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Review Article

Personalized Periodontal Treatment: A New Paradigm Shift

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Abstract

The goals of traditional periodontal therapy have been to eliminate deep pockets, gingival bleeding, and achieve precise plaque control, but this goal is rarely achieved. Personalized periodontics is aimed at real-time evaluation of disease activity and predicting therapeutic outcome and post-treatment stability. This review highlights the importance of personalized periodontal treatments, a tailored strategy for each patient with the help of developing high tech diagnostic tools.

Keywords: *Personalized Periodontal Treatment; Paradigm Shift*

Introduction

Dentistry has recorded splendid growth in the last decades. It is essential to introduce new concepts of personalized treatment to reevaluate the guidelines in dentistry. The goals of traditional periodontal therapy include eradication of deep pockets, gingival bleeding, and achieve plaque control. This goal is rarely achieved and indeed is fated to failure by misunderstanding the role of the individual and focusing solely on a "one size fits all" treatment model [1]. Periodontal treatments have become more focused and aim to reduce all undesirable clinical findings to as low a level as is possible. This is achieved by (i) treating the periodontal diseases as opportunistic infections modified by host inflammatory responses, (ii) controlling the inflammation and infection, (iii) reducing predisposing factors, (iv) controlling modifying factors and (v) providing continuous assessment and supportive periodontal care. Even this model suffers from being too broad-based and designed for the "average" patient. Although it is very successful for a few patients, for others, it is entirely unsatisfactory and does not produce the desired clinical outcomes of periodontal health [1].

The majority of oral diseases arise from a posh interaction of genetic, biological, behavioral, environmental, and various other factors. Because of differential expression and interaction of these factors, individuals differ in their susceptibility and expression of disease. Personalized medicine can be defined as a medical model that involves the customization of healthcare, which includes medical decisions and practices, and products being tailored to the individual patient need [2]. It enables the patients to receive the most effective and safe therapeutic agent as their first line of treatment, based on their biomarkers (immunological, genetic, or epigenetic). The benefit of such an approach could maximize clinical outcomes, cost-effectiveness, and patient satisfaction by accurately identifying a tailored strategy for each particular patient. A similar developing concept in periodontology is personalized periodontics, which is aimed at real-time evaluation of disease activity and predicting therapeutic outcome and post-treatment stability. Instead of using nonsurgical debridement as the first line of management, patients could have a chairside test to determine. It is a field fraught with costs, ethical and legal challenges and

potentially social issues, including insurance and data ownership. Personalized periodontics is still in its infancy, but its use is increasingly becoming realistic [1].

Contemporary periodontics

Periodontitis is a chronic and progressive inflammatory disease predominantly caused by the interaction of microorganisms and host immune response and is an important cause of tooth loss among adults. They are complex diseases of multifactorial origin and variable treatment outcomes [3]. It is the individual's host inflammatory response, and other superimposed modifying and predisposing factors that eventually determine the clinical presentation and outcome of the many and varied forms of periodontal disease [4]. Disease progression appears to be regulated by environmental and genetic factors specific to the individual. Thus, the practice of contemporary periodontics dictates that the unique inflammatory response and associated controlling factors of the patient must be considered when diagnosing, treating, and managing the periodontal diseases.

New and emerging technologies will allow the integration of biologic responses, and factors affecting their efficacy and magnitude will become central to the practice of personalized periodontics [5].

Clinical significance and personalized periodontal therapy

Every person shows a unique variation of the human genome. Personalized medicine can be predicted as a tailored therapy based on the interactions between genetic, clinical, and environmental factors affecting that individual. Recent advances in epigenomic approaches allow mapping of the methylation state in the genome, which may help in the identification of epigenetic biomarkers [6]. Individualized periodontal therapy is the upcoming concept of medical treatment for an improved clinical outcome. Genomic approaches link personalized medicine and epigenetics, enabling it to act as a useful tool [7]. Epigenetic alterations and their associated disorders cause the patient not to respond to routine therapies. In such cases, they are managed by personalized medicines that are derived from assessing the individual's genomic profile [8].

5PS for five diagnostic levels

In the future, periodontal diagnosis with traditional instruments will be combined with chairside diagnostic biomarkers for periodontal diseases, which are more efficient in the identification of periodontal diseases. The futuristic '5Ps' (predictive, preventive, personalized and participatory periodontology) focuses on the early integrated diagnosis and the active role of the patient in maintaining their health. High-tech diagnostic tools enable the clinician to detect the patients at risk and combined with early detection (a predictive approach), increases the success rate of the treatment. A combination of diagnostic imaging and periodontal charting enables the clinician to have thorough information on the patient's periodontal status and formulate further plans.

Diagnostic imaging

A high-resolution professional imaging device can be utilized to acquire full-mouth images (lingual, left lateral, right lateral, palatal and frontal sides) during the patient's initial visit. This, combined with a computer screen, enables the patient to view their dental and periodontal health status.

Full-mouth periapical X-rays

A valuable tool to support diagnosis in periodontal patients is a full-mouth X-ray series. They recreate a complete view of the patient's teeth and surrounding bone tissue. These x-rays, when combined to thorough periodontal charting calculations, will provide an accurate assessment of the bony defects, either 'angular' or 'horizontal'.

Periodontal charting

Periodontal charting helps to attain an overall picture of the complete periodontal health status of a patient. This includes halitosis, mobility, full-mouth plaque score, probing depth, recessions, full-mouth bleeding score, migration, clinical attachment level, and bleeding on probing [9].

The disadvantage of the tool mentioned above is that it provides only a prediction of the course of the disease and nothing about the origin of the disease. This also has led to a shift in the current reactive research perspectives to advanced predictive models [10].

HI-TECH diagnostic tools and specific biomarkers for the detection of early periodontal damage

Immunological, genetic, and microbiological advancements revealed the underlying processes in periodontal diseases. Rapid diagnostic tests in the form of Point-of-care (POC) testing provides instant results. They also include Chairside tests (CSTs) and can provide a rapid indication of the overall periodontal health of the patient. Development of CSTs for gingival crevicular fluid, saliva, bacteria sampling, and cells have been widely adopted and are being integrated into the routine practice by the periodontists as it helps in paving a new approach for diagnostic, monitoring, prognostic and management of periodontally compromised patients.

Five diagnostic levels

To attain a clear picture of the vulnerability of an individual to periodontal diseases and to categorize them based on the risk, five diagnostic levels were proposed.

First diagnostic level:

1. Identification of sub-clinical initial periodontal lesion.

2. Intercept 'active phase' of periodontitis: Lab-on-a-chip prototypes, gas chromatographs, and cone-beam computed tomography (future high-tech devices for routine clinical for diagnosing periodontal health).

Lab-on-a-chip: A lab-on-a-chip (LOC) is a tool integrating several laboratory functions on a one- millimeter sized chip and can affect fluid volumes which are even lesser than picolitres (microfluidics). The use of microfluidic devices has several significant advantages such as smaller sample requirements; reagents come with the chip and reduced reagent consumption that means an immediate indication of the periodontal health of a single patient to dental operators [11].

Gas chromatographs: Halitosis is a public concern and contemplates itself into a worldwide multi- million-dollar industry. It can occur either due to physiologic conditions or due to pathologic conditions. A significant component of exhaled air is sulfur and is used in the measurement of halitosis utilizing a device called as Halimeter [12]. However, it is limited to identify sulfur and does not measure other components that are involved (e.g. Volatile fatty acids), and this can lead to false-negative results due to the reduced levels of the sulfur compound. Oral Chroma™ (Abilit Corp., Osaka, Japan) is a portable gas chromatograph that has been introduced recently to detect volatile sulfur compounds.

Cone-beam computed tomography: CBCT uses a cone-shaped beam to acquire the entire image in a scan using only one rotation and obtain up to almost 600 separate images.

Second diagnostic level: Genetic susceptibility

The Fc-gamma receptor genes are responsible for the ethnic polymorphisms associated with both chronic and aggressive periodontitis. Kornman., *et al*. described a two polymorphic loci composite genotype - interleukin-1A (later outdated by interleukin-1A G-T dimor-

phism) and interleukin-1B - single nucleotides with C-T transition. Later studies found that both interleukin-1A and interleukin-1B are in a state of linkage disequilibrium and the Interleukin 1A single nucleotide polymorphism exhibiting the same genetic information [13].

Third diagnostic level: Bacterial infection

By utilizing anaerobic culture test, all cultivable microbial species in the sub-gingival sample can be detected along with other pathogens and their proportions. It also allows the concurrent antimicrobial susceptibility test for periodontal pathogens. A DNA-based chair-side test (PCR) can be done if the bacterial samples are non-viable for culture and sensitivity test and also has the added benefit of not being time-sensitive.

Fourth and fifth diagnostic levels: Tissue breakdown products and host response factors

Oral fluid (whole saliva) as a diagnostic tool

Oral fluids are non-invasive to collect with easy access and acceptance by the patient and are constituted by gingival crevicular fluid (GCF) and glandular-duct saliva. GCF is collected from the gingival sulcus and acts as a non-invasive and versatile means to sample the biomarkers of inflammation and bone resorption intraorally. The GCF exudates are usually mixed with local physiologic and pathologic phenomena that help it to act a significant role in the periodontal health assessment. Glandular-duct saliva is collected from salivary gland ducts with specific collectors and is majorly constituted by secretory IgA [14].

Salivary biomarkers for periodontal disease

Over 65 GCF components with salivary proteins have been scrutinized to determine whether they will act as possible markers to determine periodontal disease progression. The components which were examined can be broadly classified belonging to inflammatory mediators, host response modifiers, host-derived enzymes and their inhibitors and tissue breakdown products. The development in the field of microfluidics and its sub-branches has influenced the development of this diagnostic periodontology and predicts the treatment prognosis [14].

Incorporating a personalized approach to tobacco cessation

Studies reveal that tobacco cessation interventions by dental professionals helped tobacco users to quit the utilization of cigarettes and smokeless tobacco [15]. A personalized dentistry approach is more straightforward than a “one-size-fits-all” approach when considering the broad range of attitudes, behaviors, and level of dependence of individual patients. The dentist must be able to guide a patient to the awareness that their tobacco habit is the most important preventable risk factor for developing systemic and oral disease, including periodontitis and oral cancer (Figure 1 and 2) [15,16].

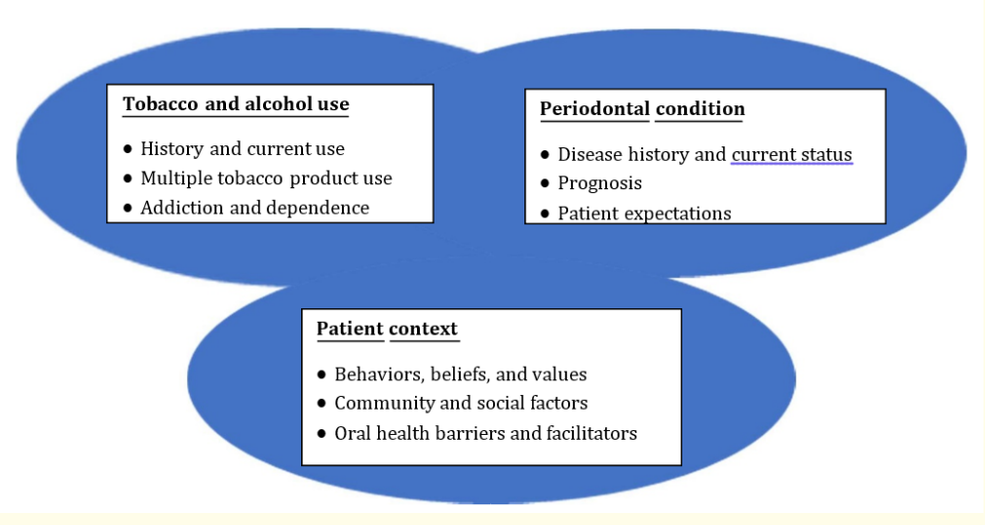

Figure 1: *Personalized patient assessment [17].*

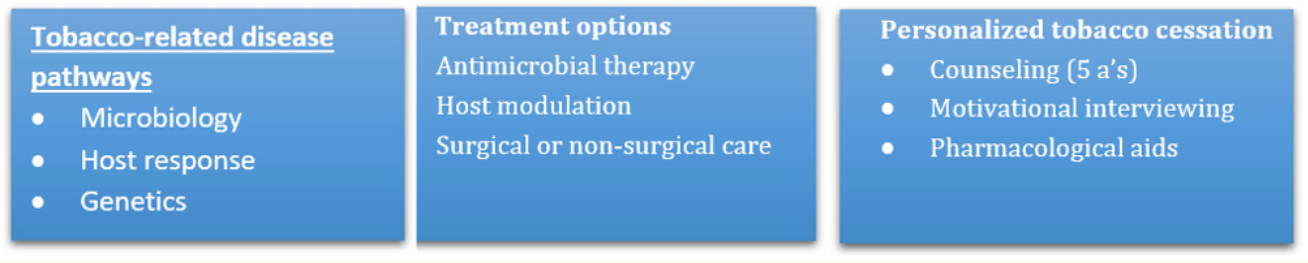

Figure 2: *Personalized treatment considerations [18].*

Treatment options

- Antimicrobial therapy
- Host modulation
- Surgical or non-surgical care.

Personalized tobacco cessation

- Counseling (5 a's)
- Motivational interviewing
- Pharmacological aids.

Conclusion

Personalized periodontics could reform the way that we understand, research, and practice periodontology. There have been hopeful early developments in diagnostic and prognostic tests using noninvasive samples, such as saliva and gingival fluid. The rise of personalized periodontics offers a stimulating move toward a medical model of disease management, explicitly recognizing the individual as the central component to what are very complex diseases. Before this becomes a reality, a considerable amount of work needs to be undertaken to refine our diagnostic, treatment and long-term management goals in terms of definable and measurable components, each of which can then be tailored to fit the individual and not the population at large.

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