

The Importance of Oral and Dental Health in Cardiovascular System Diseases

Kardiyovasküler Sistem Hastalıklarında Ağız ve Diş Sağlığının Önemi

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Özet

Günümüzde ağız ve diş sağlığının önemi, genel sağlık üzerindeki etkisi toplumun büyük kesiminin bildiği bir konudur. Dişlerin insan yaşamında, özellikle kaliteli bir hayat sürmek adına fonksiyon, fonasyon ve estetik açıdan çok büyük önemi vardır. Bu gerçeğe rağmen ülkemizde yetişkin nüfusunda yüksek oranda diş ve dişeti hastalıklarının bulunduğu, ağız hijyeninin yeterli olmadığı da maalesef gerçektir. Bireylerin kötü ağız hijyeni ve bunun doğal sonucu olarak meydana gelen periodontal hastalıkların kardiyovasküler hastalık riskini arttırdığı yönünde görüşler özellikle son yıllarda daha fazla taraftar bulmuştur. Bu konuda yapılan araştırma sayısının oldukça artması da bunu desteklemektedir.

Son yıllarda yapılan araştırmalar periodontitisin kardiyovasküler hastalıkların ilerlemesiyle ilişkili olabileceğini yönde sonuçlar ortaya koymuşlardır. Kardiyovasküler hastalıklar yirminci yüzyılın başlarından itibaren özellikle sanayileşmiş ülkelerde morbidite ve mortalitenin en önemli sebeplerindendir

Anahtar Kelimeler: Kardiyovasküler hastalık, Oral patoloji, Periodontitis

Abstract

Today, the importance of oral and dental health and their impact on general health are widely accepted facts known by the majority of society. Teeth have great importance in human life, especially in terms of function, phonation, and aesthetics in order to lead a quality life. However, there is still a high proportion of dental and gingival diseases and insufficient oral hygiene in adult population in Turkey. The view that poor oral hygiene and periodontal diseases increase the risk of cardiovascular disease has been gaining popularity in recent years. The increase in the number of research studies on this subject also supports this outcome.

Previous studies have demonstrated that periodontitis may be related to the progression of cardiovascular diseases. Cardiovascular diseases have been one of the most important causes of morbidity and mortality especially in industrialized countries since the beginning of the twentieth century.

Keywords: Cardiovascular disease, Oral pathology, Periodontitis

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INTRODUCTION

Similar to developed countries, modern medical applications have been transforming drastically from remedial medicine to preventive medicine in Turkey. The most concrete examples of this pleasing development in protective medicine appear in cardiovascular diseases. Today, almost all segments of society have established awareness of “protecting the heart”. Society has been informed about the things to be done and the measures to be taken in various ways. In this respect, one of the major factors affecting the cardiovascular health is oral and dental health. Cardiovascular diseases (CVD) which cover a wide spectrum and affecting the brain and other vital organs are the leading reasons of morbidity and mortality in the 20 th century in industrialized countries (1).

Today, the importance of oral and dental health and its impacts on the general health is an issue that is known to the majority of society. Teeth have a great importance in human life in terms of function, phonation, and aesthetics, especially in order to maintain a quality life. Despite this reality, there is a high rate of dental and gingival diseases in the adult population in Turkey and oral hygiene is largely inadequate. This can have multiple reasons. Dental and gingival diseases, especially periodontitis, is a bacterial infection that can affect other dynamics of the body as well as intraoral dynamics (**Figure 1a, Figure 1b**). Periodontal diseases are known as the most important cause of the loss of dental and supportive tissues in adults, and they affect 90% of the world population (2).

Cardiovascular diseases are the most important causes of morbidity and mortality in Turkey and even in developed countries, and unfortunately the number of deaths related to cardiovascular diseases has been increasing globally. The effects of chronic viral and bacterial infections, as well as environmental and genetic factors, should not be neglected in the etiology of cardiovascular diseases, which affect the brain and other vital organs (3,4).

Particularly in recent years, there has been more support for the view that poor oral hygiene, and thus periodontal diseases, increase the risk of cardiovascular disease. The increase in the number of research studies on this subject also supports this reasoning. Different studies in many different countries and regions have found that atherosclerosis and acute thromboembolic diseases are associated with chronic oral infections, especially periodontal diseases (5,6). In these studies, Gram-negative periodontal pathogens have been detected in atheroma plaques (4).

PERIODONTAL DISEASES- CARDIOVASCULAR DISEASES

General Overview

Periodontal disease is a very stubborn bacterial disease that negatively affects the hard and soft tissues around the teeth and causes the destruction of these tissues. The most important cause of tooth loss in adults is the destruction of these supporting tissues (7). The bacteria that cause periodontitis primarily are *Aggregatibacter actinomycetemcomitans* (Aa) and *Porphyromonas gingivalis* (Pg), which are called Gram (-) periodontal bacteria. In addition, the involvement of some other bacteria such as Gram (+) *Peptostreptococcus micros* and *Streptococcus intermedius* may cause a mix of chronic infection (8). These bacteria were also observed in plaque control in patients undergoing atherosclerosis. Many studies have shown that, on average, advanced periodontitis occurs in 10% of the adult population and 30% of those who are 50 years or older (9).

Atherosclerosis is a developing multifactorial disease, due to chronic inflammatory conditions. Cardiovascular Atherosclerosis, which is part of the disease, is the leading cause of deaths in developed countries and of deaths for almost half of Europe’s citizens (10). Recent studies have shown that periodontitis may be related to the progression of cardiovascular diseases. Based on their results, proteins and bacteria causing



Figure 1.a. Periodontitis clinical overview,



b. Healthy gum clinical overview

inflammation in the periodontal tissue mix into the system through blood circulation and cause various negative effects in the cardiovascular system. Another research showed that an increase in blood vessel thickening level is associated with the presence of bacteria causing periodontitis in the dental bacterial plaque (11). Therefore, the bacteria plaque accumulated on the teeth and gums endangers both oral-dental as well as the general health in individuals with a poor oral hygiene and who do not receive adequate dental care.

In a study conducted in Turkey, Cetinkaya et al. concluded that periodontal diseases play a significant role in the etiology of cardiovascular diseases (CVD). Acute-phase proteins, C-reactive protein (CRP), and fibrinogen, known as cardiovascular risk factors, have also been associated with inflammatory conditions such as periodontal diseases. In this study, it is considered that the increased CRP level is an important cardiovascular risk factor affecting the severity of the periodontal disease. In addition, no correlation was found between other risk factors, such as total cholesterol, triglyceride, LDL-cholesterol, HDL-cholesterol levels, and periodontitis (12). Another study examining acute phase proteins and other risk factors (such as age, smoking, diabetes, cholesterol, high body mass index, and low socioeconomic status) concluded that there was a strong correlation between CRP and fibrinogen levels and the severity of periodontal disease; however, its correlation with total cholesterol was weak. No relationship was reported with the other factors (13).

Cardiovascular diseases, the most common of which are coronary heart diseases and stroke (narrowing, blockage or hemorrhage of the cerebrovascular system), are the most important cause of morbidity and mortality since the early twentieth century, especially in industrialized countries (14). According to reports published by the World Health Organization (WHO), 20% of the world's mortality (which corresponds to approximately 14 million people) is caused by cardiovascular diseases. This ratio, which is mostly made up of adults, can reach up to 50% in developing countries (15).

Although common risk factors such as smoking, obesity, hypertension, and diabetes are known as the main causes of coronary artery deaths, these factors are not 100% responsible for all losses caused by cardiovascular diseases (16). It has been a research topic for many years that infectious diseases are also a risk factor in the etiology of CVD. Numerous studies have been conducted on this subject in the last 30 years and, as a general result, chronic infectious diseases have been found to be risk factors for atherogenesis and CVD (17).

THE EFFECT OF PERIODONTAL DISEASES ON CARDIOVASCULAR DISEASES

In many studies investigating the relationship between periodontal and cardiovascular diseases, it is reported that advanced periodontitis poses a very wide range (25%-90%) of CVD risk (18). Many publications, especially in recent years, directly or indirectly link the role of pathogen-related infections and inflammatory consequences associated with

periodontal diseases in the development of cardiovascular diseases (19).

The activation of a systemic inflammation is thought to be important for causes of increased risk of the rupture of atherosclerotic plaques and the start of acute coronary syndromes (10,20,21). A joint report was published in 2009 in the American Journal of Cardiology and Periodontology about relationships between periodontitis and atherosclerotic cardiovascular diseases. In this consensus report it is recommended that patients with moderate and severe periodontitis should be informed about the possible risks of cardiovascular diseases and those with multiple risks should be evaluated medically (22).

Cardiovascular diseases and periodontal diseases are reported to be commonly seen in middle-aged, low-educated men with an inadequate income, who are smokers, stressful, and therefore mostly isolated from social settings. These studies have shown that the prevalence of periodontal disease is high in patients with myocardial infarction. Another remarkable result is the prevalence of atherosclerosis in people with periodontitis. The association between periodontal diseases and CVD is estimated to be atherothrombogenesis, caused by increased cytokine, CRP, and fibrinogen levels (23). In a study by Mattila et al., in myocardial infarction patients and healthy control subjects, it was observed that caries, periodontitis, periapical lesion, and pericoronitis occurred substantially more in patients compared to controls. The same group of researchers continued to evaluate such patients over the years and concluded that poor oral health posed a risk factor for coronary artery problems, especially in terms of progression (24).

As a result of extensive reviews, The American Heart Association (AHA) has revealed that periodontal diseases are associated with atherosclerotic vascular diseases regardless of other factors and that this relationship is level A evidence. Recent publications have directly or indirectly associated the role of infection caused by periodontal pathogens and the inflammatory response that occurs due to these in the development of CVS (25).

THE EFFECT OF DENTAL CARIES ON CARDIOVASCULAR DISEASES

Although dental caries is an easily preventable disease, it is one of the most common chronic diseases in the world. The World Health Organization (WHO) World Oral Health reports highlight the impact of oral-dental health on general health and focused on studies and policies to improve it (26).

Untreated tooth decay in the initial stage causes pulpitis in time. Pulp and periodontal attachment are the two most important and necessary tissues for dental health in the oral cavity (**Figure 2**).

Lesions involving the alveolar bone and the periodontal ligament surrounding the root of the tooth comprise inflammation in the periodontium and pulp tissue (27). The causes

of inflammation of the pulp, other than caries, are the entry of bacteria and bacterial toxins into the pulp during a trauma or operative interventions. Physiopathologically these diseases are very similar to periodontitis. Eventually, they are all infectious diseases, caused by a microbial flora composed mainly of anaerobic Gram-negative bacteria, which are very similar with each other. Therefore, due to the similar physiopathological characteristics of periapical infections caused by tooth decay or trauma, it is considered that interactions in systemic diseases may be caused by periodontitis and similar diseases and biochemical parameters are evaluated (28).

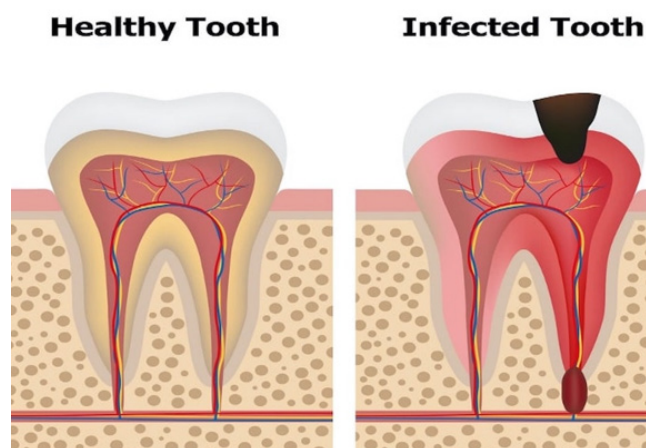


Figure 2. Schematic overview of healthy and diseased tooth

Bacteria present in the mouth may enter into the body through the circulatory system via various reasons, even during a slight chewing movement, and cause undesirable consequences, such as endotoxemia. The severity and prevalence of the condition may vary depending on the severity of the infection (29). There is also the possibility that bacteremia may occur during dental treatments and even when the person is brushing his/her teeth. This is directly proportional to the severity of the present oral pathology. Bacteria and bacterial products that spread into the body may play a role in triggering cardiovascular pathologies, such as hypercoagulability and atherosclerotic formation (30).

Numerous studies have shown that there is a strong inflammatory component in the process of atherosclerosis. Elevated levels of systemic inflammation are known to be a precursor for cardiovascular diseases. Systemic inflammation markers, such as CRP, are also high in individuals with periodontitis or other oral infectious diseases. Following the treatment of these diseases, the CRP level decreases to a normal level. Transient bacteremia and the infusion of bacterial products, such as lipopolysaccharide, into the circulatory system trigger a systemic inflammatory response. There are various mechanisms in the relationship between CVD and periodontal disease. Firstly, the direct effect of periodontal pathogenic microorganisms can be considered. These mic-

roorganisms were found to damage the endothelial cells by themselves and exacerbate platelet aggregation and thromboembolic events (31). Apart from this direct effect, the role of the common risk factors for CVD and periodontal disease can be considered. Acute-phase proteins, CRP and fibrinogen, are especially noteworthy in the relationship between these two diseases. Many different studies have shown that infection and inflammation caused by periodontal disease increase the risk of CVD (32). In a study in which other risk factors in cardiovascular diseases were controlled, a significant relationship was found between tooth brushing habit and CRP/fibrinogen level and CVD. It was also reported that patients with poor oral hygiene, which results in a high accumulation of calculus and bacterial plaque in the mouth, are twice as likely to develop CVD (33).

A comparative assessment of 63 studies investigating the relationship between periodontal and cardiovascular diseases revealed a strong relationship between the development of subclinical atherosclerosis and periodontal disease. Therefore, it is important to evaluate oral and dental health, especially in terms of periodontal disease, as well as general risk factors such as age, sex, and smoking in cardiovascular diseases. It has been observed that, in patients with periodontitis, a systemic immune response may be induced as a result of long-term chronic bacteremia (34). This outcome has increased the interest in the subject. The link between cardiovascular diseases and oral pathologies has continued to be examined. Studies conducted in more than 100.000 adult female and male patients in different groups in many different localities yielded results supporting the relationship between these two disease groups (35).

The European Periodontal Health and Cardiovascular Disease Consensus Report supports the view that oral and dental health is an important component in the prevention of CVD (36). The basis of the relationship between periodontitis and CVD has been shown to be systemic inflammation that initially begins as a local inflammatory attack (37).

RESULT

The importance of the relationship between cardiovascular disease and oral-dental health, more accurately oral infections, is increasing, especially because the incidence of these diseases is quite common in society. Especially periodontal and cardiovascular diseases are the most common diseases in adult individuals worldwide. Various studies have shown that patients with periodontitis have a higher risk for developing CVD than other individuals and that oral infections (such as periodontitis, acute pulpitis, and apical infections) may cause coronary disorders in predisposed individuals because systemic bacteremia and periodontal pathogens caused by periodontitis are considered to be biologically appropriate risk factors.

Of course, it is not possible to conclude from this information that cardiovascular diseases can be prevented only by treating or preventing periodontal diseases. It should be

noted that cardiologists and dentists should remind patients that these common diseases may be related. Maintaining oral and dental health in particular is quite simple, through daily maintenance, perhaps not lasting more than five minutes in total. Awareness should be raised by reminding society at every opportunity. By spreading the preventive medicine in all areas of health, many problems will be solved before they occur, especially when this consciousness is established from a young age. To this end, dentists, medical doctors, and all members of society should cooperate.

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REFERENCES

- Luepker RV. Cardiovascular disease: rise, fall, and future prospects. *Annu Rev Public Health* 2011;32:1-3.
- Philstrom B, Michalowicz BS, Johnson NW. Periodontal disease. *Lancet* 2005;366:1809-20.
- Lowe GDO. The relationship between infection, inflammation, and cardiovascular disease: An overview. *Ann Periodontol* 2001;6:1-8.
- Haraszthy VI, Zombon JJ, Trevisan M, Zeid M, Genco RJ. Identification of periodontal pathogens in atheromatous plaques. *J Periodontol* 2000;71:1554-1560
- Mattila KJ, Nieminen MS, Valtonen VV, Rasi VP, Kesäniemi YA, Syrjälä SL et al. Association between dental health and acute myocardial infarction. *BMJ* 1989;298:779-781.
- Mattila KJ, Valle MS, Nieminen MS, Valtonen VV, Hietaniemi KL. Dental infections and coronary atherosclerosis. *Atherosclerosis* 1993;103:205-211
- Özcan E, Atuğ Özcan SS. Periodontal Rejenerasyonda kök hücrenin yeri. *Atatürk Üniv. Diş Hek. Fak. Derg.* 2010;20(2):123-130.
- Dave S, Van Dyke T. Special review in periodontal Medicine. The link between periodontal disease and cardiovascular disease is probably inflammation. *Oral Disease* 2008;14:95-101.
- Socransky S, Haffajee A, Cugini M, Smith C, Kent R. Microbial complexes in subgingival plaque. *J Clin Periodontol* 1998;25:134-144.
- Kjellström B, Ryden L, Klinge B, Norhammar A. Periodontal disease-important to consider in cardiovascular disease prevention. *Expert Rev Cardiovasc Ther* 2016;14:987-989.
- Desvarieux M, Demmer RT, Rundek T, Boden-Albala B, Jacobs DR, Sacco RL et al. Periodontal microbiota and carotid intima-media thickness: the oral infections and vascular disease epidemiology study (INVEST). *Circulation* 2005 Feb 8;111(5):576-582
- Çetinkaya BÖ, Keleş GÇ, Köprülü D, Keskiner I, Yeşiladağ O, Açıkgöz G. Periodontal hastalığın Kardiyovasküler hastalık risk faktörleri ile ilişkisi. *19 Mayıs Üniv. Diş Hek Fak. Derg.* 2005;6(2):77-82.
- Wu T, Trevisan M, Genco RJ, Falkner KL, Dorn JP, Sempos CT. Examination of the relation between periodontal health status and cardiovascular risk factors: serum total and high density lipoprotein cholesterol, C-reactive protein, and plasma fibrinogen. *Am J Epidemiol* 2000;151:273-282
- Luepker RV. Cardiovascular disease: rise, fall, and future prospects. *Annu Rev Public Health* 2011;32:1-3.
- Nieto FJ. Infections and atherosclerosis: new clues from an old hypothesis? *Am J Epidemiol* 1998;148:937-948
- Dorn BR, Dunn WA, Proquleske-FoxA. Invasion of human coronary artery cells by periodontal pathogens. *Infect Immun* 1999;67:5792-5798.
- Persson GR, Persson RE. Cardiovascular disease and periodontitis: an update on the associations and risk. *J Clin Periodontol* 2008;35:362-379
- Janket S-J, Baird AE, Chuang SK, Jones JA. Meta-analysis of periodontal disease and risk of coronary heart disease and stroke. *Oral Surg. Med Oral Pathol Radiol Endod* 2003;95:559-569.
- Li C, Lv Z, Shi Z, Zhu Y, Wu Y, Li L et al. Periodontal therapy for the management of cardiovascular disease in patients with chronic periodontitis. *Cochrane Database Syst Rev* 2014 15; CD009197. doi:10.1002/14651858. CD009197.
- Nichols M, Townsend N, Scarborough P, Rayner M. Cardiovascular disease in Europe 2014:epidemiological update. *Eur Heart J* 2014;35:2950-959.
- Friedewald VE, Kornman KS, Beck JD et al. The American Journal of Cardiology and Journal of Periodontology Editors' Consensus: periodontitis and atherosclerotic cardiovascular disease. *Am J Cardiol* 2009;104(1):59-68.
- Schenkein HA, Loos BG. Inflammatory mechanism linking periodontal diseases to cardiovascular diseases. *J Clin Periodontol* 2013;40:51-69.
- Bahekar AA, Singh S, Saha S, Molnar J, Arora R. The prevalence and incidence of coronary heart disease is significantly increased in periodontitis: A meta-analysis. *Am Heart J* 2007;54:830-837.
- Schenkein HA, Loos BG. Inflammatory mechanism linking periodontal diseases to cardiovascular diseases. *J Clin Periodontol* 2013;40:51-69.
- Mattila KJ, Nieminen MS, Valtonen VV, Rasi VP, Kesäniemi YA, Syrjälä SL et al. Association between dental health and acute myocardial infarction. *BMJ* 1989;298:779-781
- Petersen PE. The World Oral Health Report 2003: continuous improvement of oral health in the 21st century-the approach of the WHO Global Oral Health Programme. *Community Dent Oral Epidemiol* 2003;31:3-24.
- Anand PS, Nandakumar K. Management of Periodontitis associated with endodontically involved teeth: a case series. *J Contemp Dent Pract.* 2005;15:118-129.
- Dülger O, Külekçi G. Apikal Periodontitis-Kardiyovasküler hastalık. *Ankem Derg.* 2011;25(Ek 2):66-69.
- Geerts SO, Nys M, De MP, Charpentier J, Albert A, Legrand V et al. Systemic release of endotoxins induced by gentle mastication: association with periodontitis severity. *J Periodontol* 2002;73:73-78
- Famer L, Larsen T, Kilian M, Holmstrup P. Incidence of bacteremia after chewing, tooth brushing and scaling in individuals with periodontal inflammation. *J Clin Periodontol* 2006;3:401-407.
- Herzberg MC, Meyer MW. Effects of oral flora on platelets: possible consequences in cardiovascular disease. *J Periodontol* 1996;67:1138-1142
- Beck J, Garcia R, Heiss G, Vokonas PS, Offenbacher S. Periodontal disease and cardiovascular disease. *J Periodontol* 1996;67:1123-1137

33. Oliveria C, Watt R, Hamer M. Tooth brushing, inflammation and risk of cardiovascular disease: results from scottish health survey. *British Medical Journal* 2010;340:1-6.
34. Batista R M, Zandonade E, Roelke L H. Association between periodontal disease and subclinical atherosclerosis: asystematic review. *Journal Vascular Brasileiro* 2011;10(3):229-238
35. Desvarieux M, Demmer RT, Rundek T, Boden-Albala B, Jacobs Jr DR, Papapanou PN et al. Relationship between periodontal disease, tooth loss, and carotid artery plaque: the oral infections and vascular disease epidemiology study (invest). *Stroke* 2003;34:2120-2125
36. Bouchard P, Boutouyrie P, D'Aiuto F. European workshop in periodontal health and cardiovascular disease consensus document. *European Heart Journal* 2010;Supplements 12(Supplement B):13-22.
37. Glurich I, Grossi S, Albini B, Ho A, Shah R, Zeid M et al. Systemic inflammation in cardiovascular and periodontal disease: comporative study. *Clinical Diagnostic Laboratory Immunology* 2002;9(2):425-432.