Journal of Advanced Zoology

ISSN: 0253-7214

*Volume **44** Issue **S-1 Year 2023** Page **1:8***

Periodontal Inflammation and Its Relationship with the Risk of Cardiovascular Diseases: Literature Review

Espinoza Guevara S[1], Guevara Jaramillo Y[2], Chicaiza Lagla A[3], Gabriela Vaca Altamirano[4]

[1]DeparUniversidad Regional Autónoma de los Andes, Matriz Ambato. Estudiante de la Carrera de Odontología
Email: oa.stefanooeg93@uniandes.edu.ec
ORCID ID: 0000-0002-7592-9717
[2]Universidad Regional Autónoma de los Andes, Matriz Ambato. Estudiante de la Carrera de Odontología
Email: oa.yulianadgj79@uniandes.edu.ec
ORCID ID: 0000-0002-0010-8412
[3]Universidad Regional Autónoma de los Andes, Matriz Ambato. Estudiante de la Carrera de Odontología
Email: oa.adrianaacl12@uniandes.edu.ec
ORCID ID: 0000-0002-7609-4619
[4]Universidad Regional Autónoma De los Andes ¨UNIANDES¨. Doctor en Ciencias Farmacéuticas y Biotecnológicas. Docente titular en la carrera de odontología, UNIANDES, Ambato, Ecuador
Email: ua.gabrielavaca@uniandes.edu.ec
ORCID ID: 0000-0003-4707-7147

**Corresponding author's E-mail: oa.stefanooeg93@uniandes.edu.ec*

Article History

Received: 06 May 2023
Revised: 06 Sept 2023
Accepted:09 Sept 2023

Abstract

For dental practice today, it has become important to emphasize the relevance of periodontal inflammation and oral microorganisms in the development and progression of atherosclerosis and cardiovascular diseases. Generally, the focus on PI as a causal factor of CVD is due to the great complexity and interaction that present the Gram-negative bacteria characteristic of chronic periodontal disease with the vast vascularization of the stomatognathic system. In many recent studies, researchers examined the association at the cellular and molecular level between periodontal and cardiovascular diseases. Although the specific causal correlation as a determining risk factor has not been established, it seems that periodontal disease is associated with several systemic diseases. In this connection, atherosclerosis is important in recent years. There is a possibility of an association documented in several field investigations, and this one refers to a systemic bacteremia caused by poor oral hygiene, which in turn can cause bacterial growth on the atherosclerotic plaques located in the coronary arteries, which possibly.

Keywords: *Periodontal Disease, Periodontal Inflation, Cardiovascular Disease*

1. Introduction

Diabetes Cardiovascular disease (CVD) comprises a wide range of disorders including diseases of the heart muscle and the vascular system that supplies the heart, brain and other vital organs, such as coronary heart disease and stroke, which are the leading causes of mortality worldwide, causing the death of 17.1 million people per year. There are a variety of risk factors involved in the pathogenesis of CVD, such as smoking, hypertension and hyperlipidemia. Numerous successful treatment modalities have been developed that are based on these etiologic or risk factors. However, in modern society, people are increasingly exposed to such factors, and the aforementioned therapies are still not enough, so the incidence of CVD increases year by year. (1)(2)

Recently, acute or chronic infections have been classified as an etiological factor in CVD; Infections that accelerate inflammation and promote thrombosis at the vascular level are believed to be a secondary pathogenic pathway. Among these infections, periodontitis might be the most common. It is defined as an infectious disease that causes inflammation within the supporting tissues of the dental organ, resulting in a progressive loss of insertion and alveolar bone. (3)

There are two reasons why periodontitis and CVD are thought to be related. First, systemic inflammation levels increase when there is moderate or severe periodontitis, and when treatment for this condition is initiated, there is a clear reduction in clinical signs, with decreased levels of systemic inflammatory mediators. The second reason is related to the complexity of periodontal bacteria, which can invade damaged periodontal tissue, enter the bloodstream and further disrupt the cardiovascular system. Various periodontal pathogens, such as *Porphyromonas gingivalis, Bacteroides forsythus, Prevotella intermediay Aggregatibacter actinomycetemcomitans* Have have been detected in carotid atheromas by polymerase chain reaction. Experimental studies have shown that the presence of these periodontal pathogens and oral bacteria in atheromas could induce platelet activation and aggregation through collagen-like cells. (4)

The objective of this literature review is to identify what are the mechanisms of action of the various periodontopathogenic microorganisms, present in the supporting tissues through which they create alterations at the periodontal level that lead to systemic conditions, focusing on cardiovascular diseases such as atherosclerosis, coronary heart disease, stroke and atrial fibrillation, and describe the ideal treatment for a heart disease patient in the dental office.

2. Materials And Methods

A ***Protocol:***

The protocol was designed according to Cochrane standards for systematic reviews. The search criteria met the guidelines Preferred Reporting Items for Systematic reviews and Meta-Analysis Protocols (PRISMA)

Inclusion and exclusion criteria:

In this study, the inclusion criteria are determined as studies published in the last 8 years, conducted on adults with periodontal conditions and their association in cardiovascular diseases, conducted worldwide, written in Spanish, English, French or Portuguese, correlating periodontal diseases with cardiovascular diseases, demonstrating the bacterial load of species in subgingival plaque samples, as well as research associated with subclinical thickening of the carotid intimal layer.

The exclusion criteria were: Studies older than 8 years, conducted on animals, without statistical analysis, in a language other than Spanish, English, French or Portuguese, as well as analytical research that does not associate periodontal inflammation with cardiovascular diseases.

Study Eligibility and Data Extraction:

Full texts of potentially relevant studies were screened to answer the research question. A matrix was generated for data extraction from selected studies. (Figure 1).

Search strategy

A bibliographic, documentary, exploratory and non-experimental, qualitative research was carried out through a search of articles in databases. We reviewed 172 scientific articles obtained by entering the terms "Periodontal Disease", "Cardiovascular Diseases" and "Periodontal Inflammation" in a span of

8 years, we searched the following databases from 2014 to March 14, 2022: 1) MEDLINE through PubMed, 2) Scielo 3) Elsevier through ScienceDirect 4) Cochrane.

Results

A total of 172 articles were reviewed, 131 studies were excluded based on the title, 15 based on the information found in the abstract and 15 after reading the articles in full text. Finally, 30 studies were included in the review. The flowchart can be seen in Figure 1.

3. Results and Discussion

The oral cavity being a large reservoir of bacterial colonies, is prone to bacteremia when the host's immune system is compromised, there is a wide variety of systemic pathogens that when encapsulated in the periodontal pocket can be exacerbated, the products of the same apart from affecting the periodontal support tissues are able to invade other systems through the bloodstream, compromising the cardiovascular system (5)(6).

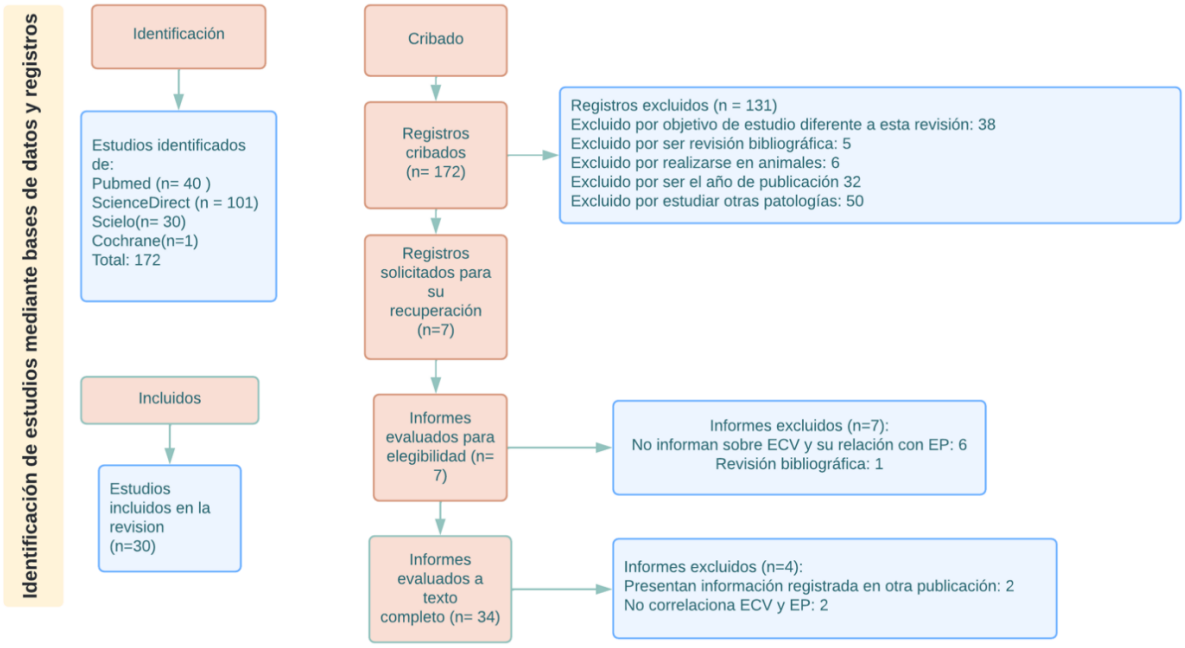

Figure 1. Flowchart of the present review. Own elaboration.

Specifically, chronic periodontal disease affects 20% to 50% of the world population, especially in unfavorable socioeconomic and demographic populations with limited access to health services, and in recent years a high and accelerated risk of cardiovascular diseases has been reported in patients who previously suffered from chronic periodontal disease, regardless of traditional risk factors such as obesity, hypertension. smoking and age, there is evidence of its association with cardiovascular disease, stroke, myocardial infarction (MI), atherosclerosis, acute coronary syndrome and atrial fibrillation. (6) (5)(7)

Periodontal microbiota involved in cardiovascular disease

Within the varied ecosystem of the oral cavity, microorganisms form the polymicrobial biofilm made up of several crowns, which typically sits on the dentinal surface and promotes inflammation of periodontal tissues, when there is a deficit in the quality of toothbrushing. At first the colonizers of the gingival sulcus are aerobic bacteria that are gradually relegated by facultative or strict anaerobic bacteria by 90%, while the gram-negative percentage rises to 75% like the spirochetes, within this large set of microorganisms those that are closely related to the processes of periodontal inflammation are: (8)(9) *Fusobacterium nucleatum*, *Campylobacter rectus*, *Prevotella intermedia*, *Tannerella forsythia*, *Aggregatibacter actinomycetemcomitans*, and , *Porphyromonas gingivalis* (10). The stomatognathic system for its anatomy and the nutrition of its structures, has an abundant vascularization and the epithelium of the groove is relatively fine and friable, this combined with the pro-inflammatory cytokines (TNF-α, IL-1β, IFN-y and PGE) that can reach high concentrations in the

periodontal tissue, making it susceptible to the spread of bacterial inflammatory products along with the inflammatory molecules of the periodontium and infiltrate the blood circulation. (11)(12)

Before the aggression of microorganisms acts a highly complex protection mechanism called inflammation, this mechanism is responsible for the identification, control, regulation and elimination of pathogens with the sole purpose of protecting the tissue even with risk of collateral damage. (6)

This is reflected in the mechanisms that use neutrophils and macrophages, on the one hand neutrophils are white blood cells that have the main function of phagocytizing extracellular pathogens, in a periodontal lesion, histopathology refers that neutrophils form a fence between the binding epithelium and the biofilm rich in pathogens, which acts as a solid antimicrobial structure and as a unified phagocytic mechanism, It is thus presented as a double-edged sword since overexcitation causes tissue damage, extension and compromise of the PID, the CD14 antigen acts as another defense mechanism specialized in the inflammatory response, but it is impaired in the presence of (13)*Porphyromonas gingivalis* which produces a proteolytic enzyme called gingipain, capable of producing proteolysis of the CD14 molecule and therefore the suppression of the immune system, as this molecule is a leukocyte receptor of lipopolysaccharides facilitating the colonization of the gingival sulcus. (14)

Atherosclerosis and Periodontal Disease

According to data collected by the World Health Organization, atherosclerosis is considered the largest epidemic in the world and it is currently estimated that periodontal disease is the main causative agent of this infection. Arteriosclerosis is caused by the involvement of endothelial cells, this type of cells fulfill functions such as secretion of molecules, control of vascular tone, hemeostasis, coagulation and inflammatory response, atherosclerosis involves the entry of bacteria of periodontal origin into the bloodstream, which helps the atheromatous process and disturbs the inflammatory process. (15)(16) (14)

The periodontopathogenic bacterial microbiota, mainly Gram-negative bacteria when passing into the bloodstream becomes a contingent thrombogenic agent, having the ability to adhere and aggregate platelets by molecular mimicry, this occurs in the union of own and foreign peptides to the body interacting with each other, resulting in the activation of T and B cells, which is also bound by mimicry of the binding sites to type I and III collagen. (14)

Inflammation is measured through C-reactive protein (CRP) that generates alterations at the systemic level, along with TNF α, IL-1, 6 and 8, the aforementioned are the markers that fluctuate with each other to generate atheromatous plaque and its subsequent rupture. (16)

Periodontal Disease and Coronary Heart Disease

Much that increasing the severity of periodontal disease carries a proportionately higher risk of coronary heart disease by about 24 to 35%. In addition, the relationship between periodontal disease and aortic vascular inflammation, which in turn is a substitute for coronary heart disease, has also been analyzed. (17) (18).

In a recent study, the relationship between periodontal involvement and coronary artery calcification was explored. The results revealed that periodontal involvement exhibits positive, linear correlation which is associated with the presence of coronary artery calcification. (19)

Periodontal Disease and Stroke

It was shown for the first time that periodontal disease was related to an increase in the thickness of the median intimal layer of the carotid artery in a cohort at high risk of atherosclerosis. In this regardd, some more studies showed that up to 31.3% of patients with periodontal disease have unilateral carotid calcifications that demonstrate an increase in subclinical carotid disease. On the other hand, some have reported different results. It was shown that periodontal disease is closely connected with higher levels of circulating CRP compared to controls and that the thickness of the middle intimate layer of the carotid artery is greater in patients with periodontal disease. In addition, the results of a case-control study reported a significant relationship between stroke and periodontal

index. In the same study, it was found out that chronic periodontitis is related to lacunar infarctions and linked to elevated CRP and TNF levels. (20) (21)

Periodontal Disease and Atrial Fibrillation

In numerous studies, inflammation plays potential role in the development of Atrial Fibrillation. It is associated with coagulation cascade disorders and the spread of thrombosis. Many patients with Periodontal Disease suffer from high systemic inflammation, as well as with an incidence rate of Atrial Fibrillation of 200 cases per hundred thousand inhabitants per year compared to 181 cases per hundred thousand inhabitants without Periodontal Disease. The effective atrial refractory period was shortened along with the increased progression of atrial fibrillation inductibility. (22)(23) (24)

Limitations and effects of the treatment of periodontal disease and cardiovascular disease.

Several research studies have been conducted to examine the association between periodontal disease and cardiovascular disease, Nonetheless, it is possible that the link is not causal. Some previous studies reported that at least part of the association between Periodontal Disease and Cardiovascular Disease is explained by the adjustment of traditional risk factors such as smoking, diabetes mellitus, age and socioeconomic conditions. In addition, periodontal therapy (scraping, root planing, antibiotic treatment) has been shown to reduce levels of pro-inflammatory markers (CRP, TNF-α and IL-6), further corroborating that periodontium is a source of these inflammatory mediators. On the contrary, this has not been demonstrated in a large randomized clinical trial. To date, there have been pilot case-study and randomized control, periodontitis and vascular event research, which compared single whole-mouth scaling and root planing with community-only care in 301 patients with stable cardiovascular disease for 6 to 25 months, presented results that were inconclusive and the study was underpowered. The association between periodontal disease and cardiovascular disease events was present but not significant. (25) (7) (26)(27)

Protocol

Daniel Quesada Chaves suggests how a patient with cardiovascular disease should be managed, which includes the following steps:(16)

1. Thorough examination of both extraoral and intraoral soft and hard tissues to rule out injury or infection.
2. Palpation of extraoral and intraoral tissues such as the palate, tongue and floor of the mouth.
3. General assessment of oral hygiene.
4. Individual examination of the teeth to determine their condition, vitality test, decayed pieces and repaired teeth.
5. Review all restorations and dentures.
6. Periodontal evaluation with exhaustive probing for the detection of a possible loss of insertion.
7. Radiographic evaluation to identify severe cases or possible complications such as abscesses in the oral cavity.

In this literature review, the importance of the link between periodontal inflammation and cardiovascular diseases was highlighted, since the periodontopathogenic microbiota, when passing into the bloodstream, is able to evade the patient's immune system, specifically neutrophils that sometimes are not able to recognize pathogens and specifically the main etiological agent of periodontitis, the *Porphyromonas gingivalis* which has a notorious thrombotic capacity. (28)

Cardiovascular and periodontal diseases despite presenting a cause-effect link presents certain factors that predispose an individual to suffer greater susceptibility to cardiovascular diseases, among which we find, obesity, hypertension, age and smoking habit being a latent factor within the majority of research examined, same factor that is predisposing to both cardiovascular and periodontal disease independently, and represents a link between both pathologies, influencing CVD in patients with PD.(29)

Although Vincent E. Friedewald states that periodontal disease has no relationship with CVD, while a positive relationship between both pathologies has been proven (35), for example Xiaoru Qin in his cohort study states that PD is modestly associated with the risk of cardiovascular diseases; In the same

study it is shown that this type of synergy between pathologies presents a predisposition for sex being the female gender predisposing to suffer myocardial infarction related to PD, Pazmiño VFC, proposes that this phenomenon presents its genesis in the hormonal changes suffered by women at certain stages of their lives combined with oral hygiene practiced. (30) (31)

Raydén states that scaling and root planing combined with antibiotic treatment is effective in treating patients with cardiovascular diseases who have periodontal conditions, and shows that it reduces the levels of (CRP, TNF-α and IL-6), on the other hand Liu W. states that treatment with scaling and root planing is completely effective in combating chronic periodontal disease in patients with CVD regardless of the use of antibiotics, Berth supports this conjecture, and states that periodontal treatment should be administered in several short sessions, and generalized treatment at the level of the entire alveolar ridge can be performed in a maximum period of 24 hours, But reiterates that this technique represents a period of widespread prolonged inflammation that could trigger an acute inflammatory response associated with a transient deterioration of endothelial function, Graziani endorses this therapeutic norm since it raises the question of whether performing longer sessions of periodontal treatment could contribute to an individual's inflammatory risk and increase their short-term risk of suffering from CVD. (25) (32)(33)(34)

Xiaoru Qin et al. affirms that despite the relevance that the subject has taken in recent years, it has several limitations to affirm whether PD has a direct relationship to CVD suffering, this due to the great heterogeneity of studies that exists presented a greater number of bibliographic reviews in relation to experimental studies, That is why it suggests the specific elaboration of a greater number of cohort studies to corroborate the direct interrelation between both pathologies. (30)

4. Conclusion

A positive association between periodontal disease and cardiovascular disease has been demonstrated, in which inflammation plays a fundamental role as a mediator. Although most of the previously evaluated studies provide important results in relation to CVD, such as myocardial infarction, heart failure, stroke or mortality related to cardiovascular diseases and PD, there is very limited evidence evaluating the impact of periodontal therapy in the prevention of cardiovascular disease, and it is insufficient to generate implications for practice. Further trials are needed before reliable conclusions can be drawn.

From our perspective, future research should focus on the use of technology that is at the forefront and provides comprehensive results such as technical imaging, such as positron emission tomography, nuclear magnetic resonance, echocardiography and coronary computed tomography to detect subclinical atherosclerosis and evaluate how it can be related to PD.

Since periodontitis is a chronic condition, a long-term approach, rather than a one-size-fits-all treatment, is likely needed to achieve sustained improvement in periodontal health. Whether treatment of periodontal disease reduces disease and cardiovascular events has not yet been established.

Randomised clinical trials involving standardised definitions of periodontal disease and standardised periodontal interventions are required to demonstrate that treatment of PD is beneficial for CVD risk reduction, with increasing research on the role of periodontal disease in CVD, periodontal disease may potentially become a CVD risk factor.

Conflict of interest:
The authors declare no conflict of interest.

References:

1. Muños Aguilar E, Jean S, Buti J, Czesnikiewicz-Guzik , Barbosa Ribeiro , Orlandi , et al. Periodontitis is associated with hypertension: a systematic review and meta-analysis. Cardiovascular Research. 2018 September; 116(1).
2. Caton JG AGBTCIJSKKea. New classification scheme for periodontal and peri-implant diseases and conditions – introduction and key changes from the 1999. Journal of Clinical Peridontology. 2018 Jun; 45(S20).

3. Martin-Cabezas R SNPCAKGSTHea. Association between periodontitis and arterial hypertension: a systematic review and meta-analysis. American Heart Journal. 2016 October; 180.
4. Fiorillo L CGLLea. Porphyromonas gingivalis, Periodontal and Systemic Implications: A Systematic Review. Dentistry Journal. 2019 December; 7(4).
5. Morón-Araújo. Periodontitis and its relationship with cardiovascular diseases. Promotion of cardiovascular health from the dental office. Rev. Colomb. Cardiol. 2021 Sep/Oct.; 28(5).
6. Ashraf Nazir. Prevalence of periodontal disease, its association with systemic diseases and prevention. International Journal of Health Sciences. 2017 Apr-Jun; 11(2).
7. Stewart, West. Increasing Evidence for an Association Between Periodontitis and Cardiovascular Disease. Ciculation. 2016 Jan; 2016(549-51).
8. Belibasakis GN, Charalampakis G, Bostanci N, Stadlinger B. Peri-Implant Infections of Oral Biofilm Etiology. Biofilm-based Healthcare-associated Infections. Advances in Experimental Medicine and Biology. 2014 October; Vol. 830.
9. Priyamvara A,DAK,BDea. Periodontal Inflammation and the Risk of Cardiovascular Disease. Coronary Heart Disease. 2020 June; 22(28).
10. Priyamvara A,DAK,BDea. Periodontal Inflammation and the Risk of Cardiovascular Disease. Springer Link. 2020 Jun; 23(28).
11. 11. Verma S, Lawrence AL, L.Bhatt. CANTOS Ushers in a New Calculus of Inflammasome Targeting for Vascular Protection—and Maybe More. Cell Metabolism. 2017 November; 26(5).
12. Sarduy Bermudez L GDMdlRSHMAD. Etiology and pathogenesis of chronic immuno-inflammatory periodontal disease. In: Compendium of Periodontology. Electronic Medical Journal. 2017 Jul-Aug; 39(4).
13. Hajishengallis G, Moutsopoulos NM, Hajishengallis , Chavakisd. Immune and regulatory functions of neutrophils in inflammatory bone loss. Seminars in Immunology. 2016 Apr; 28(2).
14. Orrego-Cardozo M, Parra-Gil , Salgado-Morales , Muñoz-Guarín , Fandiño-Henao. Porphyromonas gingivalis and systemic diseases. CES Dentistry. 2015 Jan/Jun; 28(1).
15. Boucourt Herrera , Rodriguez Hernandez , Boucourt Eagle. Periodontal disease as a risk factor for atherosclerosis. JOURNAL OF MEDICINE Isle of Youth. 2017 January; 18(1).
16. Quesada-Chaves. Relationship between periodontal disease and cardiovascular disease. The need for a management protocol. Costa Rican Journal of Cardiology. 2018 Dec; 2(20).
17. Nguyen TT NLPASRS. Promsudthi A, Surarit R. Salivary oxidative stress biomarkers in chronic periodontitis and acute coronary syn- drome. Clin Oral Investig. 2017 September; 21(7).
18. Amorina I, T. Osberne, Kholy KE, Takx RAP, Adcelrahman A, Yaun. Periodontal Disease Associates With Arterial Inflammation Via Potentiation of a Hematopoietic-Arterial Axis. JACC: Cardiovascular Imaging. 2019 November; 12(11).
19. Y. Leira ILDSAMRYRLTSFCMBJBJC. Chronic periodontitis is associated with lacunar infarct: a case-control study. European Journal of Neurology. 2016 July; 23(10).
20. Hernandez-Rios, Pussinen PJ, Vernal R, Hernandez. Oxidative Stress in the Local and Systemic Events of Apical Periodontitis. Front Physiol. 2017 Nov; 8.
21. Lavie CJ PALDAMSP. Obesity and atrial fibrillation prevalence, pathogenesis, and prognosis: effects of weight loss and exercise. Journal of the American College of Cardiology. 2017 October; 70(16).
22. Chen D-Y LCHCYMCHH. Risk of atrial fibril- tion or flutter associated with periodontitis: a nationwide, popula- tion-based, cohort study. PLoS One. 2016 October; 11(10).
23. Xu S SMXYLXHYQZ. The association between periodontal disease and the risk of myocardial infarction: a pooled analysis of observational studies. BMC Cardiovasc Disord. 2017 February; 17(1).
24. Liljestrand JM PSPMBKPGNMea. Immunologic burden links periodontitis to acute coronary syndrome. Atherosclerosis. 2018 January; 2018.

25. Rydén L BKEEdFUGAHJea. Periodontitis increases the risk of a first myocardial infarction. Journal of Vascular Surgery. 2017 Feb; 133(83).
26. Angelovich TA HAMAKTJA. Quantification of monocyte transmigration and foam cell formation from individuals with chronic inflammatory conditions. Journal of visualized experiments. 2017 October;(128).
27. and Berlin-Broner MFLL. Association between apical periodontitis and cardiovascular diseases: a systematic review of the literature. International Endodontic Journa. 2017 October; 50(9).
28. Sanz M, Castillo del AM, Jepsen, González-Juanatey J. Periodoncitis and cardiovascular diseases: Consensus report. Journal of Clinical Periodontology. 2020 February; 47(3).
29. Lavigne SE, Forrest JL. An umbrella review of systematic reviews of the evidence of a causal relationship between periodontal disease and cardiovascular diseases: Position paper from the Canadian Dental Hygienists Association. Canadian Journal of Dental Hygiene. 2020 February; 54(1).
30. Qin , Zhao , Guo. Periodontal disease and myocardial infarction risk: A meta-analysis of cohort studies. The American Journal of Emergency Medicine. 2021 October; 48.
31. Pazmino VFC ANPEDAJTLIdeelepRdlAPI. Influence of estrogen on periodontal disease. Literature review. Advances in Periodontics and Oral Implantology. 2015 August; 27(2).
32. Liu W, Yubin C, Ye Z, Wu, Ihezoro Z. Periodontal treatment for primary or secondary prevention of cardiovascular disease in patients with periodontitis. Cochrane Library. 2019 December;(12).
33. Bertl , Pallaku A, Pandis N, Buhlin K, Björn , Starvopulos. The effect of local and systemic statin use as an adjunct to non-surgical and surgical periodontal therapy—A systematic review and meta-analysis. Journal of Dentistry. 2017 December; 67.
34. Filippo G, Cei S, Gennai S, Gabriele M, Filice , Nisi M, et al. Acute-phase response following full-mouth versus quadrant non-surgical periodontal treatment: A randomized clinical tria. Journal of Clinical Periodontology. 2015 August; 42(9).
35. Friedewald V, Kornman K, Beck J, Genco R, Goldfine A, Libby P et al. The American Journal of Cardiology and Journal of Periodontology Editors' Consensus: Periodontitis and Atherosclerotic Cardiovascular Disease††Published simultaneously in the Journal of Periodontology, the Official Journal of the American Academy of Periodontology. The American Journal of Cardiology. 2009;104(1):59-68.