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STRESS, HPA AXIS AND PERIODONTITIS : A LOGICAL LINK

DR. RYTHM BATRA [1] | DR. NEETIKA GUPTA [2] | DR. SHERRY VERMA [3] | DR.JAIPREET SINGH GILL [4] | DR. AMAN KHURANA [5]

[1] JUNIOR RESIDENT, I.T.S DENTAL COLLEGE, HOSPITAL & RESEARCH CENTRE.

[2] POSTGRADUATE STUDENT, DEPARTMENT OF PERIODONTICS, I.T.S DENTAL COLLEGE, HOSPITAL & RESEARCH CENTRE, GREATER NOIDA.

[3] JUNIOR RESIDENT, K.D.DENTAL COLLEGE, HOSPITAL & RESEARCH CENTRE, GREATER NOIDA.

[4] JUNIOR RESIDENT, I.T.S DENTAL COLLEGE, HOSPITAL & RESEARCH CENTRE, GREATER NOIDA.

[5] GRADUATE STUDENT, I.T.S DENTAL COLLEGE, HOSPITAL & RESEARCH CENTRE, GREATER NOIDA

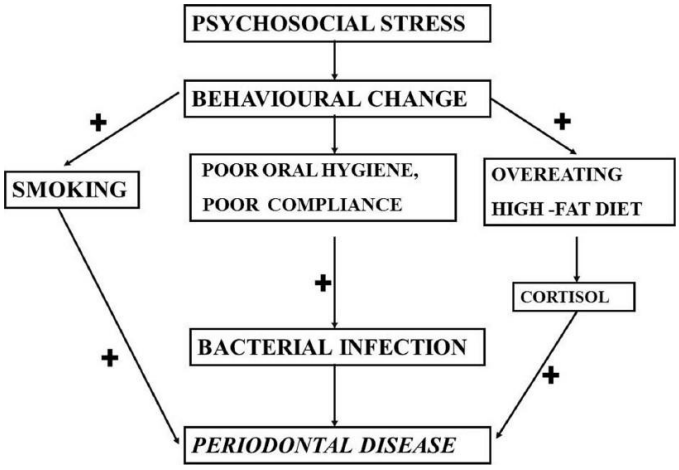
ABSTRACT:

Stress is a term that is commonly used today but has become increasingly difficult to define. It shares, to some extent, common meanings in both biological and psychological sciences. Stress typically describes a negative concept that can have an impact on one's mental and physical well-being, but it is unclear what exactly defines stress and whether or not stress is a cause, an effect, or the process connecting the two. An interrelationship between stress and periodontal disease has been suspected for centuries, but evidence to explain the connection has only elucidated in the past few decades. The purpose of this review article is to provide the progression of evidence present in the field of stress and periodontal disease for dental professionals so that they can better understand the link between stress and periodontal diseases.

KEYWORDS:

INTRODUCTION

The term "stress" originated from a Latin word "stringere," which means "tight strained. Stress is regarded as a cognitive perception of uncontrollability and/or unpredictability, i.e., Expressed in a physiological and behavioral response[1]



Coping-It is the response of the individual to stress (emotionally and physically). Emotional coping methods appears to render the host most susceptible to the destructive effects of periodontal disease than do the practical coping methods. Chronic stress and adequate coping could lead to changes in daily habits, such as: - poor oral hygiene ,clenching and grinding , decreased salivary flow ,suppressed immunity

According to Lumsden in 1975 the concept of stress was "one of the most significant and integrative concepts ever developed in social and biomedical sciences" and "its potential as a prime intellectual tool for not only understanding, but also explaining, individual and collective human behaviour and diseases".[2]

"**eustress**----Stressors that act to produce positive changes in the body (e.g., Exciting, pleasurable), leading to a response state

"distress."----Stressors could be negative that induce sensations that threaten homeostasis with pain, discomfort, and physical pathology

Holmes (1967) developed a scale to measure stress in terms of life changes. In this scale, the life events are ranked in order, from the most stressful to the least stressful. [3]

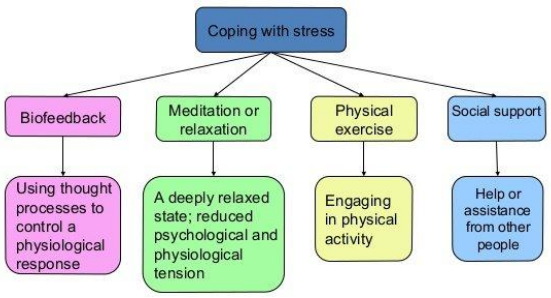
STRESS AND PERIODONTITIS

Although bacteria play an essential role, they seem to be insufficient to explain the occurrence or progression of the disease. 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 coined the term "Periodontal Emotional Stress Syndrome" suggested a role of occupational stress in the progression of periodontitis. Dean and Dean (1945) and Schluger (1949) were instrumental in suggesting that

psychological stress might play a role as an etiological agent of periodontal disease. Robert J. Genco - 1999 - Relationship of stress, distress and inadequate coping behaviours to periodontal disease. Suggested that psychosocial stress is a significant risk indicator for more severe periodontal disease , along with smoking and the presence of Tannerella forsythia and Porphyromonas gingivalis .

Table 1: Life change scale

Event	Score
Death of spouse	100
Divorce	73
Marital separation	65
Jail term	63
Death of close family member	63
Personal injury or illness	53
Marriage	50
Fired from job	47
Marital reconciliation	45
Retirement	45
Change in health of family member	44
Pregnancy	40
Sex difficulties	39
Gain of new family member	39
Business readjustment	39
Change in financial state	38
Death of close friend	37
Change to different line of work	36
Foreclosure of mortgage	30
Change in responsibilities at work	29
Son or daughter leaving home	29
Trouble with in-laws	29
Outstanding personal achievement	28
Wife begins or stops work	26
Begin or end school	26
Change in living conditions	25
Revision of personal habits	24
Trouble with boss	23
Change in residence	20
Change in school	20
Change in recreation	19
Change in church activities	19
Change in social activities	18
Change in sleeping habits	16
Change in eating habits	15
Vacation	13
Christmas	12
Minor legal violations	11



EFFECTS OF STRESS ON PERIODONTAL DISEASE-

- Endocrine Changes
- Gingival Circulation
- Alteration in Salivary Flow and Components
- Lowered Host Resistance

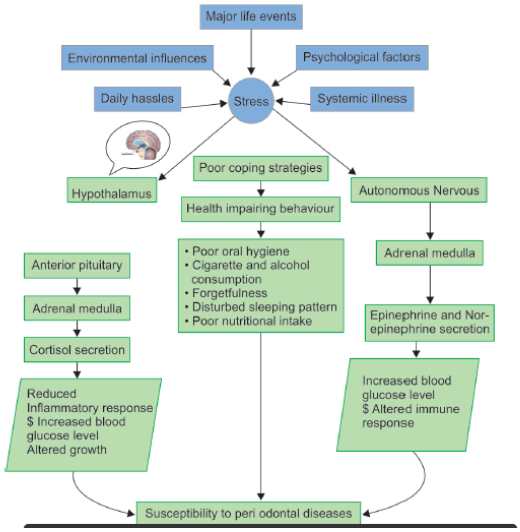
ENDOCRINE CHANGES

It has been suspected that periodontal status is related to alterations in the concentration of adrenal corticoids and by altering the responses of oral tissues to bacterial toxins and other hormones involved in the general adaptation syndrome.[4]

Potential role that psychosocial stressors may play in initiating a cascade of events in the corticotropin-releasing hormone/hypothalamic–pituitary–adrenal (HPA) axis, the autonomic nervous system, and the central nervous system, the physiological consequences of which are to depress immunity, enhancing the likelihood of infection and, specifically, periodontal disease.

Recent studies had confirmed the fact that the concentrations of cytokines [interleukin 6, IL-1β, etc., And cortisol in the gingival crevicular fluid (GCF) are higher in persons showing depression signs.High cortisol levels may be especially negative on periodontal tissue because of the extremely fast turnover of some periodontal components. Elevated levels of glucocorticoids can decrease *in vitro* fibroblasts, collagen production and *in vivo* sulphated glycosaminoglycans.

These alterations may be enough to cause imbalances in the synthesis and breakdown of periodontal tissues, especially if preexisting inflammation is present



GINGIVAL CIRCULATION

The tonus of the smooth muscle of blood vessels may be altered by the emotions by way of the autonomic nervous system. Furthermore, in long or continued emotions, a constant constriction of blood vessels could alter the supply of oxygen and nutrients to the tissues.[5]

ALTERATION IN SALIVARY FLOW AND COMPONENTS

It is assumed that both increase and decrease in salivary flow, induced by emotional disturbance, may affect the periodontium adversely. Emotional distress may also produce changes in saliva pH and chemical composition like immunoglobulin IgA secretion. These relationships between salivary physiology and psychological status do not necessarily demonstrate causation of periodontal disease, but they show a pathway in which periodontal health is influenced by salivary changes.[6]

LOWERED HOST RESISTANCE

Periodontal diseases are inflammatory diseases associated with local and systemic elevations of proinflammatory cytokines, such as tumor necrosis factor, IL-6, and prostaglandins and result in tissue destruction by the contribution of matrix metalloproteinases.Stress impairs the balance between proinflammatory and anti-inflammatory responses. The relationship between stress and periodontal diseases might be mediated by alterations in GCF IL-1, IL-6 levels, and reduction in polymorphonuclear leukocyte chemotaxis and phagocytosis, and reduced proliferation of lymphocytes.[7]

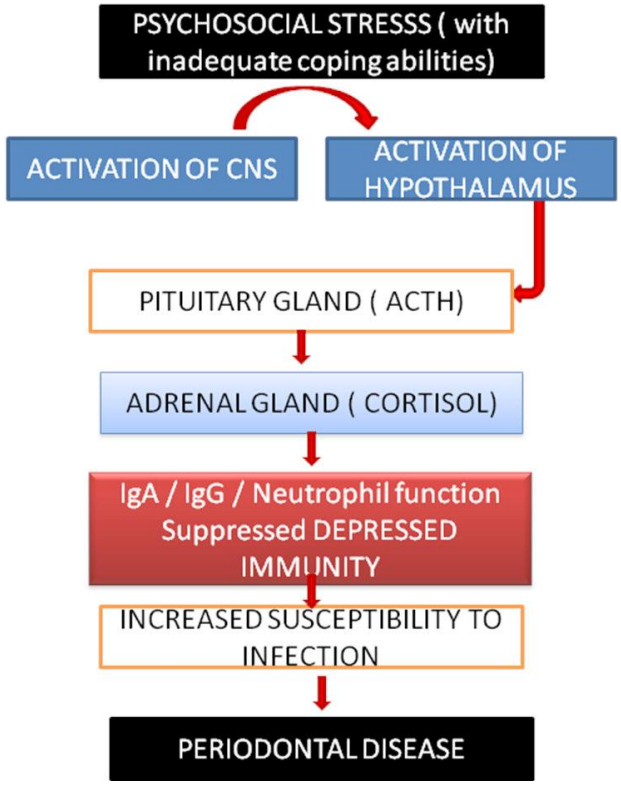
PSYCHOSOCIAL STRESS

Stimulates the brain where its stimulation or inhibition is dependent on adaptive and maladaptive coping respectively. On stimulation, the autonomic nervous system leads to prostaglandin and protease secretion that leads to periodontal disease progression.The HPA Leads to a production of glucocorticoids (cortisol) that depresses the immune system by diminishing the IgA and IgG secretions, thereby enhancing the periodontal disease progression and poor treatment response.

MECHANISM OF CORTISOL RELEASE UPON STRESS- HPA AXIS

Increase vulnerability of periodontal tissues to pathogenic microorganisms by activation of cellular responses leading to local tissue destruction. The **hypothalamic–pituitary–adrenal axis** (**HPA axis** or **HTPA axis**) is a complex set of direct influences and feedback interactions among three components: the hypothalamus, the pituitary gland (a pea-shaped structure located below the thalamus), and the adrenal (also called "suprarenal") glands (small, conical organs on top of the kidneys).[8]

Neurons in the paraventricular nucleus (PVN) of the hypothalamus release two neurohormones—CRF and arginine vasopressin (AVP)—into the blood vessels connecting the hypothalamus and the pituitary gland (i.e., hypophysial portal blood). Both hormones stimulate the anterior pituitary gland to produce and secrete adrenocorticotropic hormone (ACTH) into the general circulation. The ACTH, in turn, induces glucocorticoid synthesis and release from the adrenal glands, which are located atop the kidneys. The main glucocorticoid in humans is cortisol.[9]



STRESS AND BEHAVIOR CHANGES

1. Neglect of Oral Hygiene

Proper oral hygiene is partially dependent on the mental health status of the patient. It has been reported that psychological disturbances can lead patients to neglect oral hygiene and that the resultant accumulation of plaque is detrimental to periodontal tissue. Academic stress was reported as a risk factor for gingival inflammation with increasing crevicular interleukin 1 -beta levels and a diminution of quality of oral hygiene.[10]

2. Changes in Dietary Intake

Emotional conditions are thought to modify dietary intake, thus indirectly affecting periodontal status. Psychological factors affect the choice of foods, the physical consistency of the diet, and the quantities of food eaten. This can involve, for instance, the consumption of excessive quantities of refined carbohydrates and softer diets requiring less vigorous mastication and, therefore, predisposing to plaque accumulation at the approximal risk site.[11]

3. Smoking and Other Harmful Habits

Among the many harmful oral habits, which are believed to be induced by emotional disturbances, smoking is possibly the most important in relation to worsened periodontal conditions. circulating nicotine results in -

(I) vasoconstriction, produced by the release of adrenaline and noradrenaline, which is supposed to result in a lack of nutrients for the periodontal tissue

(ii) suppression of antibody responses

(Iii) inhibition of oral neutrophil function.[12]

4. Oral Habits

Neurotic needs find oral expression. The mouth may be used to obtain satisfaction, to express dependency or hostility, and to inflict or receive pain. Sucking, biting, sensing, and feeling may become habitual as in thumb sucking, tongue thrusting, infantile swallowing, and biting of tongue, lip, cheek, or fingernail. These actions also figure in bruxing, clenching, tooth doodling, and smoking. Such habits may lead to tooth migration, occlusal traumatism, and occlusal wear.

STRESS AND ACUTE NECROTIZING ULCERATIVE GINGIVITIS

Host tissue resistance may be changed by mechanisms acting through the autonomic nervous system and endocrine glands resulting in elevation of corticosteroid and catecholamine levels. [13]This may reduce gingival microcirculation and salivary flow and enhance nutrition of *Prevotella intermedia* , and at the same time also depress neutrophil and lymphocyte functions, which facilitate bacterial invasion and damage. Acute Necrotizing Ulcerative Gingivitis (ANUG) is the most studied periodontal disorder in relation to psychosocial predisposing factors.[14]

EFFECT OF STRESS ON WOUND HEALING

Stress releases highly active hormones like catecholamine, which results in altered blood flow, peripheral vasoconstriction may affect oxygen dependant healing mechanism which impairs wound healing. [15]

1. Hyperglycaemia which impairs neutrophil formation and thus impairs initial phase of wound healing.

2. Decreases level of growth factors which may down regulate tissue repair system.

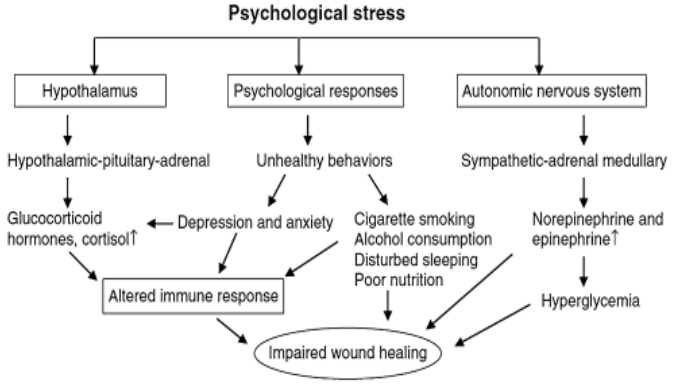
3. Alters cytokine profile that may affect recruitment of macrophages and fibroblast causes impaired wound remodeling.

4. Decreases the MMP level which impairs tissue turnover and causes decrease in wound healing

Table 2. Mechanisms by which stress may affect periodontal wound healing

Health-impairing behaviors	Pathophysiological effects
Poor oral hygiene Increased consumption of cigarettes Increased alcohol consumption Forgetfulness and difficulty concentrating Disturbed sleeping patterns Poor nutritional intake	Higher glucocorticoid levels (cortisol) and higher catecholamine levels (epinephrine and norepinephrine), which may lead to any or all of the following: Hyperglycemia, which may impair neutrophil function and impair the initial phase of wound healing Reduced levels of growth hormone, which may down-regulate the tissue repair response Altered cytokine profiles, which may affect recruitment of cells important to wound remodeling, such as macrophages and fibroblasts Reduced tissue matrix metalloproteinase levels, leading to impaired tissue turnover and reduced wound remodeling Decreased natural killer cell levels, reducing the host ability to mount an appropriate immune response to periodontal pathogens Altered Th1/Th2 ratio, leading to an increased susceptibility to periodontal disease

Th1, T helper 1 cell; Th2, T helper 2 cell.



CONCLUSION

Acute stress conditions are immune-enhancing, while chronic stress is immunosuppressive. Stress is associated with more severe periodontal disease as well as poorer healing responses to traditional periodontal therapy. Thus, stress should be assessed and managed properly, As it influences the periodontal tissue destruction, tissue healing, and periodontal therapy outcome. Stress can cause behaviour modification (e.g., Smoking, Alcohol abuse) and immunosuppressant effect (decreased Polymorph nuclear leukocytes, altered T helper 1 cell/T Helper 2 cell ratio), which may result in greater recurrence of periodontal disease. The role of the dentist is to discuss Lifestyle in a broader concept than just oral hygiene; They should be more psychologically oriented. It is very Important to understand the patient's situation to help them to maintain a healthy periodontium.

REFERENCES

1. Koolhaas JM, Bartolomucci A, Buwalda B, De Boer SF,Flügge G, Korte SM, Meerlo P, Murison R, Olivier B, Palanza P et al. Stress Revisited: A critical evaluation of the stress concept. Neurosci Biobehav Rev 2011 apr;35(5):1291-1301

2. Kaplan H.I. and Saddocks B.J., Comprehensive text book of Psychiatry, 9th ed., 15-56.

3. Holmes TH, Rahe RH. The social readjustment rating scale.J Psychosom Res 1967 Aug;11(2):213-218

4. Davis CH, Jenkins CD. Mental stress and oral disease. J Dent Res 1962 Sep-Oct;41:1045-1049.

5. Manhold JH, Doyle JL, Weisinger EH. Effects of social stress on oral and other bodily tissues. II. Results offering substance to a hypothesis for the mechanism of formation of periodontal pathology. J Periodontol 1971 Feb;42(2):109-111.

6. Gupta OP. Psychosomatic factors in periodontal disease. Dent Clin North Am 1966 Mar:11-19.

7. Sheiham A, Nicolau B. Evaluation of social and

psychological factors in periodontal disease. Periodontol 2000 2005;39:118-131.

8. Genco RJ, Ho AW, Kopman J, et al. Models to evaluate the role of stress in periodontal disease. Ann Periodontol 1998;3:288-302

9. Jaiswal GR, Jaiswal SG. Psychological stress. Its effect on periodontal status of individuals. J Ntr Univ Health Sci 2015;4:241-5.

10. Deinzer R, Granrath N, Spahl M, Linz S, Waschul B, Herforth A. Stress, oral health behaviour and clinical outcome. Br J Health Psychol 2005 May;10(Pt 2):269-283.

11. Suchday S, Kapur S, Ewart CK, Friedberg JP. Urban stress and health in developing countries: development and validation of a neighborhood stress index for India. Behav Med 2006 Fall;32(3):77-86.

12. Haber J. Smoking is a major risk factor for periodontitis. Curr Opin Periodontol 1994:12-18.

13. Reners M, Brecx M. Stress and periodontal disease. Int J Dent Hyg 2007 Nov;5(4):199-204

14. Breivik T, Thrane PS, Murison R, Gjermo P. Emotional stress effects on immunity, gingivitis and periodontitis. Eur J Oral Sci. 1996 Aug;104(4):327-34.

15. Boyapati L, Wang H L. The role of stress in periodontal disease and wound healing. Periodontol 2000. 2007;44:195-210