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Review Article

Predicting the Periodontal Disease

# Risk Assessment in Periodontal Disease – A New Way of Predicting the Periodontal Disease Outcome

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**Abstract:** The present review aims to assess the clinical significance of the risk assessment tool, in periodontal diagnosis. Periodontal disease is a multi-factorial disease. It has been proven that certain risk factors are associated with disease development. In addition, host-microbiome interaction is associated with periodontal disease. So, treating a disease requires a different approach. Risk assessment in periodontics estimates the risk of susceptibility to periodontal disease. It consists of assessing the level of bleeding on probing, pocket depth, tooth loss, radiographic bone loss, loss of attachment, patient age, systemic condition of the patients, and finally, an evaluation of environmental and behavioral factors. All these factors are evaluated together. This helps determine the patient's risk for periodontal disease and its progression for an individual approach. Evaluating the likelihood of developing periodontal disease can play a vital role in clinical decision-making by providing valuable information to design appropriate treatment plans. However, controlling risk factors should become a more explicit focus in many dental practices. This article reviews the application of risk assessment in clinical setup and periodontal disease management to the population and groups at risk of developing periodontal disease. This review addresses gaps in previous articles by comprehensively covering all aspects of periodontal disease. Most of the review studies focus on epidemiology and management of the disease, so by proper awareness about a disease and its management, the burden of the disease and its ill effects can be reduced. Based on the article's findings, implementing healthy dietary habits, making lifestyle changes, and managing risk factors can effectively control the increasing incidence of periodontal disease and reduce the likelihood of developing it.

**Keywords:** periodontitis, periodontal risk assessment, risk evaluation, Periodontal risk, risk communication, risk factors.

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## 1. INTRODUCTION

The periodontium is a group of tissues that support and surround the teeth, and it is commonly affected by a chronic condition known as periodontal disease. Gingivitis and chronic periodontitis are the most prevalent forms of this disease. Several studies suggest that the likelihood of developing periodontal disease varies between individuals and is determined by a combination of acquired and intrinsic risk factors. Epidemiological studies suggest that the prevalence of chronic periodontitis in adults is 35% to 50%. A better understanding of the pathogenesis of periodontitis has emerged. Risk factors related to risk assessment have been focused on identifying new risk factors and developing an algorithm to assess risk in the clinical setup. Our objective is to review the current state of risk assessment related to the diagnosis and management of chronic periodontitis, identifying a practical means for clinicians to develop a risk profile for each patient. Over the past years, numerous studies have demonstrated that the etiology, pathogenesis, and host play a vital role in periodontal disease. And now, pathobiology and risk play a major role in periodontal disease. So, it is important to know the risk factors and indicators, as well as reducing the risk can help maintain oral health and prevent the onset of periodontal disease. [1,2]Assessing the patient's periodontal disease risk has a significant clinical impact on clinical decision-making. The diagnosis of periodontal disease has primarily relied on clinical observations. The clinician must rely on 1) the severity and extent of inflammation, 2) the severity and pattern of periodontal pockets and clinical attachment loss, 3) patient age at onset, 4) the rate of progression, and 5) miscellaneous.[3,4] The prevention and treatment of periodontal diseases are based on accurate diagnosis, reduction or elimination of causative agents, risk management, and correction of the harmful effects of the disease. Prominent and confirmed risk factors or predictors for adult periodontitis include smoking, diabetes, race, P. gingival is, P. intermedia, low education, infrequent dental attendance, and genetic influences. Several other specific periodontal bacteria, herpesviruses, increased age, male sex, depression, race, traumatic occlusion, and female osteoporosis in the presence of heavy dental calculus are associated with loss of periodontal support and considered risk indicators of periodontitis.[1,3] The presence of furcation involvement, tooth mobility, and a parafunctional habit without using a bite guard is associated with a poorer periodontal prognosis following periodontal therapy. An accurate diagnosis can only be made by a thorough evaluation of data that have been systematically collected by: 1) patient interview, 2) medical consultation as indicated, 3) clinical periodontal examination, 4) radiographic examination, and 5) laboratory tests as needed.[5]Some risk factors can be modified to reduce one's risk of initiation or progression of the disease, such as smoking and improved oral hygiene, and the factors that cannot be modified, such as genetic factors, are associated with periodontal disease. This article aims at the role of risk assessment and periodontal disease management, and the objective of this review is to assess the role of risk assessment in diagnosing periodontal disease and the progression of the disease and the significance of risk assessment software be implemented in clinical setup for a successful periodontal treatment plan

## 2. RISK FACTORS FOR PERIODONTAL DISEASE

Risk can be identified in terms of risk factors, risk determinants, risk indicators, or risk predictors/markers.

### *2.1. Risk factors*

It recognizes individuals who are at a higher risk of developing a disease. A risk factor is thought to be causal for a disease. As such, it should satisfy two criteria: It is biologically plausible as a causal agent for disease and has been shown to precede disease development in future (forward design) clinical studies.

### *2.2. Risk determinants*

These types of risk factors cannot be modified.

### *2.3. Risk indicators*

Probable risk factors were identified in cross-sectional studies but not confirmed through longitudinal studies. Certain risk indicators may serve as risk factors if they play a role in the onset of a disease.

### *2.4. Risk predictors/markers*

A characteristic linked with a higher likelihood of a disease but may not be a direct cause, and can be utilized to anticipate the disease's progression or increased likelihood, is known as a risk marker. Risk can be classified as risk factors, indicators, or predictors. A risk factor is causative for periodontal disease. To qualify as a risk factor, the agent should be proven to be causative and demonstrated to precede the onset of the disease in prospective clinical studies. Risk factors are related to the occurrence of disease but need not imply the causative effect of the disease. Risk factors do not develop into disease when present in a patient.[6,7] The absence of risk factors does not mean the disease will not develop. Numerous studies in evidence-based dentistry have shown that several risk factors directly and significantly impact the progression of periodontal disease. Numerous studies have shown that oral biofilm is a prerequisite for developing periodontal disease. However, many individuals exposed to oral biofilms do not develop periodontitis. Thus, the term risk is appropriate even if the agent is a prerequisite to the occurrence of the disease. These factors are named causal risk factors or factors associated with chronic disease proximity indicates causal risk factors.[8,9] The terms real risk factor, classical risk factor, traditional risk factor, or established risk factor are used for proximal risk. It is more appropriate to use the term risk marker, risk indicator, or putative risk factor for intermediate risk factors (i.e., markers of the true risk factors) and predisposing factors for distal risk factors.[10] Diabetes and smoking are true risk factors for periodontal diseases. Similarly, sugar intake is a true risk factor for dental caries.[9] For chronic diseases, exposure to risk factors indirectly affects the probability of the event occurring.[10]Risk assessment can help predict a patient's risk of developing periodontal disease, improve clinical decision-making, improve patients' self-care oral regimen, and improve successful periodontal disease management. According to AAP, Risk assessment has been defined as the process by which qualitative or quantitative assessments are made of the likelihood for adverse events to occur because of exposure to specified health hazards or by the absence of beneficial influences [10].

## 3. COMPONENTS OF RISK ASSESSMENT

- Gives an understanding of the risk factors.
- Anticipates disease progression and outcomes.
- Fosters the treatment of the disease process instead of
- treating the outcome of the disease.
- Selects and individualizes frequency, duration, and
- the intensity of treatment for a patient.

## 4. NON-MODIFIABLE VERSUS MODIFIABLE RISK FACTORS

Risk factors may or may not be changed. Non-modifiable risk factors include age, gender, genetics, and ethnicity. Modifiable risk factors that can be controlled are local risk factors and systemic factors. Most health determinants are modifiable risk factors. Clinical signs of the disease and biomarkers to be determined to identify the occurrence of periodontitis can also be prognostic and predictive factors. Salivary biomarkers have been explored to predict periodontal disease severity, progression, or recurrence.[6] However, no unique independent biomarker is currently validated. [7,11] The trend in periodontal systemic interactions studies is to investigate associations of salivary biomarkers to predict the risk of periodontitis. Indeed, biomarkers should be independent risk predictors characterized by high specificity. For example, hs-CRP is an independent predictive factor for coronary disease. While this biomarker is not suitable for investigating the link between periodontal disease and systemic health, as it is not an independent factor of periodontitis, Apo lipoprotein A-I autoantibodies may serve as useful predictive biomarkers for assessing the risk of atherosclerosis in individuals with periodontal disease.

## 5. SPECIAL POPULATIONS

Providing targeted interventions and frequent follow-ups to population groups with identified risk factors can improve oral health outcomes and slow disease progression. Some of these patient groups are described below.

## 6. GERIATRIC PATIENTS

As the three-generation age, the number of people 65 and older will increase dramatically. Periodontal disease is more prevalent in older than younger groups, so age-related risk increases in elderly patients. In addition, many of the comorbid conditions associated with periodontal disease occur more frequently and with greater severity in people of advanced age.[10,12] As a precaution always, early treatment is more important in older patients.

## 7. SOCIOECONOMIC STATUS

People at lower socioeconomic levels. There is a correlation between gingivitis and inadequate oral hygiene with socioeconomic status. Borrell and colleagues confirmed that education and income were associated with severe periodontitis. Economic status is also relevant to more periodontitis due to disparity in treatment.

## 8. SMOKING

Smoking may inhibit immunological function and negatively affects immunoglobulin levels, which may increase susceptibility to typical and unusual microbial pathogens, so risk assessment in patient encounters with smokers provides clinicians with an opportunity to identify patients at risk and deliver critical information about the benefits of smoking cessation and the importance of daily self-care strategies to control the plaque biofilm.[7]

## 9. PREGNANCY

Periodontal disease is being shown to be associated with preterm delivery and low birth weight, which puts infants at risk of experiencing increased medical complications. In addition, many studies have proven that pregnancy and periodontal disease are interconnected due to the increased hormone levels in pregnancy. [6] It is important to advise expectant mothers about the importance of good oral health and oral hygiene care during pregnancy.

## 10. SYSTEMIC COMORBIDITIES

Oral health is associated with several complex systemic medical conditions. In several cases, identifying and treating oral diseases involves addressing potential periodontal concerns and increasing patients' awareness of medical conditions. Diabetes mellitus is a chronic medical condition that significantly impacts oral health. The underlying defect in diabetes is an inability to maintain normal blood glucose levels; this disturbance leads to the derangement of fats, carbohydrates, and protein metabolism. Diabetes has been associated with several oral complications, including periodontitis, gingivitis, dental caries, salivary gland dysfunction, xerostomia, burning mouth syndrome, and increased susceptibility to oral infections. Of particular concern are patients with diabetes, who are at an increased risk of developing periodontitis.[11] In diabetic patients, host responses may be impaired, wound healing is delayed, and collagenolytic activity may be enhanced. In addition, since wound healing may be impaired in this group, surgical intervention may need to be avoided. As a result, periodontitis may be a particular problem in patients with diabetes.

- ***Immunosuppression***

Immunocompromised patients should be increased susceptibility to oral infection, especially with unusual pathogens, which can occur in these patients and require intervention, often in concert with medical professionals. It should be noted that the oral manifestations of HIV infection have been reduced significantly since the introduction of highly active antiretroviral therapy.[11,12] Nevertheless, vigilance in disease management and communication and cooperation with medical professionals can enhance care for these patients

- ***Cancer***

Patients undergoing chemotherapy and radiation therapy may have oral complications, including mucositis, xerostomia, radiation-induced dental caries, and osteoradionecrosis. In addition, opportunistic infections such as Candida albicans have been shown to increase in frequency with mucositis and immunosuppression. Consulting with the patient's oncologist and developing a targeted daily oral hygiene regimen and a special recall visit will increase the patient's clinical outcome.

## 11. CLINICAL RISK ASSESSMENT FOR PERIODONTAL DISEASE

Information concerning individual risk for developing periodontal disease is obtained by carefully evaluating the patient's demographic data, medical history, dental history, and clinical examination. Risk factors that may elevate the likelihood of disease can include a patient's age, gender, and socioeconomic status. The medical history may reveal elements like the history of diabetes, smoking, HIV/AIDS, osteoporosis, and the level of stress.[12] The dental history can reveal a family history of early tooth loss, a history of periodontal disease, and information about the frequency of dental visits. On clinical examination, location and extent of bacterial plaque accumulation, presence of plaque retentive factors, anatomic retentive factors, presence of calculus, attachment loss extent, and presence/ absence of bleeding on probing.[13]Once the social, demographic, medical history, dental history, and clinical presentation data are collected. They must be analyzed to find people at risk of contracting the disease. Dental professionals may select patients who need additional education or focused interventions to prevent or lessen the effects of periodontal disease by using a proper risk assessment tool to help them identify patients at increased risk of developing the condition.[14]Risk assessment examines risks so that they may be avoided, reduced, or managed.

## 12. USES OF ASSESSMENT[15]

- To predict which patients are at risk for disease.
- For scheduling the frequency of hygiene appointments.
- Diagnosis of disease.
- Prevent disease by identifying and modifying the risk factors.

There are several ways to study exposure to a certain factor and disease development. For example, in a study of the association between exposure to risk factors and disease occurrence, confounding can occur when an additional factor associated with the disease exists and is unevenly distributed among the groups under investigation.[11] Risk assessment studies in dental research have been confined to two steps.

***Risk assessment process***

1. identifying one or several factors that appear to be associated with the disease.
2. In case of multiple factors. A multivariable risk assessment model should be developed to disclose which combinations of factors most actively discriminate between health and disease.
3. The assessment step in which new populations are screened for this combination of factors with a subsequent comparison of the level of disease assessed with the one predicted by the model.
4. The targeting step in which exposure to the identified factors is modified by prevention or intervention, and the effectiveness of their regimen is evaluated.

***There are three levels of risk assessment.***

1. Patient level - subject risk assessment
2. Tooth risk assessment
3. Tooth site risk assessment

***Methods of identifying individuals at risk of disease progression are***

1. Diagnostic tests and laboratory assays.
2. Evaluation of GCF components.
3. Subjective risk assessment - Careful evaluation of patients' demographic data (age, gender, SES), medical history (DM, osteoporosis, HIV, smoking, level of stress), dental history (family history of early tooth loss may show a genetic predisposition to aggressive periodontitis) and clinical examination (extent of plaque accumulation, presence of retentive factors, CAL, BOP).

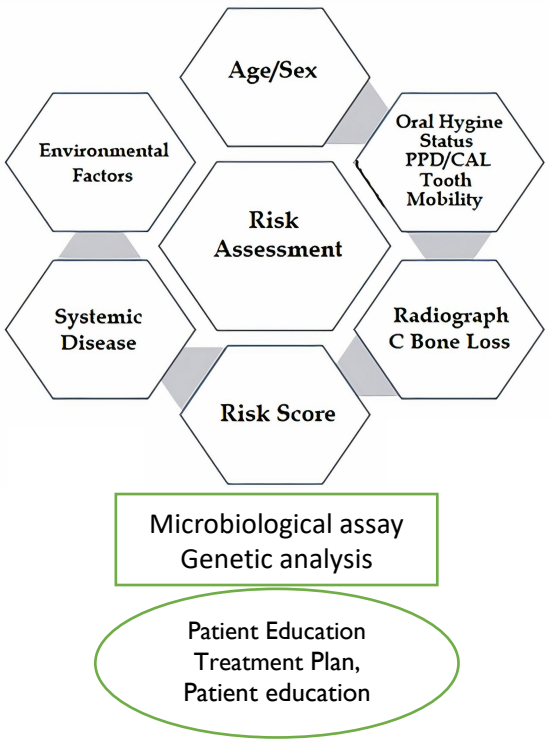


**Fig:1 Risk Factors, Risk Predictors and Treatment Planning**

**Table 1: Risk Models**

| S.Nos | Authors | Risk Model | Risk Factors | |
|---|---|---|---|---|
| 1. | Page et; al (2002)[16] | Periodontal Risk Calculator (PRC)* | Age, smoking history, DM, history of periodontal surgery, BOP, furcation involvements, subgingival restorations, vertical intrabony defects, root calculus, PD, radiographic bone loss | Only the deepest PD and greatest bone loss per sextant are entered for PD and radiographic bone levels. |
| 2. | Lang and Tonetti (2003)[5] | Periodontal Risk Assessment (PRA) | : Full-mouth BOP %, PD ≥ 5mm, tooth loss, radiographic bone loss-to-age ratio, systemic and/or genetic conditions, smoking | All sites of BOP and PD ≥ 5mm must be entered. Alveolar bone loss is limited to the most severe posterior site. Binary designation for "systemic and/or genetic conditions" category. Six-point scale for each factor |
| 3. | Viswa Chandra (2007)[17] | Modified PRA | Full-mouth BOP %, PD ≥ 5mm, tooth loss, CAL to age ratio, smoking, DM, dental status - systemic factors interplay, psychosocial factors Modified PRA model (see above). DM is separated from systemic conditions. | Alveolar bone loss is not evaluated. Five-point scale for each factor |
| 4. | Leininger et al (2010)[12] | Periodontal Risk Assessment Diagram Surface (PRAS) | : Full-mouth BOP %, PD ≥ 5mm, tooth loss, radiographic bone loss-to-age ratio, systemic status, smoking Modified PRA model | Identical to PRA, except it uses a 5-point scale for each factor. |
| 5. | Trombelli et al (2009)[18] | UniFe | BOP, PD ≥ 5mm, radiographic bone loss-to-age ratio, smoking, DM. All sites of BOP and PD ≥ 5mm must be entered. | An Alveolar bone loss included one interproximal site of each tooth. |
| 6. | Lindskog et al (2010)[19]DentoRisk† | | 20 factors: Systemic Predictors: Age history of chronic periodontitis, family history of chronic periodontitis, systemic disease, related diagnoses, the result of skin provocation test, patient cooperation, disease awareness, socioeconomic status, smoking, and clinician experience. Local Predictors: bacterial plaque (oral hygiene), endodontic pathology, furcation involvements, vertical intrabony defects, radiographic marginal bone levels, PD, BOP, marginal dental restorations, increased tooth mobility, missing teeth, abutment teeth, presence of purulence | |

## 13. VALIDATION OF STUDIES

Page RC et; al 2003,[16] conducted a study to evaluate the accuracy and validity of the Periodontal risk calculator (PRC) tool on 523 subjects' clinical records and radiographs covering 15 years. Information from baseline examinations was entered into the risk calculator, and a risk score on a scale of 1 –5 for periodontal deterioration was calculated for each subject. Actual periodontal status regarding alveolar bone loss was determined using 12 digitized radiographs, and tooth loss determined from the clinical records was assessed at years 3, 9, and 15. The strength of the association between risk prediction and actual outcome was determined statistically. The results showed that the risk scores were strong predictors of future periodontal status measured as worsening severity and extent of alveolar bone loss and tooth loss, especially loss of periodontally affected teeth. They concluded that using the risk assessment tool over time might result in more uniform and accurate periodontal clinical decision-making, improved oral health, reduced complex therapy, and reduced healthcare costs. A study on periodontal risk assessment for patients in supportive periodontal therapy (SPT) said that subject risk assessment might estimate the risk for susceptibility to the progression of periodontal disease.[5] It consists of an assessment of the level of infection, the prevalence of residual periodontal pockets, tooth loss, an estimation of the loss of periodontal support concerning the patient's age, an evaluation of the systemic conditions of the patient, and finally, an evaluation of environmental and behavioral factors such as smoking. All these factors should be contemplated and evaluated together, and it concluded that a functional diagram might help the clinician determine the risk for disease progression on the subject level. This may be useful in customizing the frequency and content of SPT visits. A study to develop a new periodontal risk assessment model based on the periodontal risk assessment (PRA)[76] models and to evaluate the risk assessment capability of the proposed model. 26 patients diagnosed with chronic periodontitis were selected randomly, and thorough examination and charting were performed. All the clinical parameters like percentage of sites with BOP, number of sites with BOP, PPD >/ 5mm, number

of teeth lost, bone loss/ age ratio, attachment loss/age ratio, diabetes and smoking status, and other systemic factors and risk determinants. Using Microsoft Excel, the parameters were plotted on the chart as per the model, and the results showed that of all the cases, the original model showed 42.3% were high-risk cases and 30.8% were low cases. In the proposed model, 46.2% of the high-risk cases and 46.2% were low-risk.[7,15,16] Only 7.7% of cases were identified with the new model as moderate risk cases, and the study concluded that risk assessment by this model does not vary significantly compared to the original model.

## 14. CONCLUSION

Identifying the disease's primary cause will help prevent or lessen the risk for the population and each individual. Periodontal diseases are the most complex non-communicable diseases. Controlling periodontal risk factors is the cornerstone of prevention and periodontal therapy success. It is important to clarify the relationship between risk and the causal that may improvise understanding of the underlying mechanism of periodontal disease. Validating the risk assessment model in longitudinal studies and expected to result in better therapeutic outcomes at a lower cost, reducing the incidence and progression of a disease. It is also mostly used for effective treatment approaches. More clinical research is needed to determine the most effective way to incorporate risk assessment in patients' education and how determining the risk leads to successful treatment. The risk assessment's goal is long-term tooth retention through prevention, early intervention, and directed therapy. Numerous risk assessment models focusing on a periodontal disease that has undergone clinical validation foresee the next generation of risk assessment models for treating periodontal disease that may emerge very shortly.

## 15. CLINICAL IMPLICATIONS

The clinical practice of risk assessment may reduce the need for complex periodontal therapy, improve patient outcomes and ultimately reduce oral health care costs. Therefore, patients are encouraged to become actively involved in periodontal disease management by following a daily three-step regimen of brushing, flossing, and rinsing with an antimicrobial mouth rinse.

## 16. AUTHORS CONTRIBUTION STATEMENT

Dr. J. Bhuvaneswari conceived the presented idea. She conceived the original idea. She supervised the project, developed, wrote the manuscript theory, and performed the computations. And Verified the analytical methods. She devised the project, the main conceptual ideas, and the proof outline. Dr. Julius Amaldas encouraged other authors to investigate and supervised the findings of this work and done the literature survey; he reviewed the manuscript. Dr. Ramya. V conceived the study and was responsible for the overall direction and planning and developed the theoretical framework.

## 17. CONFLICT OF INTEREST

Conflict of interest declared none.

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