

The Relationship between Oral and Ocular Health: The Role of Periodontitis in Eye Related Conditions

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Abstract

Background: Periodontal disease is a chronic inflammatory disease that has been linked to a number of systemic diseases. Although, its effect on ocular health is still open for further considerations. The present study aims to explore the association between periodontal disease and health and ocular health in tertiary hospital setting.

Methods: An outpatient cross-sectional study was carried out on two hundred and fifty participants attending dental and ophthalmology clinics. Periodontal disease was evaluated using some clinical variables like probing pocket depth clinch and intraocular pressure alongside retinal examination for ocular health. The multivariate logistic regression was employed in examining the relationship between the two variables while controlling for other variables.

Result: The study demonstrated a significant relationship between moderate and severe periodontitis and an increased occurrence of glaucoma and diabetic retinopathy ($p < 0.05$). Other evidence suggest that individuals with extreme cases of periodontitis had increased levels of systemic inflammation which up-regulated the instances of ocular disease. The above findings provide an impression that particular types of ocular conditions may be attributed to individuals suffering from periodontal disease through normal circulation.

Conclusion: The present study emphasizes the link between diseases of the periodontium and the eye which necessitates an evidence of inter-disciplinary approach. More studies should be conducted to prove this assertion and also look at how changes in periodontal status affect ocular health.

Keywords: Periodontal disease, ocular health, systemic inflammation, glaucoma, diabetic retinopathy, oral-systemic connection

Introduction

A periodontal disease can be classified as a condition that is degenerative and leads to inflammation. It is estimated that it affects almost half of the adult global population and it also considered one of the major oral diseases (Eke et al., 2012). However, the disease only does not stay restricted, as studies have shown evidence that periodontal disease spreads to cardiovascular disease, diabetes and respiratory troubles Sanz et al., 2020.

Other than cardiovascular disease, there are other factors which contribute to the inflammation diseases, which include diabetes, and diabetic retinopathy. Some researchers believe there are links between eye

diseases, such as glaucoma and uveitis that potentially act as indicators for systemic inflammation (El-Asrar, 2012). Such diseases can further lead to the weakening of one's eyesight. Ocular or glaucoma for example, can potentially worsen due to conditions like the periodontal disease and its vice versa, as they are both interconnected.

The oral health-systemic health link has considered in some studies the connection between oral health and cardio-metabolic diseases, but there is very little research that examines teasing out its effects on ocular health. The goal of this study is to assess the possible association between periodontal condition and eye diseases, aiming to find out whether the prevalence of ocular condition is high in patients with periodontal disease and trying to provide plausible biological mechanisms that may link the two. Knowledge of this link can be of great importance in dental practice as well as in that of ophthalmology, integrating both disciplines in patient care.

Literature Review

Introduction to Periodontal Disease

The definition of periodontal disease is in accordance with the International Federation of Periodontology which states that it is a chronic inflammatory disease that affects the structures around the teeth that are the alveolar bone and the centers of the teeth. This disease develops from gingivitis, which is inflammation of the gums with no loss of bone, then phases out into periodontitis where there is destruction of the bone and the connective tissues around the teeth (Kinane et al., 2017). It has been known that periodontitis infection also has effects beyond the mouth as it has several negative impacts on the body as there are constant emissions of bacteria and several inflammatory chemicals from the blood infected periodontium into the blood standard (Preshaw et al., 2012).

Interrelationship with Periodontal Disease and Type II Diabetes Mellitus

The association of periodontal disease to overall systemic health has been investigated upon a lot. It is believed that the inflammation resulting from the periodontal tissues contributes in worsening the situation with systemic diseases such cardiovascular disease, diabetes mellitus, and respiratory diseases (Tonetti et al., 2007; Sanz et al., 2020). The past studies have shown that many people that have periodontal diseases tend to have high levels of C reactive protein and interleukin-6 (IL-6), all these biological markers have been related to many other diseases in the past (D'Aiuto et al., 2013).

Ocular Diseases and Systemic Inflammation

There are several eye diseases such as Glaucoma Uveitis and diabetic retinopathy, which are among the major international causes of blindness. There are a variety of systemic inflammatory ailments and this specific research reveals that ocular disorders have similar pathways with those systemic ailments (El-Asrar, 2012). It's noted that when systemic inflammation is high, the diabetic retinopathy condition worsens because the retina blood microvascular structures are destroyed (Tang & Kern, 2011). Moreover, the timely onset of systemic immunity is triggered by an inflammatory disorder of the eye called Uveitis as well (El-Asrar, 2012).

Oral-Inflammatory Pathways and Ocular Diseases

To reiterate the disease link, one can state the interrelationship between the severity of periodontal disease and ocular disorders at that point of systemic inflammation. The two components released during periodontal infections, IL-6 and TNF- α , have been demonstrated to spread throughout the body and reach remote sites, even the eyes (Preshaw et al., 2012). This pathway strongly connects inflammation present in

the periphery of the eye, which links these ocular diseases to inflammation of the periodontal region (Loos, 2005).

Common Risk Indicators for Ocular and Oral Diseases

An overlap of factors putting one at risk for both diseases of the mouth and the eyes also provides evidence for an association between the two body systems. The common risk factors for oral diseases such as periodontal conditions, as well as ocular diseases including, but not limited to glaucoma and diabetic eye disease include advancing age, smoking, diabetes and systemic hypertension (Genco & Borgnakke, 2013; Tham et al., 2014). As an illustration, it was found that persons with diabetes suffer from more severe forms of periodontitis and diabetic retinopathy, reinforcing this idea of an inter connection in people with multi-morbidities (Chapple & Genco, 2013).

Associations of Oral Conditions with Eye Diseases

While still scant, the growing body of literature hints at links between periodontal disease and the broader class of eye disease. Studies have indicated that people with a history of severe periodontitis have a significantly greater risk of suffering from other ocular diseases such as glaucoma and retinal vessel occlusion, as compared to a population without such history (Karesvuo et al., 2023). Furthermore, a correlation between gum problems and high intraocular eye pressure, a major risk of glaucoma was reported by Aroch et al. (2009).

Review of Literature and Research Trends Beyond 2023

While the evidence linking periodontal disease to systemic conditions continues to grow, the relationship between periodontal disease and eye diseases has received little emphasis. There is a need for more longitudinal studies of patients with periodontal inflammation to determine causality and the mechanisms that lead to ocular manifestations. Moreover, oral health and its potential impact on eye health is an aspect that clearly lacks awareness among health professionals today, which points out once more the importance of integrated patient care.

Methodology

Study Design

This study set out to establish possible association of periodontal health and the occurrence of conditions relating to both eye diseases and or vision impairment. The study took place at a Tertiary Hospital located in Riyadh, Saudi Arabia. Consent was received through the developmental process from the ethics committee and all patients were read explanations of the study and signed written forms of consent before taking part in the study.

Study Population and Sampling

The target population was the adult patients aged above 30 years who frequented dental and ophthalmology outpatients departments of the tertiary hospital during the time the study was being carried out. Out of the 250 patients targeted for the study, the researchers applied convenience sampling making sure that patients with various degrees of periodontal and eyes health got sufficient representation. The inclusion criteria are: (1) adults aged over 30 years regardless of gender, (2) patients diagnosed and or treated of certain chronic diseases such as hypertension but the control guidelines set standard risks are aimed to be delivered following their surgical procedures, (3) give patients with a plethora of eye conditions such as developing moderate to thick cataracts and or diabetic retinopathy and may also have middle to late stage glaucoma.

Patients on medications espouse, control ocular pressure but may have uncommon inflammatory conditions of the eyes, narrow angles and congestive attacks or arterial occlusions.

Data Collection Procedures

The participants were recruited from patients appearing for their routine dental or ophthalmology check-ups. The data was collected via clinical examinations, interviews with the patients along with a review of their medical history and records. The data was gathered by trained dental hygienists, ophthalmic technicians and research staff.

Periodontal Health Assessment

Standard clinical measures were employed in assessing periodontal health which included the following:

-Probing Pocket Depth (PPD): For each tooth, PPD was recorded on six sites with a calibrated periodontal probe. PPD greater than 4 mm suggested periodontitis.

-Clinical Attachment Level (CAL): This was determined in order to have an idea of the degree of periodontal support loss experienced.

-Bleeding on Probing (BOP): The presence of any BOP was assessed to be an indication of the inflammation.

To guarantee accuracy and uniformity of results the periodontal evaluations were done by licensed periodontists.

Ocular Health Assessment

Ophthalmologists performed ocular health assessments during the regular eye examinations. The following evaluations were carried out:

-Intraocular Pressure (IOP): The risk of glaucoma was assessed by determining IOP through Goldmann applanation tonometry.

-Retinal Examination: Fundus photography and optical coherence tomography (OCT) were performed to check for diabetic retinopathy and other for other signs and symptoms of retinal disease.

-Visual Field Test: We sought to assess peripheral vision loss in patients suffering from glaucoma using visual field test.

All the ocular evaluations were done by trained ophthalmologists without a priori knowledge of the periodontal status of the subjects.

Demographic and Medical Data

Age, gender, smoking history, and other demographic and medical data were recorded during patient interviews and electronic medical records review. Also, diabetic and hypertensive status was documented to adjust for potential confounding variables.

Data Analysis

The statistical analyses were and the familiar SPSS version 28. Descriptive statistics were computed regarding such demographic and clinical features of the participants. The chi-squared test of Pearsons was employed to study the association between the severity of periodontal diseases and the existence of certain eye problems. Multivariate logistic regression was deployed to control for possible confounders such as age, gender, and smoking and diabetes and evaluate the relationship of periodontal disease and vision conditions without other confounding factors.

Ethical Considerations

This research and information-gathering effort regarding ‘Long-Term Effects of Intermittent Fasting ’ received the approval of the Ethics Committee of the tertiary hospital. In writing, explicit consent was received from all of the participants after explaining thoroughly the potential benefits and the risks involved in the study. All the data were de-identified, which enabled the researchers to uphold participant confidentiality. The study protocol adhered to the edited principles of the Declaration of Helsinki.

Findings

Participant Characteristics

The study, which was focused on the health of participants, enrolled 250 participants with age average of 55.2 years (SD = 12.8). The gender, smoking status, and other systemic conditions were recorded as presented in Table 1. Out of the sample, there were 134 females (53.6%) and 116 males (46.4%), with 40.4% of the participants as being current smokers There were 37.2% of the sample who had a definite diagnosis of diabetes mellitus and 29.6% had hypertension.

Table 1: Demographic and Clinical Characteristics of Participants

Characteristic	Frequency (n = 250)	Percentage (%)
Gender		
- Male	116	46.4
- Female	134	53.6
Smoking Status		
- Current Smoker	101	40.4
- Non-Smoker	149	59.6
Diabetes Mellitus		
- Yes	93	37.2
- No	157	62.8
Hypertension		
- Yes	74	29.6
- No	176	70.4

Periodontal and Ocular Health Findings

Of the 250 participants, 170 participants (68%) had been diagnosed with periodontitis of various forms. Out of these, 55 participants with mild periodontitis were 32.4%, 60 participants (35.3%) had moderate, while 55 participants (32.4%) had severe form of periodontitis. Similarly, 112 participants (44.8%) had at least

one form of ocular disease primarily glaucoma (25.6%), diabetic retinopathy (12.8%) and uveitis (6.4%) among many others.

Table 2: Presence of Periodontal and Eye Diseases amongst the Study Population

Condition	Frequency (n = 250)	Percentage (%)
Periodontal Disease		
- Mild Periodontitis	55	22.0
- Moderate Periodontitis	60	24.0
- Severe Periodontitis	55	22.0
Ocular Diseases		
- Glaucoma	64	25.6
- Diabetic Retinopathy	32	12.8
- Uveitis	16	6.4

Periodontal Problems and Eye-related Disorders: Within the Zoom of Influence Interrelation/ Causation

According to the study, the two facets of health – periodontal and of the back of the eye, were interrelated. The study participants who had moderate and severe periodontitis had an increased occurrence of ocular diseases when compared to participants who in contrast were healthy or had mild periodontitis. ‘Such conditions are visible in the global occurrence of glaucoma and diabetic retinopathy and previous work outlined in the background.’

Table 3: The Correlation Between Ocular Conditions and Periodontal Disease Severity.

Ocular Condition	Periodontal Disease Severity	Percentage
Glaucoma	No Periodontitis (n = 80)	10 (12.5)
Diabetic Retinopathy	No Periodontitis (n = 80)	4 (5.0)
Uveitis	No Periodontitis (n = 80)	2 (2.5)
Glaucoma	Mild Periodontitis (n = 55)	12 (21.8)
Diabetic Retinopathy	Mild Periodontitis (n = 55)	6 (10.9)
Uveitis	Mild Periodontitis (n = 55)	4 (7.3)
Glaucoma	Moderate Periodontitis (n = 60)	18 (30.0)
Diabetic Retinopathy	Moderate Periodontitis (n = 60)	10 (16.7)
Uveitis	Moderate Periodontitis (n = 60)	5 (8.3)
Glaucoma	Severe Periodontitis (n = 55)	24 (43.6)
Diabetic Retinopathy	Severe Periodontitis (n = 55)	12 (21.8)
Uveitis	Severe Periodontitis (n = 55)	5 (9.1)

Over the evaluation period, participant data suggest that moderate to severe periodontitis was a consequence of ocular diseases with the multivariate logistic regression indicating that these factors do not disappear after adjusting for confounders which include age, gender, diabetes, and smoking status (adjusted OR = 2.43, 95% CI: 1.32–4.49, $p < 0.01$).

Relationship Between Inflammatory and Systemic Markers.

The best treatment for systemic inflammation in the study was C-reactive protein CRP and interleukin-6 IL-6. These treatments were applied to patients with severe periodontitis. Furthermore, these two putative markers exhibited a strong correlation to the presence of both glaucoma and diabetic retinopathy (adapter $p < 0.05$) in the presence of severe periodontitis.

Discussion

The aim of the current investigation was to establish the association between ocular diseases and periodontal health in a tertiary care setting. The results indicate a strong link of periodontal disease with the reported cases of glaucoma, diabetic retinal changes among other diseases despite controlling for age, smoking status, and diabetes. The above findings are in line with the established evidence linking systemic and oral health and add to the possibilities that the state of one's periodontal health is a determinant of ocular health outcomes as well.

Interpretation of Findings

Our study suggests that the presence of moderate or severe periodontitis increased the risk of diabetes mellitus and glaucoma. This indicates that inflammation of the periodontal tissues might be a risk factor or an aggravating condition to the ocular pathologies. Since there is a plausible connection that may well explain the linkage of the two where periodontal disease causes chronic periodontitis which increases levels of CRP and IL-6 thus causing systemic inflammation (Preshaw et al., 2012). Glaucoma and diabetic retinopathy are both characterized by pathology in the eye associated with increased levels of systemic inflammation that leads to vascular changes and micro vascular damage (Tang & Kern, 2011).

The outcomes portray a univariate risk trend, indicating that as the severity of ocular diseases increased, the stage of periodontitis also progressed. The evidence supports the existing literature that relates the development of severe periodontitis to systemic diseases such as cardiovascular diseases and diabetes among others, which are presumed to have potential complex inflammatory mechanisms associated with eye diseases (Tonetti et al., 2007; Sanz et al., 2020). It is possible that the alteration of the ocular tissues is the end result of prominent systemic inflammation induced by the translocation of periodontal bacteria into the bloodstream.

Comparison with Existing Literature

The connection of oral health and ocular health, especially in case of patients suffering from systemic ocular diseases gets support from the findings of this research. For example, Karesvuo et al. (2023) reported that patients suffering from periodontitis suffered from glaucoma more often in comparison to individuals not suffering from periodontal diseases. This study contributes to the findings reported by other researchers in that it evaluated the ocular health of diabetic patients and patients with ocular inflammation or uveitis but with varying periodontal disease severity levels. Our study corroborates the existing body of literature about the influence of oral cavity on eye diseases.

In addition, the study results build on the work of other scholars that have sought to address the common risk factors that may exist for oral and ocular diseases. Known risk factors for both periodontal and ocular diseases include diabetes, smoking, as well as systemic inflammation (Chapple & Genco, 2013). Our analysis showed that even when these factors were controlled, periodontitis still increased the risk of ocular diseases. This further suggests that there is more to preservation of the dentition in as far as its effect on health is concerned other than the confounding systemic factors.

Implications for Clinical Practice

In this regard, the study results reaffirm the need to adopt a more holistic approach to patient care, particularly for patients at the risk of developing both periodontal and ocular diseases. The clear and strong relationship noted between periodontal disease and that of the eye indicates the necessity of collaboration between ophthalmologists and dentists to screen patients for risk factors and to provide the necessary follow-up. Including the screening process for periodontal health, as part of the routine assessment, may assist in the identification of ocular disease patients, particularly those with glaucoma or diabetic retinopathy. This would help to identify patients who have a possible underlying systemic inflammatory condition and aid in the management of the patients.

Apart from that, these findings emphasize the significance of the patients in being educated on such good oral hygiene so as to avoid systematic and ocular health issues. Considering the massive evidence linking inflammation to disease progression, it is reasonable to hypothesize that strategies directed at ameliorating periodontal inflammation may have oral as well as ocular benefits.

Study Limitations

Many limitations need to be pointed out. Due to the cross-sectional approach of this study, causal inference was not possible. At the same time, it is worth noting that there is a significant relationship between periodontal health and eye health, although the direction of the relationship is questionable. There is a useful gap that needs to be filled and that is long term perspective studies to determine what affects what: is it periodontitis that brings about eye problems or the other way round? Further, the patient sample came from one tertiary referral centre and as such questions the extent to which the results can be extrapolated to the general population.

Further, these studies had the shortcoming of clinical evaluation of periodontal disease without the microbiological examination of pathogens responsible for specific periodontitis forms. Further studies may focus on the different species of bacteria and their effects on systemic disease and ocular disease.

Future Research Directions

Additional studies should seek out the causative pathways which may relate periodontitis to the eye. Such investigations will help elucidate causation, especially when cohort studies are employed. Moreover, looking at specific inflammatory markers and periodontal pathogens may assist in providing the biological basis for this association. Furthermore, research that assesses the impact of peri-odontic treatment on the course of disease processes in the eye, would give a much desired rationale for combined strategies aiming at the peri-odontic-ocular disease axis.

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