In both of

these studies, orthodontists thought that there was a greater chance of bacteremia during band fitting than at band removal. This is in contrast to our findings: the orthodontists clearly perceived that the removal of bands has virtually the same chance of producing bacteremia as band placement. As a result, the risk of bacteremia could be just as high while debanding when the gingival tissues adjacent to the molar bands are inflamed. In 2001, Erverdi et al²¹ found that the prevalence of bacteremia from debanding was only 6.6%. However, patients with poor oral hygiene were deliberately excluded from their study.

In our study (Table V), 73% of the orthodontists use antibiotics in their private practices. Among this group of users, amoxicillin was prescribed by 81.1% as the prophylactic antimicrobial agent for nonallergic patients. A recommended preoperative dosage of 2 g was prescribed by 66.0%, and 84.9% of orthodontists indicated that 60 minutes before dental treatment was the time for administering the antibiotics. A postoperative antibiotic dosage was prescribed by 24.5% of the group. The percentages of those who correctly knew the recommended antimicrobial regimen components were similar across the 2 groups; there were no statistically significant differences. However, the prescription regimen has not changed since 1997.

Approximately 26% of the orthodontists in the low risk-assessment knowledge group and 47% of those in the high risk-assessment knowledge group had patients inquire about potential sequelae associated with their orthodontic treatment (Fisher exact test, $P = 0.062$). Overall, approximately 36% of orthodontists had patients who made such inquiries. This finding might be

influenced in part by the more extensive inquiries made by the orthodontist after reviewing the medical history at the initial appointment. However, another possible reason could be the small numbers of patients who are referred for evaluation of suspected endocarditis by the orthodontist and the even smaller numbers of incidences of infective endocarditis each year. Furthermore, patients who are at high risk for infective endocarditis might be fully aware of their potential sequelae associated with dental procedures from their previous interactions with their physicians and other dental health professionals.

As with most online surveys, there were limitations associated with this study. The sample size was relatively small ($n = 78$); the number of female respondents from our survey was greater than the national average. However, most of the sample's characteristics were consistent with national averages, such as average years out of residency, median age group, average hours per week spent in direct patient care, average number of patients treated on a typical day, and average percentages of adults in the practice. This supports that the sample was reasonably representative.

CONCLUSIONS

1. The data from this study suggest that there is little difference between the low risk-assessment knowledge group and the high risk-assessment knowledge group with respect to screening for cardiac conditions and managing patients at risk for infective endocarditis.
2. The high and low risk-assessment knowledge groups managed their patients at risk for infective endocarditis similarly, suggesting that these 2 areas of knowledge remain rather separate, with associated implications for future training efforts.
3. Both the low risk-assessment knowledge and high risk-assessment knowledge groups thought that placing and removing molar bands were the procedures most related to the risk of bacteremia.
4. Although most orthodontists take and review a medical history, few follow up with a discussion with a physician or obtain a release before starting treatment.
5. Patients at risk for infective endocarditis are somewhat likely to inquire about possible treatment sequelae.

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