

From Mind to Mouth: Stress and Its Role on Periodontal Health

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ABSTRACT

Stress has been linked to the development of various inflammatory disorders, including periodontal disease. There is a direct link between stress and weakened immune function, which delays the healing of periodontitis. There is still a lack of understanding about the potential link between stress and an increased risk of periodontal disease. It has been found that people with periodontal disease have several stress markers in their blood and saliva, which affect the course of the disease by altering the inflammatory response and changing the composition of tooth biofilm, among other processes. The aim of this review is to provide insight into the relationship between psychological stress and periodontal diseases.

KEYWORDS: Stress, periodontal disease, cortisol, saliva

INTRODUCTION

The interaction of a sound mind with the enhancement of a healthy body has been recognized throughout most of recorded history from the time of ancient Romans, Greeks, and Chinese [1]. In 1976, Hans Selye defined stress as a response state of the organism to forces acting simultaneously on the body which if excessive, that is straining the capacity of adaptive processes beyond their limits, leading to disease exhaustion and death. In other words, it can be described as an organism's physiological reaction to a perceived challenge or threat [1,2].

Selye described "stressors" as forces that might compromise an organism's ability to adapt, and he claimed that stressors could be either physical or mental (e.g., emotional). He observed that stresses acting on the body might be positive (which he called "Eustress") or negative (which he classified "Distress")

Periodontal diseases are defined as inflammatory diseases caused by pathogenic microflora organized in biofilms surrounding the teeth resulting in the destruction of teeth-supporting tissues that can lead to tooth loss [3]. There are several factors such as age, tobacco use, systemic diseases, and psychological stress that have been identified as important risk factors for periodontitis.

De Marco (1976) [4] first used the term "Periodontal Emotional Stress Syndrome" for individuals exhibiting severe periodontitis who suffered emotional stress associated with active service in Vietnam suggesting a role of occupational stress in the development and progression of periodontitis.

The objective of this review is to provide insight into psychological stress pathways, how stress can influence the course and outcome of periodontal disease, and the significance of stress management in enhancing the effectiveness of treatment.

PATHOPHYSIOLOGY OF STRESS RESPONSE

Psychosocial stress can affect the periodontal tissues by directly influencing the biological mechanism and indirectly through the changes in lifestyle such as ignoring oral-hygiene measures, smoking more heavily, and consuming more fat and sugar in Diet [5].

Hence, there are two proposed mechanistic links: one biological and the other behavioural. The biological mechanism emphasizes how stress and depression can weaken immune system function and promote chronic inflammation. Whereas, in the physiological response to stress, the hypothalamus-pituitary-adrenal cortex (HPA) axis is stimulated that leads to the secretion of corticotropin-releasing factor and vasopressin from the anterior hypothalamus, which acts on the hypophysis. The pituitary gland, in turn, releases adrenocorticotrophic hormone, which acts on the adrenal cortex and increases the production and release of cortisol and glucocorticoid hormones [6].

Additionally, after periods of prolonged increase, cortisol loses its capacity to inhibit inflammatory responses initiated by immune reactions, which leads to chronic inflammatory destruction within the periodontium. The autonomic nervous system also becomes stimulated, causing the release of adrenaline from the adrenal medulla, which is induced by the release of several neuropeptides, including substance P from the sensory nerve fibres [7].

The behavioural mechanism emphasizes that individuals who are under stress and depression are likely to perform unhealthy behaviours such as smoking, drinking, eating poorly, and neglecting their oral hygiene. As a result, the oral biofilm load rises and the periodontium's resistance to inflammation decreases. It has been suggested that patients with periodontitis who have ineffective coping mechanisms for stressful situations (defensive coping) are more likely to develop severe periodontal infections [8].

STRESS AND ITS IMPACT ON PERIODONTIUM

The hypothesis that stress and periodontal disease are linked was suggested over 50 years ago and has now been confirmed by several studies. A first prospective longitudinal study for a year that investigated the association between stress and changes in periodontal condition, concluded that oral hygiene negligence was related to an increase in periodontal attachment loss. (Freeman et al., 1993) [9].

Physiological (alterations in saliva and gingival fluid circulation, hormonal imbalances, and altered immune responses) and psychosocial (oral hygiene, tobacco use, drug use, nutritional intake) factors can affect the periodontal status of a person with impaired immune function [10]. It has also been reported in several studies that both animals and humans who experience long-term physical or emotional stress are more vulnerable to systemic diseases and experience delayed wound healing [11]. A diminished immune response causes the release of local neuropeptides such as substance P and neurokinin A, which may provide a mechanism for neural modification of inflammatory changes and is due to the mediating effect of chronic stress on the periodontium [12,13].

Stress hormones have been shown to bring about a shift from T helper cell phenotypes to TH2 cell dominance, causing the progression of periodontitis. This shift is known to decrease collagen production from fibroblasts due to an increase in glucocorticoids and sulphated glycosaminoglycans. In cases of existing inflammation, these changes in hormone levels are enough to bring about the breakdown of

periodontal tissue. Thus, the progression of periodontitis can be attributed to the combined effects of stress hormones, glucocorticoids, and sulphated glycosaminoglycans on collagen production and tissue integrity [14].

STRESS AND PHYSIOLOGICAL CHANGES

Emotional distress or psychological stress may also produce changes in saliva pH and chemical composition like immunoglobulin (Ig)A secretion.[15]. The systemic and oral health status of an individual can be monitored using blood, saliva, and GCF [16]. Furthermore, a salivary analysis can be used to monitor stress by determining the presence of stress-related markers, in particular [17]. These markers have biological characteristics that determine the genesis and progression of periodontal diseases.

CORTISOL

The hormone cortisol, which is well known for its impact on stress, is present in the blood, the saliva, and the gingival crevicular fluid (GCF) [18,19]. In the blood, cortisol is mostly bound to the plasma protein corticotropin-binding globulin, transcortin, or albumin, and it also exists in the free bioactive form [20]. The salivary level of cortisol reliably reflects HPA axis activity and is used in human psychological studies as a biological marker of stress [21].

Cortisol acts as an anti-inflammatory and immunosuppressive hormone by preventing the growth of T lymphocytes and decreasing the activity of natural killer cells (NK) or macrophages [22,23]. In addition to these outcomes, it raises blood sugar levels and affects fat metabolism [24].

CATECHOLAMINES

Chemicals like catecholamines are crucial to relay signals from the CNS to the immune system[25].It has been shown that catecholamines affect a wide range of immune functions, including cell proliferation, , inhibition of pro-inflammatory cytokines such as interferon-gamma (IFN- α), interleukin-2 (IL-2), interleukin-6 (IL-6) as well as interleukin-12 (IL-12) and tumor necrosis factor-alpha (TNF- α)[26], suppression of lymphocyte proliferation, NK activity[27] antibody production, and cytolytic activity[28].

CHROMOGRANIN A

Chromogranin A is an acidic phosphorylated secretory glycoprotein that is stored and released by exocytosis with CAs from the adrenal medulla and sympathetic nerve endings as well as by serous and ductal cells of the human submandibular gland. As a result, Chromogranin A has the potential to function as an effective index of psychological stress [29].

NEUROPEPTIDES

The substance P plays a crucial role in initiating and maintaining inflammation, increasing pro-inflammatory cytokine production, and limiting the production of transforming growth factor-b (TGF-b) and interferon-gamma (IFN- α)-activated macrophages [30].

STRESS AND LOWERED HOST RESPONSE

Periodontal diseases are inflammatory diseases characterized by local and systemic elevations of pro-inflammatory cytokines, such as TNF- α , IL-6, and prostaglandins, and result in tissue destruction by the production of cytokines [31,32]. Psychosocial stress stimulates the brain where its stimulation or inhibition is dependent on adaptive and maladaptive coping respectively. Upon stimulation of the autonomic nervous system, prostaglandins and proteases are secreted, leading to periodontal disease progression.

Patients suffering from periodontitis who are under stressful conditions have increased levels of IL-6 [33] and IL-1b [34] in GCF, and similarly, patients with aggressive forms of periodontitis have elevated levels of IL-6 and IL-1b in serum.

STRESS AND BEHAVIOUR CHANGES

ORAL HYGIENE NEGLIGENCE

It is obvious that proper oral hygiene is partially dependent on the mental health status of the patient. Some patients may be psychologically disturbed or distracted, causing them to neglect their personal hygiene. Certain individuals may purposefully disregard their oral hygiene in order to satisfy their intense neurotic desire.

CHANGES IN DIETARY INTAKE

Psychological effects on food preferences, dietary consistency, and food consumption have an indirect impact on periodontal health. This may involve, for example, consuming excessive amounts of refined carbohydrates and eating softer diets that require less forceful chewing, predisposing to plaque buildup at the approximate risk site [35].

ORAL HABITS

Psychological disorders associated with stress can be expressed at the level of the oral sphere by the introduction of certain rare behaviors, which may include thumb-sucking and infantile swallowing. The act of biting the tongue, lips, cheeks, or objects (like a pen, etc.) occurs more frequently. Nail-biting, object-sucking, and tongue pressure on the teeth can also occur. When done repeatedly, these behaviors might result in dental migration and occlusal trauma, which can either induce or worsen periodontal disease.

SMOKING

Nicotine is a highly psychoactive tertiary amine. Chronic exposure of nicotine enhances the proliferation of nicotinic acetylcholine receptors on postsynaptic neurons as well as the release of dopamine into the central nervous system (CNS), neuronal cleft, and other sites. Repeated exposure causes CNS stimulation by nicotine gradually decrease, and more nicotine is required to prevent withdrawal symptoms. In addition to being a "risk factor" for other diseases, nicotine dependency is also a medical condition that must be treated.

ROLE OF STRESS IN PERIODONTAL DISEASE

STRESS AND GINGIVAL DISEASE-

Gingivitis is the organism's response to persistent microbial plaque and is characterized by a well-established inflammation affecting the superficial gingival connective tissue [36]. Stress lowers the

release of saliva and promotes the growth of dental plaque, which causes gingival irritation. In a study conducted by Deinzer, et al., on university students during their exam period, academic stress was found to be a risk factor for gingival inflammation, with rising levels of crevicular interleukin-1b and diminishing oral hygiene quality [37].

According to Cojen, et al., individuals with acute necrotizing ulcerative gingivitis (ANUG) exhibited depressed PMN chemotaxis and phagocytosis and reduced lymphocyte proliferation upon stimulation by a nonspecific mitogen. The study further suggested that stress may be responsible for the pathophysiology of ANUG by decreasing various host defense mechanisms [38].

STRESS AND PERIODONTAL DISEASE

Several cytokines, interleukins (IL-1b, IL-6, IL-8), and TNF-a are involved in the production of phagocytic cells, which are necessary for wound healing and regulating the development of fibroblasts and epithelial cells [39].

In a typical healing phase, cytokines, interleukins (IL-1b, IL-6, IL-8), and TNF-a production are considerably decreased. Because the production rate is high in a stressed patient with periodontitis, the severity of the periodontal damage increases [40]. In a case-control study, it was found that people with aggressive periodontitis were more likely to experience depression and social isolation than those with chronic periodontitis (Monteiro da Silva, 1996) [42].

RESPONSE TO PERIODONTAL TREATMENT

A study was carried out to assess the clinical and microbiological condition of patients with aggressive periodontitis who had received supportive periodontal care every 3 to 6 months for a period of 5 years after active periodontal treatment. The findings demonstrated the efficacy of supportive periodontal therapy, but some sites continued to progress, which can be attributed to the presence of factors like *Porphyromonas gingivalis*, *Treponema denticola*, total bacterial load, number of acute episodes, number of teeth lost, smoking, and stress that are responsible for the disease's progression (Kamma, et al., 2003) [43].

A study was conducted in which they examined patients exhibiting maladaptive coping mechanisms in response to non-surgical periodontal care, concluding that these patients had advanced periodontitis. Therefore, it was concluded that treating and maintaining patients with periodontal disease, maladaptive behaviors are of great importance (Wimmer, et al., 2005) [44].

MANAGEMENT OF STRESS

Coping against stress is the effort to try to reduce, control, or tolerate the state of stress. Successful coping occurs when the person can handle the stress and maintain control of the situation. When the individual is overwhelmed by stressors and reacting to stress, this is an unsatisfactory coping mechanism [45].

It is important to obtain a careful history to rule out any underlying stress-related or psychiatric disorders. A referral to a psychiatrist should be made before the patient commences dental treatment [46,47]. Four basic approaches to dealing with stress are removal or alteration of the source of stress, learning to change the way of perceiving stressful events, Reducing the effect of stress on the body, and learning alternative ways of coping—Proactive coping: Dealing with stress in advance. [48].

CONCLUSION

Stress plays a significant role in the development of periodontal disease and influences treatment outcomes. Dental practitioners may always refer patients to appropriate professionals for assistance and counseling. Therefore, identifying patients who are under chronic stress could lead to the development of specific multidisciplinary treatment plans for improving periodontal treatment outcomes and the long-term impacts of coping with stress factors.

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