

**Personalized Periodontal Care: An Exploration of Its Reality**

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**Abstract**

Periodontal diseases have always been highly specific whether it is in terms of microbiological profile, host response, genetic make-up or environmental factors. The susceptibility of one individual differs constitutionally with any other. However, the current diagnosis and treatment is done as per same objectives for all. This does manage the disease but complete eradication requires an understanding and implementation at the individual level. The developing technology allows for tailored made approaches identify and stratify patients according to their susceptibility as well as prognosis. The use of tools such omics technology, artificial intelligence and targeted

therapy with risk assessment can be employed to optimize the patient care and avoid unnecessary exposure to the treatment which may have little or no effect but are practiced routinely. The present review tries to debunk the concept of personalized periodontics and assess if this is the future of periodontal care.

**Keywords:** Personalized periodontics, precision periodontics, periodontal genes, biomarkers, omics

**Introduction**

“Eyes can’t see what the mind doesn’t know.” This saying goes well when everything which is to know is visible however, in the field of medicine there is an always something which is obscuring, hidden or even

confounding. The answers usually lie in these covert and cryptic signals and messages which the body tries to express. If only a clinician can decode these messages, a breakthrough in diagnosis, treatment planning and its implementation will occur. This personalized approach is gaining popularity in all fields of health care, periodontology is no exception.

Periodontitis affects a major portion of the world's population. Indian population has shown a prevalence of 51% as evidenced in a meta-analysis.<sup>1</sup> These statistics are concerning and intriguing at the same time for oral health practitioners. This urges to do things differently in the field of periodontal care so as to achieve a reduction in disease count and attain holistic health. Periodontal diseases are complex multifactorial in nature. The diagnosis is challenging while aetiology is ambiguous. An approach which increases the understanding of the diagnosis as well as the prognosis will dictate the therapeutic course. The four P concept (Predictive, Prevention, Personalized, Participatory) which has been proven beneficial in precision medicine can work wonders if correctly applied and properly executed.<sup>2</sup>

#### **Precision or personalized: What are we aiming?**

The terms Precision and personalized have become synonymous. Precision medicine aims to meticulously assess the underlying pathologies and deliver the specific treatment.<sup>3</sup> Personalized or Precision both work on the tailored made approach based on deep understanding of the individual's genetic and environmental factors and delivering the specific treatment to combat the disease process.<sup>4</sup> The efficiency of any proposed modality is calculated on the fact how the general population is perceiving it rather than the individual. This is the very basis of Personalized approach.<sup>5</sup>

There has been proposed models in the past which has highlighted the importance of specific responses from the

bacteria and host explaining their effect on the pathophysiology of periodontal diseases. This marks the foundation of the fact not everyone will have the same course of the disease and hence a unique assessment for each patient in spite of having similar conditions has to be done in order to achieve a disease-free life. The road map to this will go through a number of steps which will include at the individual level, the molecular level and the clinical level. There has been research which are trying to comprehend this by studying genetics, epigenetics, the omics including the proteomics as well as biomarkers but these could only conclude if a thorough risk assessment of the patient is done. A correct diagnosis, prognosis and treatment planning is what we should aim for.<sup>6</sup>

#### **Risk Assessment: Insights to specific biology**

Risk assessment involves evaluating patients and determining the factors, markers as well as predictors of periodontal diseases. It is an excellent method to segregate the high risk and low risk patients.<sup>[7]</sup> As personalized periodontics includes the tailor-made approach, the more knowledge of patients' response and underlying pathology, the better it would be to act specifically. Periodontitis as substantiated by plethora of literature have shown systemic connections, genetic linking as well correlation with lifestyle changes. The role of stress in pathophysiology of periodontal diseases is yet another aspect. All these has to be considered if personalized periodontitis is to be practiced. At present the risk assessment charts or scales are not strictly followed. It may be due to cumbersome process or lack of time and efforts. We, therefore propose for a handy method to assess the profoundness of the underlying and often neglected links of the periodontal pathology. Another advantage would be to get a clear picture as every patient will have a different response to the same

treatment for the same pathology. Although, exact physiology can only be assessed with more specific procedure such as genetic studies and omics but an initial examination and diagnosis is absolutely necessary. Thus, risk assessment can provide an insight for any therapeutic procedure.<sup>8</sup>

### **The Roadmap**

At present the contemporary practice has a definite workflow which has been practiced by the clinicians. Below is the flowchart depicting the steps followed in planning of periodontal treatment.<sup>2</sup>

1. Patient with symptoms + clinician with formal training
2. Interaction with patient and clinician
3. Detailed history, clinical and radiographic examination, assessment of blood samples
4. Diagnosis
5. Treatment planning and delivery
6. Supportive periodontal therapy

These primary steps are followed for every patient. If personalized practice needs to be done, upgradation and specificity in these steps are required. Below are the proposed advancements which can be followed to achieve the goal of personalized periodontics.

### **Personalized Diagnosis and its importance**

The current classification has divided the periodontal diseases based on clinical attachment loss keeping in consideration the systemic and environmental factors.<sup>9</sup> This furthers the need for accurate diagnosis where factors influencing and regulating homeostasis of the body can be expressed. There had been suggestion from the literature which has changed the emphasis on proven facts to newer discoveries. The emergence of key stone pathogenesis highlighting the changes of periodontal flora composition in disease mechanism rather than role of specific periopathogen, has shown why diagnosis at

individual level is necessary.<sup>10</sup> In the studies done by Hajishengalis et al, they have shown how inflammatory component of host defence such as interleukin and tumor necrosis factors affect pathogenesis and virulence of microbes. They also indicated that the immunological dysbiosis of the host may alter the course of periodontal diseases. Furthermore, the interaction between dysbiotic biofilms, dysbiotic microbiome and dysregulated inflammation are required to cause periodontal disease.<sup>[11]</sup> Thus, the comprehensive host biology has to be contemplated in order to achieve the precision. Then again, the use of ultrasensitive machinery is difficult in day-to-day practice. The machine learning or artificial intelligence are available but they are either too costly or not easily accessible at every dental clinic. This is another drawback which may hamper the “perfect diagnosis.” Relying on the routine measures with certain chairside kits to rule out the basics seems to be better option at present.

### **Mystery of OMICS**

The OMICS are study of genome, proteomes and metabolomes collectively. They are referred to as genomics, proteomics or metabolomics respectively. They assimilate the biological molecules, characterize them; understand the structure and functioning of the organisms as well as the hosts.<sup>12</sup> Saliva is the choice of sample in this. The obvious facts of easy availability and non-invasiveness makes it a perfect study material. The research in this field is extensive. If employed in terms of periodontal diseases and treatment modalities, there is a good chance to characterize the disease progression to bring it to a halt preventing recurrence.<sup>13</sup> The study of omics is still in infancy and a long way has to be covered before it can be applied in routine clinical practice.

### **Favouritism of biomarkers**

Biomarkers are the representative of underlying pathological activity which is happening. They are valuable indicators of the disease and healthy conditions. By definition they are the objective measure of normal biologic process, pathogenicity, pharmacological responses as well as effect of treatment.<sup>[14]</sup> They have been the favourites as they reveal the actual in vivo conditions since they are quantifiable. Throughout the periodontal literature, numerous studies are found which compares the concentration of specific biomarkers from healthy, gingivitis and periodontitis patients. The evidence was further strengthened when an accompanied treatment procedure has shown likely decrease in concentration of biomarkers. Thus, they are excellent tool to assess the clinical as well as chemical picture of the host. The biomarkers in periodontology are classified based on the release from tissues such as connective tissues or bone; whether they can be obtained from saliva or GCF. Rakic classified biomarkers as 1) Static: Genetics and histopathological and 2) Dynamic: Biochemical and Microbiological. Biomarkers can be predictive, diagnostic and prognostic.<sup>[6]</sup> As the name suggests, they are an excellent marker of their respective evaluation.

Another reason of higher reliance on the biomarkers is that they are easily available. The patients are comfortable as mostly the samples are obtained with little or no invasion. They are cost effective too. The biomarker spectra include inflammatory markers such as Interleukin (IL)-1beta, Interferon (IFN) gamma and Tumor Necrosis factor (TNF) - alpha, soft tissues markers such as MMPs and bone markers such as osteoprotegrin or ICTP (pyridinoline cross-linked carboxyterminal telopeptide of type I collagen). Genetic markers such as Single Nucleotide Peptides (SNP) and

microbiological markers also can be easily quantified with the present developments.<sup>15,16</sup> Biomarkers can help to correlate the clinical findings and make the diagnosis precise and accurate.<sup>17</sup> They can also guide the treatment process and prognosis for the patients rendering them the most useful trait of personalized periodontics. The only drawback is that not all biomarkers have a chairside kit particularly those measuring at the molecular level. The storage of sample can be an issue, so single use kit for each patient could be something to work upon.

### **The periodontal genes**

The genetic predisposition of periodontal diseases is well marked. Studies based on familial aggregation, linkage analysis, twin studies have found enough link to connect periodontitis and genetic heritage. Association of IL-1 polymorphism with severity of periodontitis has been a breakthrough in genetic markers. Polymorphism in genetic markers have been studied and they have been useful in determining the individuals' susceptibility. TNF-alpha, markers to differentiate between chronic and aggressive periodontitis have been performed too.<sup>[18,19]</sup> The GWAS or the genome-wide association study (GWAS) has become the main-stream method of polymorphism analysis. The link of periodontitis with syndromes such as Chediak-Higashi syndrome, Papillon lefevre syndrome has been able to identify and mapped using these methods.<sup>20</sup> Moreover, the genetic makeup of periodontal pathogens is being studied to intercept their virulence and produce an efficient defence mechanism. Epigenetic modifications which interfere with gene expression and by extension disease progression are being tried to use as targeted therapy.<sup>21</sup> The development of periodontal vaccines seems a solid foundation towards this.

At present certain testing kits such as MyPerioID or Omnigene are available. They help in patient profiling

and identification of microbial DNA respectively. These have been used and results are reproducible. However, the question of feasibility remains. The use of such kits which are expensive for an average patient in the country will not entice the mass attention. The patients will be reluctant as affordability will be a problem while the clinician will be hesitant. The management of database is yet another problem in hand.

#### **Database difficulties**

The summarization of records obtained from the patient can be biggest hassle in the way of personalized periodontitis. The record keeping of any patient starts from the very first visit. The components of detailed case history, systemic history, current medications, blood profile as well as bone status has to be recorded. This is a lengthy process and taxing to say the least. To practice at the personalized level, information such as adverse habits, the status of cardiovascular health, diabetic prospects and as well as genetic mapping has to be documented in a manner which helps in categorizing the patients based on their risk status. A specialized database keeping software which can remind and predict the needs plus maintenance protocol of the patient is essential for personalized periodontitis to come in action.

#### **Is Artificial Intelligent**

With the development of Artificial Intelligence (AI), life is gradually becoming dependent on it and field of periodontology is no exception. At present, AI has become a reliable friend in need. While they do answer every question asked to them but the intelligence of the machine can really compete the deliberation of human mind seems far-fetched. Even with the help of robotics in medicine with first ever dental procedure done in the form of root canal treatment can open new avenues but the efficiency of tactile sensitivity may be lacking. The use of new generation probes with temperature control

can provide an accurate picture of fundamental pathology but the predicament of total dependence on the AI is questionable right now. To have a collaboration of human acumen and artificial intellect seems to be cautiously optimistic.

#### **To conclude - Myth or Reality?**

The current concept of disease control, determining the etiopathogenesis of the disease and maintenance of periodontal health is based on a number of longitudinal and cross sectional; observational and interventional studies. There is no doubt they are producing effective results once the disease occurrence happens. However, the percentage of population being affected worldwide urges the periodontal care providers to navigate the boulevards at individual level. It is to find the piece of jigsaw which is amiss to complete the puzzle. Personalized periodontics can be an answer to that. The aim is to dive into a real time working of the host physiology which will affect, effect and produce the outcomes in the battle of periodontal diseases. The steps can seem as short and insignificant as routine oral prophylaxis but they can affect the whole biomarkers as discussed earlier. The biomarkers are the lead if “Personalized Periodontics” has to come to life. It cannot remain a lavish practice and the ground reality of interest amongst the patients as well as clinician should be generated alike. Newer cheaper technologies are the need of the hour. The motivation will require herculean efforts from our society. If the leap is higher than the steeple, it is safe to say we could have a new reality.

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