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Personalized Periodontics

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Abstract:- The introduction of personalized periodontics is an exciting step toward a medical paradigm of disease management, namely, the recognition of the individual as the fundamental component in the management of extremely complicated diseases. Tobacco, uncontrolled diabetes, obesity, cardiovascular disease, and stress must all be considered in a recreational approach for comprehensive periodontal disease therapy.

The many components of individualised periodontics are discussed in this review.

I. INTRODUCTION

Periodontal disorders are regarded to be complex diseases with varying treatment outcomes. While bacteria are the cause of periodontal disease, the individual's inflammatory response as well as other modifying and predisposing factors ultimately determine the clinical presentation and outcome. Disease progression is influenced by environmental and genetic factors that are unique to each person. When diagnosing, treating, and managing periodontal diseases, the individual's specific inflammatory response and associated regulating factors must be taken into account.

As a result, there is now a clear need to identify individuals with advanced and complex illness and find preventive or treatment measures that may be used to control the oral (and likely systemic) implications of periodontal diseases on an individual basis.

Personalized medicine is a medical approach that emphasizes tailoring oral healthcare decisions, practices, and/or products to the specific needs of each patient. [1] Predictive, personalized, preventative, and participative features are included in the 'P4 medicine' concept, which is an extension of personalized medicine. [2] The term 'P4 medicine' was coined by Leroy Hood [3] more than 5 years ago to describe a continuing shift in medicine from a reactive to a proactive discipline, with the ultimate goal of maximizing wellbeing for each individual rather than simply treating the disease.

- A **Predictive** strategy based on the use of high-tech diagnostic techniques will allow us to identify at-risk patients and diagnose periodontitis early, when it is simpler to treat successfully.
- It is a tailored **Prevention** based on a specific patient's genetic and microbiological status.
- **Personalized** treatment based on the patient's unique medical situation.
- The patient's active engagement will be highlighted with the introduction of **Participatory** periodontology, a concept in which networked individuals will take a leading role in their own health care.

Personalized periodontics is one part of the 4 P approach to treatment. Individual differences in genetic variables, circumstances, lifestyles, and behaviour are all taken into account in personalised periodontics. As a result, personalised periodontics is defined as the division of patients into distinct groups and the tailoring of clinical decisions, procedures, and/or products to each patient.

II. IDENTIFYING INDIVIDUAL RISK FOR PERIODONTITIS

To identify individual risk for periodontitis, a set of risk factors must be individually validated. Since there are multiple risk factors for a chronic disease like severe chronic periodontitis, a mechanism to stratify patients utilizing combinations of various risk factors must be used.[4]

- **Step 1: Identify probable periodontitis risk factors.** To find specific characteristics that are linked to patient differences in periodontal clinical indicators, progression or severity, treatment response, or systemic consequences of periodontitis**.**
- **Step 2: Putative risk factors must be clinically validated.**
- **Step 3: Clinical utility necessitates the use of risk variables to categorise people into groups in order to guide illness prevention and treatment.**

Predefined parameters that stratify every patient into well-defined categories that are mutually exclusive are the first step in individualising periodontitis risk and prevention and therapy.

III. RISK FACTORS AND INDIVIDUALIZED TREATMENT APPROACH

Tobacco use, uncontrolled diabetes, obesity, cardiovascular disease, and psychological stress are all presented in the context of how different lifestyles must be incorporated into a tailored periodontal disease management strategy.[5]

The knowledge of risk factors aids in the detection and treatment of periodontitis pathobiology, because risk varies widely from one person to the next. A patient-centered, individualised treatment plan is created and implemented.

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A. SMOKING

Tobacco use, in all forms, has a negative impact on both periodontal disease and peri-implant conditions, and is strongly linked to altered microbiology, host/inflammatory responses, and genetic traits that are unique to each tobacco-using patient.

a) Microbial considerations

Smokers showed a higher prevalence of dental plaque than non-smokers suggested that more severe periodontal disease in smokers might be because of greater accumulation of plaque.

In smokers, studies have shown significantly higher periodontal pathogen recovery rates [6],earlier establishment of periodontal pathogenic bacteria into the biofilm, less reduction in periodontal pathogens following scaling and root planing[7],diminished healing response to systemic antibiotic regimens [8], and a shorter rebound period to a pathogenic flora following resolution of gingival inflammation.Shifts in biofilm ecology toward a microbiota associated with periodontal health, were reported following successful smoking cessation.[9]

b) Host response considerations

Acute exposure to high concentrations of tobacco constituents during smoking and chronic exposure to compounds that persist in the tissues, saliva, and GCF at low concentrations following tobacco use significantly alter the interactions between the host response and the oral microbiota. [10]The major driving force in periodontal breakdown, is an imbalance between the protective and destructive/inflammatory functions of the host response.

The first host-response events occur in the periodontal pocket between the plaque biofilm and neutrophils that have migrated out of the tissue, aided by complement and antibody. These neutrophils migrate to the plaque biofilm and engulf the target bacteria.

The defensive capabilities of neutrophils, such as chemotaxis and phagocytosis, can be harmed by products found in cigarette smoke. Smoke also causes neutrophils to generate tissue-destructive chemicals such as superoxide and hydrogen peroxide.

The GCF of smokers with periodontitis has higher amounts of RANKL and lower levels of the bone-protective OPG. Nicotine can slow healing by diminishing fibroblast adhesion and lowering collagen synthesis, among other things.

c) Effects of Smoking on Response to Periodontal Therapy

After non-surgical periodontal therapy, which includes scaling and root planing as well as systemic or locally administered adjuvant metronidazole, the reduction in pocket depth is more successful in non-smokers than in smokers. In terms of vertical and horizontal attachment gain, smokers had a poorer healing outcome after surgery. The healing of a GTR-treated infra-bony defect is hampered by smoking. [11] In terms of pocket depth reduction and attachment level gains, smokers respond less favourably to flap debridement surgery.[12]

Changes with use of tobacco	Effects
Increased vasoconstriction	Paler tissue color
Decreased blood flow	Oxygen depletion
Thickened fibrotic consistency, minimal erythema relative to extent of disease	Compromised immune response
Fewer and impaired PMNs reduced IgG antibody	
Increased collagenase production	Gingival recession
Increased TNF-α, and PGE2 in GCF	
Decreased GCF flow	Increased inflammation
	Bleeding on probing
Reduction of bone mineral and impaired fibroblast formation	Increased tooth loss
	Greater probing depth, bone and attachment loss, furcation invasion
	Increased rate of periodontal destruction
	Increased colonization of shallow periodontal pockets by periodontal pathogens
Decreased lymphocyte proliferation	Impaired wound healing
Altered neutrophil chemotaxis, phagocytosis and oxidative burst	
Increased neutrophil collagenase and elastase in GCF	

- **Management**

There are a number of approaches that can be used to give individual advice to smokers. This can vary from ‘very brief advice', where attention is drawn to the smokers' habit, 'brief advice' including 5 step programme and is a more detailed advice such as that given by the specialist smoking cessation services.

Very brief advice

The goal of this advice is to call attention to smokers, their habits, and to provide guidance on how to quit smoking in under three minutes. Rather than increasing cessation rates, this advice's major effect would be to stimulate attempts to quit.

Brief advice

Brief advice for the patient to stop smoking may last for around l0 min.

A 5-step program recommended by the Agency for Health Care Research and Quality, which uses the five A's -

- Ask - Identify patients tobacco use status
- Advise - On association between oral disease and smoking and the benefits of quitting.
- Assess –Determine patient’s interest and willingness to participate in tobacco cessation programs
- Assist – Use right strategies to help patient quit smoking
- Arrange - Follow-up contacts with the patient

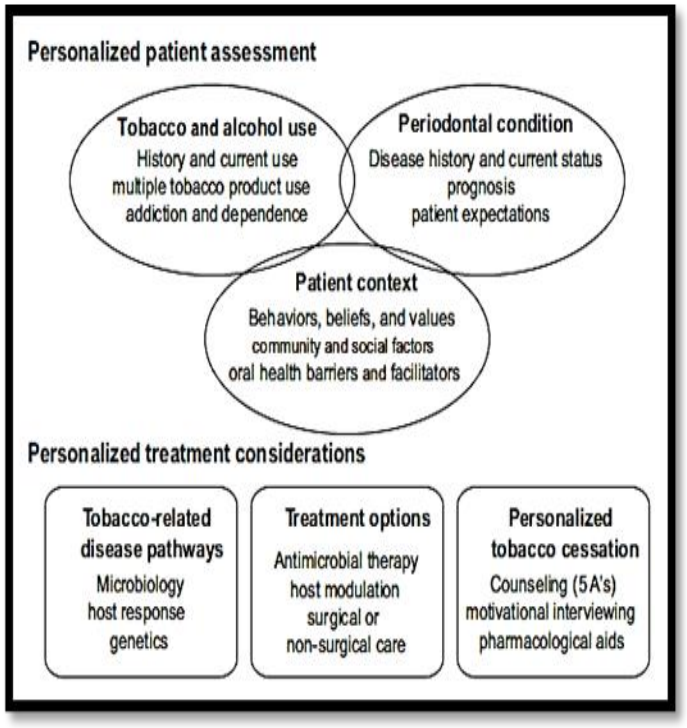

Fig. 1

B. DIABETES MELLITUS

Diabetes is one of the major risk factors for periodontitis. Individuals with diabetes are more likely to have periodontitis of increased severity when their diabetes is uncontrolled or poorly controlled. Periodontitis is now considered to be the 6th complication of diabetes.

Diabetes contributes to increased inflammation in the periodontal tissues, which increases the risk of periodontitis. For example, higher AGE accumulation in periodontal tissues is associated with diabetes, and interactions between AGEs and their receptor (RAGE, the AGE receptor located mostly on macrophages) result in activation of local immunological and inflammatory responses. Increased release of cytokines such IL-1, TNF-, and IL-6, increased oxidative stress, and disruption of the RANKL/OPG axis favour bone resorption as a result of these upregulated responses. All of these factors cause local tissue injury, accelerated breakdown of periodontal connective tissues, and alveolar bone resorption, resulting in periodontitis aggravation.

When looking at the relationship in the opposite direction, i.e., the impact of periodontitis on diabetes, the proposed mechanism is that periodontal bacteria and their products, along with inflammatory cytokines and other mediators produced locally in inflamed periodontal tissues, enter the circulation and contribute to upregulated systemic inflammation. This results in decreased insulin signalling and insulin resistance, resulting in diabetes aggravation. Increased HbA1c levels, in turn, increase the risk of diabetes complications (including periodontitis), producing a bidirectional, two-way link between the diseases.[14]

- **Management**

Periodontal health is harmed by poor glycemic control, and periodontitis can affect a diabetic's glycemic state.

If a patient is suspected of having undiagnosed diabetes, lab testing, including fasting blood glucose and random glucose, are performed. If a patient has diabetes, it is vital to determine the level of glycemic control before beginning periodontal treatment. Oral hygiene recommendations, mechanical debridement to eliminate local causes, and frequent maintenance should be given to diabetic individuals with periodontitis.

4%-6%	Normal
<7%	Good diabetes control
7%-8%	Moderate diabetes control
>8%	Action suggested to improve diabetes control

Fig. 2

The therapeutic goal for many patients is to achieve and maintain an HbA1c below 8%. Patients with relatively well-controlled diabetes (HbA1c < 8%) usually respond to therapy in a manner similar to nondiabetic individuals. Poorly controlled patients (HbA1c >10%) often have a poor response to treatment, with more postoperative complications and less favourable long-term results. Improvements in HBA1c values after periodontal therapy may provide an indication of the potential response.

Before undergoing surgical treatment, a HbA1c of less than 10% should be established whenever possible. Although recent research suggests that tetracycline antibiotics in combination with scaling and root planing may improve glycemic control, systemic antibiotics are not required routinely.

C. CARDIOVASCULAR DISEASES

There are four proposed mechanisms that suggest Periodontal disease is a risk factor for atherosclerosis. [15]

- The 1stis that periodontal pathogens or its components enter the bloodstream directly. Pathogenic bacteria in periodontal tissues, particularly Gram-negative bacteria (P. gingivalis), enter the bloodstream and cause bacteremia. LPS and other Gram-negative bacteria products cause systemic inflammation, which then acts directly or indirectly on the arterial walls, causing endothelial dysfunction.
- The 2nd is to induce systemic inflammatory response. Periodontal inflammation can increase the levels of cytokines in blood, including IL-1, IL-6, and TNF-a, and then lead to the production of intrahepatic inflammatory mediators such as CRP, which causes systemic inflammation, damage endothelial cells and lead to formation of arterial plaques.
- The 3rd is to trigger a systematic immunoreaction. Since heat shock proteins (HSP) of bacteria and humans are very similar in structure, the cross-reaction is easy to take place between HSP60 of *P. gingivalis* and humans.

The over-expression of HSP60 of *P. gingivalis* can result in the damage of endothelial cells and then promote cellular immunologic response of plaques which will induce inflammation of the plaques.

- The 4th is to influence lipid metabolism. The oxidation and aggregation of low-density lipoprotein cholesterin can be promoted by periodontal pathogenic bacteria (LDL-C).

Increased levels of inflammatory markers (such as CRP, IL-6, and TNF-a) in moderate to severe periodontal disease patients can promote endothelial cell destruction and worsen angiosclerosis, raising the risk of hypertension. Evidence suggested that the ROS might be an important contributor to both PD and hypertension because ROS produced by neutrophil infiltration participate in the destruction of periodontal tissues, and the imbalance of oxidation-antioxidation in oral cavity could negatively affect oxidative status in the whole body.

- **Management**

In collaboration with the patient and his physician, dental practitioners may be the first line of defence in the discovery and referral of a patient with cardiovascular illness, an uncontrolled disease status, or oral adverse drug reactions, and they play an important role in the prevention and treatment of oral and systemic disease.

The following basic suggestions assist medical and dental healthcare workers who work with individuals who have or are at risk of developing PD and CVD.[16]

Patients with moderate to severe PD should be informed that they may be at a higher risk of developing CVD than periodontally healthy adults, and PD patients who have one or more CVD risk factors should seek medical assessment if they have not done so in the previous year.

- Medical and dental experts should work collaboratively to control common risk factors for PD and CVD in patients with both of these disorders, such as hyperlipidemia, hypertension, smoking, and metabolic syndrome in PD patients.
- To manage plaque and gingivitis, standard treatment should be provided, as well as oral hygiene guidelines, such as the use of anti-plaque toothpaste, mouth rinse, and interproximal cleaning

D. OBESITY

The biologic processes behind the link between obesity and periodontitis are unknown, but adipose-derived cytokines and hormones play a vital role.

Obesity causes a 60% infiltration of macrophages in adipose tissue. Adipocytes secrete bioactive compounds termed adipokines, which operate as signalling molecules to the liver, muscle, and endothelium both locally and systemically.

Classic hormones (e.g., TNF-), hormone-like proteins (e.g., leptin, resistin), proteins involved in vascular hemostasis, and angiotensin play a variety of roles. These adipocytokines stimulate monocytes, causing them to produce more inflammatory cytokines, and hence play a key role in the onset of periodontal disease.

- **Management**

Dentists should be well-versed in metabolic syndrome and related disorders' indications, symptoms, and diagnostic tests. It's critical to develop protocols that help individuals with metabolic illnesses manage and avoid oral diseases on an individual basis. These must include more than just closely monitoring obese patients for periodontal disease burst. Changes in lifestyle, including but not limited to weight loss and food and dietary supplement intake, should be considered in protocols to assist diminish a hyper-responsive inflammatory trait. To better reduce periodontal inflammation, dentists should recommend overweight and obese periodontal patients for weight-loss interventions such as dietary therapy, behavioural therapy, medication, and surgical procedures.

E. *STRESS*

Chronic and repeated exposure to stressors have the same effect on periodontal tissues in as they do on other body systems.[17]

Stress pathways to periodontal disease

a) Stress and the immune system

Stress can affect the immune system in 3 different ways i.e., through the neural and endocrine systems: [18]

- Through the autonomic nervous system path ways
- Through the release of neuropeptides
- Through the release of hypothalamic and pituitary hormones.

b) Stress and behavioral changes

Health impairing behaviour and periodontal diseases:

- Neglected oral hygiene– increase plaque accumulation– gingival inflammation.
- Cigarette smoking- impairs collagen synthesis and increases MMP 8 level
- Alcohol consumption
- Disturbed sleeping pattern – decrease in growth hormone- impairs the tissue repair response.
- Poor nutritional intake can result in impaired wound healing.

- **Management**

The use of stress biomarkers offers a way to adapt periodontal treatment to individual patients based on more complicated and objective risk factors. This will improve treatment outcomes while also lowering periodontal treatment costs.

One of the most common ways to estimate physiological stress is to look at cortisol levels. Circulating levels of IL-6, TNF, CRP, and insulin-like growth factor are all extensively used indicators of chronic stress. [19]

The stress reduction protocol consists of techniques that, when applied alone or in combination, reduce the amount of

stress experienced by the patient during therapy, lowering the level of risk.

The Dental Office Stress Reduction Protocol includes the following steps:

- Recognize medical risk and worry.
- Seek medical advice.
- Medication in advance (Anti-anxiety or sedative-hypnotic drugs given one night before the appointment or one hour before appointment).
- Scheduling of appointments.
- Reduced anxiety by reducing the amount of time spent waiting.
- Monitoring vital signs: blood pressure, heart rate, rhythm, and respiration rate
- Sedation by means of psychotherapy.

IV. GENETIC BASIS OF PERIODONTITIS

Individual genetic diversity is responsible for a large portion of the variation seen in the development of periodontal diseases. [20]

Identification of probable genetic variations associated to various phenotypes and features of periodontitis, as well as identifying and devoting resources to individuals actually at risk of developing oral issues, rather than treating everyone as if they all have the same risk and disease experience. Family studies, twin studies, population studies, and single nucleotide polymorphisms have all been used to examine the genetic basis of periodontal disease. Periodontitis and IL-1 and TNF-alpha gene polymorphisms have been thoroughly examined, and a favourable association between periodontitis and these polymorphisms has been shown.

Epigenetics is the study of alterations in gene regulation not caused by changes in the DNA sequence. It is the link between environment and phenotype. Epigenetic modifications involve

- DNA methylation,
- Histone modification, and
- gene regulation by non-coding RNAs.

Epigenetic modifications lead to the activation and inactivation of a gene. Cancer and autoimmune or inflammatory illnesses, such as periodontitis, can arise as a result of these modifications [21].

Many environmental factors, including diet, smoking, inflammation, chemicals, medicines, and ageing, can impact gene regulation, resulting in epigenetic changes in the genome. Major factors for the development of periodontal disorders, as well as the link between genotype and phenotype, are host-microbial interactions and environmental factors.

Epigenetic modifications, unlike genetic mutations, can be reversed. Traditional medicines do not work for epigenetic modifications and the diseases they cause. Epi-drugs are medications that reverse epigenetic modifiactions. Personalized medicine can be defined as a treatment plan based on the interactions between genetics, clinical, and environmental factors that affect a person's health.

V. DISCUSSION

Through defining lifestyle, behavioral, and genetic factors, and how these interplay at the individual level to modify the clinical manifestation of the periodontal diseases, will become an intrinsic part of routine clinical practice. However, before this can happen, we must first define our diagnostic, therapeutic, and long-term management goals in terms of separate and measurable components, each of which may then be tailored to the individual rather than the population as a whole.

Individualizing periodontitis risk is a critical necessity for progress in the field of periodontitis. We have achieved significant advances in our understanding as a result of remarkable discoveries and efforts by investigators and physicians all around the world, but we now need to move beyond retrospective observations and associations.

The only way to move forward in a procedure that may differentiate the value of periodontal specialist treatment is to stratify patients in short-term challenge models and long-term intervention studies. To demonstrate usefulness in reducing local oral complications of periodontitis and assisting the management of chronic systemic diseases, we must identify complex situations that require alternative preventative and therapy procedures.

VI. CONCLUSION

Personalized periodontics has the potential to change the way we think about, research, and practise periodontology. Early breakthroughs in diagnostic and prognostic testing employing noninvasive samples such as saliva and gingival fluid have been encouraging. These could aid in determining who would develop periodontitis as a result of gingivitis. Periodontal health can be achieved simply by practising good daily plaque control and refraining from smoking, but high-cost, cutting-edge scientific breakthroughs in periodontics are critical. The most difficult task will be to turn breakthrough technology, such as personalized periodontics, into public-health-relevant services that are available to everyone.

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