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Review Article

ORTHODONTIC TREATMENT AND CARDIAC HEALTH: A NARRATIVE REVIEW

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Abstract

More medically vulnerable individuals, including those at risk of getting infectious endocarditis and other cardiac diseases, are seeking orthodontic treatment as a result of access to high-quality healthcare. There aren't many current recommendations for cardiac health and orthodontic treatment. The goal of this review is to give an evidence-based update on how orthodontic treatments and cardiac health are related. We looked for published English-language literature on cardiac health and orthodontics in PubMed, Ovid Medline, and Google Scholar. Between October 2017 and December 2022, endocarditis, antibiotic prophylaxis, cardiac, medical problems, medically compromised, orthodontics, and dentistry were among the search terms used in the literature review. Additionally, a thorough search of the references of the chosen papers was done. It was observed that bacteremia is a precondition for heart disease. Orthodontic procedures such as insertion of separators, installation of bands, removal of expanders and placement of micro implant have also been observed to significantly increase bacteremia. The use of elective invasive procedures that are likely to result in bacteremia should be avoided because there is a lack of high-quality data and the AHA guidelines must be consulted before performing orthodontic treatment in patients having cardiac problems.

Keywords: Orthodontic treatment, cardiac health.

Introduction

In the United States and throughout the world, atherosclerotic cardiovascular disease (ASCVD) is the primary cause of disability and fatalities. Although it is generally known that addressing proven ASCVD risk factors lowers morbidity and death from the disease, other preventive measures might also help lower cardiovascular risk.[1,2] Dental infection has been shown to be a possible mediator of ASCVD in mechanistic studies. It is unclear whether this

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process is started and promoted by direct bacterial translocation, direct translocation of bacterial products, or downstream inflammatory and immune-mediated pathways. Numerous investigations have shown that bacteremia, of varying degrees, occur after tooth brushing and dental extractions and is correlated with inflammatory markers in the body.[3-5]

For all patients, orthodontic therapy is an optional procedure. On average, youngsters between the ages of 8 and 17 make up 67% of orthodontic patients. More children with medical issues are receiving orthodontic treatment today as a result of advancements in medical care, extending life expectancies, and raising expectations for improved quality of life. Because congenital heart problems occur in between 2.4 and 13.7 out of every 1000 live births, children with cardiac disorders may be seen in orthodontic practice. Although it is thought that orthodontics is the least invasive form of dentistry, there are possible hazards for patients who have heart conditions that must be taken into account, and particular measures are needed to reduce complications.[6-8]

A dangerous and sometimes fatal condition, infectious endocarditis (IE), is an infection of the endocardial surface of the heart, including the heart valves, the mural endocardium, and the septum. With about 05 to 12 cases per 1000 paediatric admissions, it has a low incidence. Although difficult to quantify, invasive dental procedures are not responsible for the majority of cases of IE. Based on an accumulation of the best available data, the American Heart Association (AHA) has been offering recommendations for the avoidance of IE in connection with dental treatments for more than 50 years.[9-12] The literature is confusing because of paucity of high-quality research and clinical guidelines in relation to orthodontic therapy and IE. The purpose of this narrative review is to provide an evidence-based update on the relationship between orthodontic procedures and IE and overall cardiac health.

We looked for published English-language literature on cardiac health and orthodontics in PubMed, Ovid Medline, and Google Scholar. Between October 2017 and December 2022, endocarditis, antibiotic prophylaxis, cardiac, medical problems, medically compromised, orthodontics, and dentistry were among the search terms used in the literature review. Additionally, a thorough search of the references of the chosen papers was done. Regarding the years of publication, there were no restrictions. There were insufficient high-quality investigations, such as randomised controlled trials, due to the nature of this serious and life-threatening illness. The literature at hand, made it possible to analyse and report a narrative synthesis.

Bacteremia from daily activities in orthodontic patients

Patients with orthodontic appliances who clean their teeth have a transient bacteremia prevalence of 25%, which is comparable to that of patients without orthodontic equipment (26%). Bacteremia is impacted by the degree of inflammation or infection at the site, and the research that is now available is consistent with the idea that maintaining good oral hygiene and avoiding dental illness reduces the frequency of bacteremia that is brought on by routine everyday activities.[13,14] An link between increased plaque formation, gingival inflammation, and the emergence of bacteremia following teeth brushing was documented in a systematic review by Tomas et al.[15] As a result, all orthodontic patients, but notably those with cardiac disorders, need to be reminded to maintain appropriate dental hygiene.

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Orthodontic procedures and bacteremia

It is unclear how bacteria and orthodontic treatments are related. It is frequently believed that the danger of bacteremia is low because orthodontic treatment is considered to be less invasive. To illustrate the need for orthodontic treatment providers to identify at-risk patients, examples of orthodontic-associated IE have been described in the literature. In the literature, there are four published case reports of IE in orthodontic patients. Hobson and Clark[16]also conducted a survey of 1038 orthodontists and discovered eight cases of IE that were discovered during or after orthodontic treatment. All of the cases involved minor orthodontic changes, which don't often call for antibiotic prophylaxis. Although some of these articles proposed that the appliance adjustment caused mucosal injury that might have contributed to IE, no direct link has been shown, and it is most likely coincidental that IE developed. Numerous authors have examined the frequency of bacteremia following various orthodontic procedures although research' findings differs due to confounding of many factors.

Streptococcus viridans is the bacteria most frequently found in investigations, both in determinations conducted in the immediate post treatment period and after a set amount of time, and the placement of bracket increases the likelihood of bacteremia between 39% and 100%.This method results in temporary bacteremia; however, a small number of studies have demonstrated that this occurrence is extremely rare when oral hygiene is kept under control. These studies also suggest that daily use of floss can reduce the likelihood of developing bacteremia. Because transient bacteremia lasts only a few minutes, there is no reason for it to cause damage to the patient's heart valves. However, BE (bacterial endocarditis) could develop if these sporadic bacteria persist.[17-20]

Not just dental manipulation can result in transient bacteremia. In a variable number of patients, routine actions including eating, chewing gum, brushing teeth, or using toothpicks also cause bacteremia that can be detected by blood cultures. According to previous study the 1029 subjects who had previously visited an orthodontist for treatment reported that their most recent appointment was for a routine checkup, band placement, or implant in 26.9% of the cases, and tooth extraction in 24.4% of the cases (only the activities considered to pose a risk of bacteremia are reported)

These findings suggest that between 5.6% and 14.4% of the population experienced transient bacteremia as a result of dental intervention in the six months prior to the study, 2.6% to 6.6% of the population experienced bacteremia between the six months and one year prior to the study, and 5.2% to 13.3% of the population experienced bacteremia one and a half years prior to the study. These studies come to a contentious and ambiguous conclusion because temporary bacteremia can result from a variety of factors, including a normal lifestyle, some infections, and atypical brushing, eating, and behavior patterns.[17-20]

Conversion of transient bacteremia into SABE

The pathogenesis of occult bacteremia is poorly understood in large parts. The presumptive mechanism starts with bacterial colonisation of the respiratory tract or another mucosal surface; in certain children, germs may egress into the circulation due to host- and organism-specific characteristics. Once viable bacteria have entered the bloodstream, they may be naturally eliminated, they may create a focal infection, or the infection may develop into septicemia, which can have fatal consequences such shock and disseminated intravascular coagulation. It is crucial to understand the etiopathology of bacteremia and BE in detail.

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Streptococcus viridans is the germ that causes about 50% of all cases of native cardiac valve BE, according to numerous studies. This information supported the theory that orthodontic manipulation, particularly treatment involving invasive procedures like extraction band pinching and implant placement, may be one of the primary causes of BE. Krcmeryet al[19]. Examined 339 BE cases diagnosed between 1991 and 2001. 15% of these instances and 29.2% of them were brought on by streptococci. After rheumatic fever (24.2%), a history of dental surgery was reported in 13.2% of the patients, making it the second-most significant risk factor.

The work conducted by Krcmeryet al[19]. Was assessed by Hricak et al[20]. His study, which included 606 patients with bacterial endocarditis, came to the conclusion that there is little danger involved with any dental or orthodontic procedure and a connection to endocarditis caused by bacteria. Transient bacteremias, which can develop spontaneously from mastication, brushing, flossing, or dental surgical operations, are mostly responsible for systemic infections caused by oral bacteria. Previous research demonstrated that bacteremia can develop without bleeding from the gingiva and that gingival bleeding is not invariably the source of bacteremia. Our findings concur with previous research' conclusions by Krcmeryet al.[19]

The majority of studies show that there are several oral bacterial species that can spread to other sites and enter the bloodstream. While anaerobic bacteria constitute a rare but significant cause of subacute bacterial endocarditis, the viridans group of streptococci has been the most frequent culprit. Viridans streptococci, most specifically S sanguinis and S mutans, are responsible for around 50% of all occurrences of bacterial endocarditis.

The extracellular polysaccharide glucan that these bacteria produce makes it easier for them to bind to heart surfaces or fibrin-platelet clots, which is a need for infective endocarditis. These 2 species are among the microorganisms that were isolated for this study. S hominis, K rosea, and M luteus are the three remaining bacteria, and they are typically found on the skin and occasionally in the mouth. These bacteria in post-removal blood cultures may have developed despite the adoption of a thorough aseptic procedure and the absence of a catheter. Skin contamination of the blood samples is possible. Most individuals who have orthodontic appliances develop mild to moderate gingivitis because they tend to hold onto food particles and bacterial plaque. It is generally established practice to administer antibiotic prophylaxis to individuals undergoing specific dental operations who are at risk of developing localised infections.[18-21]

The orthodontic banding and debanding controversy

Only the first insertion of orthodontic bands, where the greater risk is connected to the band margins' subgingival location, is advised by the most recent AHA guidelines (2007).[21] However, a lot of recent review studies continue to state that high-risk patients should additionally receive antibiotics when debanding. Following the publication of the 2007 AHA recommendations, a survey conducted by Leong et al[22] in 2012 revealed that 98.4% of American Association of Orthodontists (AAO) members advised using antibiotics when placing molar bands and 90.2% when removing bands. This demonstrates a lack of adherence to the AHA recommendations despite a relative consensus among orthodontists that the chances of bacteremia are almost same during band insertion and removal. In 1972, Degling became the first researcher to examine the connection between orthodontic banding, debanding, and IE.[23]Because banding does not usually result in detectable bacteremia or because older microbiological isolation techniques have problems detecting germs, no

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bacteremia was found after the placement or removal of orthodontic bands. While Erverdiet al[24] identified an increase from 0% to 7.5% from banding, McLaughlin et al[25] reported an increase in bacteremia from 3.3% to 10% of patients after banding. Bacteremia following banding may have a hydraulic effect caused by the installation of bands that force bacterial deposits from the tooth surface into the gingival sulcus.

One could argue that because the gingival tissues next to the bands are frequently irritated, removing the bands should lead to a higher prevalence of bacteremia. The prevalence of bacteremia was slightly lower at band debanding than at band fitting, according to Erverdiet al.[24] however patients with poor oral hygiene were not included in their study. Regardless of oral cleanliness, Burden et al.'s[26] investigation of all orthodontic patients revealed an elevated frequency of bacteremia following debonding and debanding. However, in contrast to Erverdietal[24], the authors removed any extra cement that was visible at the gingival borders during debanding using a tungsten carbide bur, which may have contributed to the bacteremia.

Rosa et al[27] discovered a rise in the prevalence of bacteremia (0%–50%) following the removal of a Haas palatal expander. This banded expander, which contains acrylic pads for palatal coverage, is challenging to clean and frequently holds food residue and biofilm that raises the possibility of bacteremia. The method may have clinical importance because the difference was substantial (50%) in size. The study sample size was somewhat tiny, and no statistical analysis was carried out.

Placement of separators

In the study conducted by Leong et al[22], 60.7% of AAO members suggested antibiotic prophylaxis for the insertion of separators in high-risk patients. This shows that despite not being particularly mentioned in the AHA recommendations, more than half of orthodontists believe that antibiotic prophylaxis is crucial for the insertion of separators. The first statistically significant finding for bacteremia following an orthodontic operation, specifically the implantation of a separator, was reported by Lucas et al[28]. The intensity of bacteremia, or the total number of aerobic and anaerobic bacteria isolated from the blood samples, considerably increased even though there was no statistically significant difference in the prevalence of bacteremia.

The significance of this observation is debatable due to the lack of information on the severity of bacteremia that "causes" IE. Placing a wooden wedge and matrix band could reportedly break up plaque into little bits, allowing bacteria easy access to the gingival tissues, according to Roberts et al.[29] The mechanism that follows the placement of separators might be comparable. Occlusal stresses on separators may traumatise the gingival margin to the point where germs can enter the circulation because elastomeric rings are also plaque retentive.

Practical implications: guidelines for orthodontic treatment providers

The level of risk for IE in cardiac patients should be assessed prior to beginning orthodontic therapy by using the most recent (2007) AHA recommendations. It is best for those providing orthodontic treatment to speak with the patient's cardiologist to discuss their specific risk of IE due to unresolved problems concerning orthodontic procedures other than banding. In the survey by Leong et al[22], 69.8% of AAO members reported infrequent or nonexistent communication with the patient's primary doctor for those patients who needed

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medical clearance due to a history of heart problems. For the patient's general health as well as legal concerns, advice from the patient's cardiologist or main physician is crucial.

Inadequate oral hygiene during orthodontic treatment with fixed appliances can induce gingival inflammation, thus orthodontic therapy shouldn't begin unless the patient's oral hygiene and dental health are perfect. Some authors advise the patient to sign a document promising to uphold a very high standard of oral hygiene throughout orthodontic treatment. The orthodontist should keep an eye out for any decline in gingival health while treating the patient. 50 Patients should be aware of the warning signs and symptoms of IE and seek professional guidance if these symptoms appear. Regular periodontal care is also indicated. Patients who are at risk for IE should have any indications of infection looked into and treated right once. If at all possible, physicians should substitute bonded attachments for orthodontic bands.[30]

Additionally, it's important to avoid leaving sharp edges around appliance margins that could harm soft tissues, secure archwires with elastomeric ligatures rather than wire ones, place and remove archwires carefully to prevent mucosal injury, and stay away from fixed acrylic appliances because they can inflame the mucosa (eg, Haas rapid palatal expander and Nance palatal button). Literature concerning association between placement of temporary anchorage device (Fig 1) or open/closed eruption of canine (Fig 2) to that of risk of endocarditis is dubious. Because clear aligner therapy is a minimally invasive, removable orthodontic treatment option, it can also be taken into consideration for this patient population. A recent randomised controlled trial found no difference in oral hygiene between transparent aligners and fixed orthodontic brackets, but no research have assessed the amounts of bacteremia that may be linked to this approach.With all orthodontic treatment methods, patients at risk for IE must have their oral hygiene strengthened.[31]

Fig 1: Patients at risk for IE must maintain excellent oral hygiene during treatment with fixed orthodontic appliances using TADs

(A)

(B)

Fig 2.A, it is controversial if there is an increased risk of bacteremia in the closed eruption technique related to the conduit along the length of the chain from the impacted tooth to the mucosal surface. **B,** In contrast, the open exposure approach involves uncovering the impacted tooth and leaving it exposed, thereby preventing the formation of a channel.

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Conclusion

Due to ethical concerns for performing prospective clinical trials, high-quality evidence about the connection between orthodontic operations and cardiovascular diseases like infective endocarditis is scarce. This now restricts the ability to undertake systematic reviews of the best available evidence in this field. Clinical interpretation based on a thorough analysis of the current literature is crucial up till such reviews are feasible. The AHA guidelines should be consulted before treating patients with cardiac problems with orthodontics since they are based on the best available data and are an accurate representation of the current standard of care. It is also crucial to speak with the patient's doctor or cardiologist. It is better to prevent elective operations that could cause bacteremia if possible, such as by switching to all-bonded brackets and tubes from bands. Additionally, the patient needs to be reminded to practice good oral hygiene because plaque buildup raises the risk of bacteremia. The removal of the orthodontic equipment can be considered if oral hygiene deteriorates during treatment and compliance with oral hygiene measures remains low.

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