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Original article

Evaluation and Comparison of Periodontal Risk with Three Different Risk Assessment Models - A Cross Sectional Study

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ABSTRACT

Aim:To evaluate the periodontal risk of subjects using periodontal risk assessment (PRA) model, modified PRA model and PRAS (periodontal risk assessment diagram surface [PRAS]) score. ***Materials and method:***Fifty chronic periodontitis patients, aged 30-60 years were selected and comprehensive periodontal evaluation was performed. Parameters namely - percentage of sites with bleeding on probing, number of sites with pocket depths ≥ 5mm, number of the teeth lost, Bone loss/age ratio, (CAL)/age ratio, diabetic and smoking status, systemic factors, as well as socioeconomic status (Kuppuswamy's classification) were recorded. All the risk factors were plotted on a radar chart for PRA, MPRA and PRAS models, using Microsoft excel 2007 and periodontal risk was categorized as low, moderate and high risk (for PRA, MPRA models), or low to moderate and high risk (for PRAS). ***Results:*** Amongst 50 patients, 26 were at high risk, 4 at moderate risk, and 20 at low risk according to PRA model. Whereas, according to MPRA model, 25 were at high risk, 4 at moderate risk and 21 at low risk. PRAS score showed that 18 were at low to moderate risk and 32 were at high risk. No statistically significant difference was found between the risk scores when the modified models(MPRA and PRAS score) were compared with the original PRA model ($\chi 2$=0.044, *p* value =0.978 (PRA vs. MPRA), χ^2= 1.026, *p* value =0.311(PRA vs. PRAS)) ***Conclusion:***All three models were effective in evaluating the periodontal risk. Although MPRA considers greater number of parameters than PRA, no statistically significant difference exists between the interpretations of the two in the population studied. Also, with in the limitations of the present study, we observe that PRAS score over estimates the subjects risk, which however did not translate into statistical significance.

Introduction

It is a well-known fact that although microbial plaque is the initiating factor for periodontal disease, a susceptible host is essential for periodontal destruction to occur. **(Van Dyke *et* al, 2005).** Factors such as systemic disease, environmental and genetic factors have been known to increase the risk of an individual to periodontal destruction **(Genco and Borgnakke, 2013).**Identifying these factors that increase disease susceptibility and understanding the measures that reduce risk can help maintaining oral health and prevent the onset or arrest the progression of the disease.

Risk assessment is a process by which assessments are made of likelihood of adverse effects as a result of exposure to specific health hazards or by the absence

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Axis score	BOP %	No of sites with PD≥5mm	Tooth loss	Smoking Cigarettes/day	AL/age ratio	Diabetic status fasting glucose in mg/dl
0	0	0	0	Non – smoker(NS)	0	<102
1	≤ 4	1 - 2	1 - 2	Former smoker(FS)	≤0.25	102 - 109
2	5-9	3 - 4	3 - 4	<10	0.26 - 0.50	110 - 117
3	10-16	5 - 6	5 - 6	10 - 19	0.51 - 0.75	118 - 125
4	17-25	7 - 8	7 - 8	20	0.76 - 1.0	126 - 133
5	≥25	>9	>9	>20	>1	>134

Table 1: Coding system for risk factors in Modified PRA model

Axis score	Status
0	Healthy
1	Healthy with minor dental problems not affecting periodontium.
2	Dental health problems affecting the periodontium including iatrogenic, endodontic, prosthodontic and orthodontic problems.
3	General health problems that might modify the progression of periodontal disease including genetic, nutritive, endocrine, haematologic, immunodeficiency and psychosomatic disorders, including risk indicators like HIV and osteoporosis
4	Severe dental problems in the presence of diseases that can modify periodontal diseases
5	More severe than above and associated with severe tooth morbidity

Table 2: Coding system for dental health-systemic factors interplay

of beneficial influences. (American Academy of Periodontology, 2008) Risk assessment is an accepted component of the American Academy of Periodontology guidelines for patient management and it has been concluded, "risk assessment should be part of every comprehensive dental and periodontal evaluation." Risk assessment goes beyond the identification of disease, extending its spectrum to factors that influence the future disease progression. Thus, it improves clinical decision-making, reduces the need for complex periodontal therapy, improves

SCORE	BOP%	PPD>4mm	TL	BL/age	Smoking	Systemic factors
2	0 - 9	≤2	≤2	≤0.25	NS	Healthy=0
4	10 - 16	3 - 4	3 - 4	0.26 - 0.49	FS	Diabetic =10
6	17 - 24	5 - 6	5 - 6	0.50 - 0.79	1 - 9 cig/day	
8	25 - 36	7 - 8	7 - 8	0.80 - 1.00	10 - 19 cig/day	
10	>36	>8	>8	>1.0	≥20 cig/day	

Table 3: Coding system for PRAS score

Risk assessment model	Low risk	Moderate risk	High risk
PRA Model	All parameters in the low risk area or at the most one parameter in the moderate risk category	Two parameter must be in the moderate risk category and not more than one parameter in the high risk category or the presence of one parameter each in moderate and high risk as moderate	At least two parameters in the high-risk category
MPRA Model	All parameters in the low risk area or at the most one parameter in the moderate and high risk category	At least three parameters in the moderate risk area and not more than one parameter in the high risk area	At least two parameters in the high-risk category

Table 4: Categorization of risk levels according to PRA and MPRA models

Variable	*Number of patients (N=50)*	*%*
% sites with BOP		
0 - 4%	*11*	*22*
5 - 9%	*8*	*16*
10 - 16	*8*	*16*
18 - 25	*6*	*12*
≥25	*17*	*34*
No of sites with PD≥5mm		
0	*0*	*0*
1 - 2	*14*	*28*
3 - 4	*7*	*14*
5 - 6	*3*	*6*
7 - 8	*0*	*0*
>9	*26*	*52*
Tooth loss		
0	*31*	*62*
1 - 2	*11*	*22*
3 - 4	*4*	*8*
5 - 6	*3*	*6*
7 - 8	*1*	*2*
>9	*0*	*0*
Smoking status		
Non – smoker(NS)	*41*	*82*
Former smoker (FS)	*2*	*4*
<10	*7*	*14*
10 - 19	*0*	*0*
20	*0*	*0*
>20	*0*	*0*

Socio economic status		
Score 0	***0***	***0***
Score 1	***12***	***24***
Score 2	***21***	***42***
Score 3	***13***	***26***
Score 4	***4***	***8***
Score 5	***0***	***0***
Diabetic status ***Fasting glucose in mg/dl***		
<102	***42***	***84***
102 - 109	***3***	***6***
110 - 117	***3***	***6***
118 - 125	***1***	***2***
126 - 133	***0***	***0***
≥134	***1***	***2***

Table 5: Demographic data

treatment outcomes, and ultimately reduces the cost of oral health care.

Unmethodical assessment of risk without the use of a model can cause inter examiner variability and could be complex and time taking. To overcome this problem, several risk assessment models have been proposed such as Periodontal Risk Calculator – PRC (Page *et al.*, 2003), Periodontal Risk Assessment(PRA)model (Lang*et al.*, 2003) etc. Amongst them, PRA model proposed by Lang and Tonetti is one of the widely accepted models(Lang *et al.*, 2003). It evaluates periodontal disease severity by measuring the probing pocket depth (PPD) and radiographic evaluation of alveolar bone level(BL) in addition to systemic factors. However, this model has been shown to have certain limitations such as, it assesses the cumulative status of individual, there is no proper identification of risk factors and risk determinants, lack of predictive power for periodontal tissue breakdown, time consumption etc.

To overcome these drawbacks, the PRA model has been modified recently. The modifications include modified PRA (MPRA) model by Chandra (2007) and periodontal risk assessment diagram surface (PRAS) score (Leininger *et al.* 2010).

Modified PRA model measures clinical attachment loss (CAL) instead of alveolar BL. In addition, it considers more number of risk factors and determinants for risk assessment than the original PRA model. PRAS score differs from the original PRA

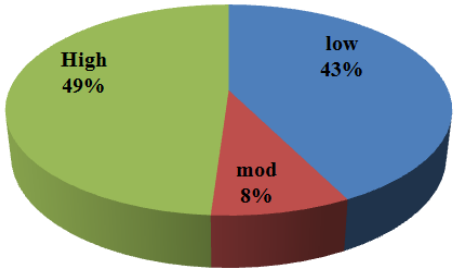

Figure 1: Distribution of risk according to PRA, MPRA and PRAS

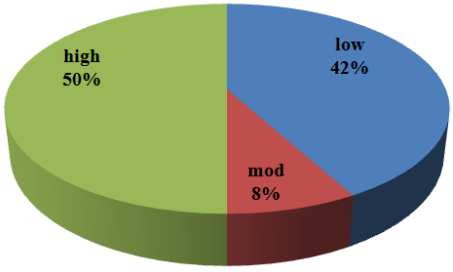

Fig 1b: Distribution of high, moderate and low risk cases according to the MPRA model

model by having different scoring for each parameter. PRA, MPRA and PRAS score are retrospective risk assessment models. The present study aims to assess the risk of individuals using these models and also to compare the risk assessment capabilities of the modified models with that of the original PRA model.

Materials and Methods

Subject Population and periodontal examination

Fifty patients with chronic periodontitis, aged 30-60 years were selected from the Outpatient Department of Periodontics, Sri Sai College of Dental Surgery, Vikarabad. Patients having atleast one pocket of ≥5mm and diagnosed as chronic periodontitis according to the AAP 1999 classification were included in the study Consideration of PPD was taken as two of the risk assessment models (PRA and PRAS score) include this criteria and not CAL as a measurement of Chronic periodontitis. Patients not willing to participate, having difficulty in mouth opening, those

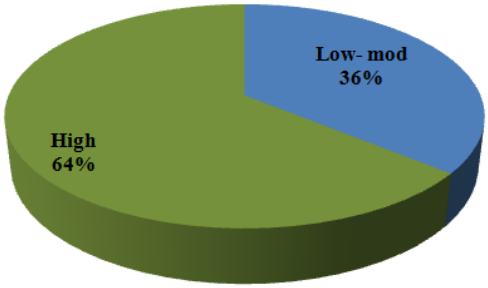

Fig 1c: Distribution of high, low- moderate risk cases according to the PRAS score

having less than 20 teeth and those diagnosed as having aggressive periodontitis were excluded from the study. The present study was approved by the institutional ethical committee board **(Ethical Board Number: 494/sscds/IRB-E/OS/2015, Sri Sai College of Dental Surgery).** Comprehensive periodontal evaluation and charting was performed using UNC 15 probe. Periodontal parameters as percentage of sites with bleeding on probing (BOP), number of sites with pocket depths (PD) ≥ 5mm, number of the tooth lost, (BL)/age ratio, systemic factors and smoking status were recorded and were plotted in the radar chart for PRA model. Alveolar bone loss was evaluated using intraoral periapical radiographs of the areas with PPD≥5mm using millimeter grid. All the parameters were measured by a single trained examiner.

Additional factors namely CAL/age ratio, diabetic status, socioeconomic status, and dental status –systemic factors interplay, were recorded for obtaining risk by MPRA model (*Table 1*).

Diabetes status was evaluated by categorizing the subjects as follows: fasting blood glucose level <102 mg/dl indicates as score 0, score ranging between 102 and 109 mg/dl as score 1, score ranging between 110 and 117 mg/dl as score 2, 118-125 mg/dl as score 3,

126-133 mg/dl score as 4 and ≥134mg/dl indicates as score 5, respectively **(Chandra., 2004, American Academy of Periodontology., 2000).**

Dental status was assessed by evaluating the systemic factors with tooth related risk factors that may act as predisposing condition for periodontal disease with axis score ranging from 0 to 5 (*Table 2*).

Socioeconomic status of the subjects was determined using Kuppuswamy's classificationas score 0 indicates no stressful environment, score 1 indicates upper high collar worker, score 2 indicates as white collar, score 3 as blue-collar worker, score 4 indicates contract employment and score 5 as unemployed. (Ravi*et al*., 2013)For evaluation of risk by PRAS score the coding system described in the *Table 3*was followed.

Interpretation of risk levels:

All the risk factors were then plotted on a radar chart for PRA, MPRA and PRAS models, using Microsoft Excel 2007 and periodontal risk was categorized as low, moderate and high risk for PRA and MPRA models (*Table 4*).

For categorization of risk levels according to PRAS score, after obtaining a radar chart, a risk score corresponding to the diagram surface was calculated. Patients having a score of ≤ 20 identified were categorized as having low to moderate periodontal risk whereas a score of > 20 with high periodontal risk (Leininger*et* al; 2010).

Statistical analysis

Statistical analysis was done using software (SPSS 20.0). Chi square test was used to compare the interpretations of the risk scores; $p \leq 0.05$ was considered as statistically significant.

(Statistical analysis was done using statistical software (SPSS 20.0). Keeping in mind the categorical nature of data obtained in this study, chi square test for goodness of fit was done to evaluate the differences in proportions in different risk categories between the three models via cross tabulation. Considering the small sample size of previous studies we attempted to include a larger sample to increase the reliability of results and in the given time period were able to select and recruit 50 patients.

Results

This study recruited 50 patients (mean age: 38.48± 6.05; males=24, females=26) amongst whom 7 were current smokers, 2 were former smokers, and 8 were diabetic. The comprehensive demographic data is represented in the *Table 5*.

Amongst 50 patients, 26 patients were at high risk, 4 at moderate risk, and 20 at low risk according to PRA model. Whereas, according to MPRA model, 25 were at high risk, 4 at moderate risk and 21 at low risk. PRAS score showed that 18 were at low to moderate risk and 32 were at high risk (*Figure 1*). No statistically significant difference was found between the risk scores when the modified models (MPRA and PRAS) were compared with the original PRA model ($\chi 2=0.044$, p value =0.978 (PRA vs MPRA), $\chi^2= 1.026$, p value =0.311(PRA vs PRAS))

Discussion

The present study determined the risk of subjects with chronic periodontitis using the original and modifications of PRA model. With regard to the evolution of risk assessment models, there is a transition occurring in periodontics from a health care model to a wellness model and at present general dentist and periodontists have a wide range of models available. An ideal model should be easy to use,

simple to understand, time efficient and at the same time should accurately predict the disease progression.

Page *et al.*(2002), developed a computer-based risk assessment tool, the PRC (Periodontal risk calculator) for objective and quantitative assessment of risk. The calculation of risk using this model is based on mathematically derived algorithms that assign relative weights to nine factors including patient age, smoking history, diagnosis of diabetes, history of periodontal surgery, pocket depth, furcation involvements, restorations or calculus below the gingival margin, radiographic bone height and vertical bone lesions. The PRC assigns the individual a level of risk on a scale from 1 (lowest risk) to 5 (highest risk).

In 2009, Trombelli and co-workers proposed a new objective method (UniFe; Union of European Railway Industries) in order to simplify the risk assessment procedures (Trombelli*et al.*, 2009) Risk assessment according to UniFe method is based on five parameters, derived from the patient medical history and clinical recordings.

Amongst various models proposed till date, PRA model proposed by Lang and Tonnetti is one of the widely accepted models. However, it has certain limitationssuch as it mainly assesses the cumulative status of the patient and there is no proper identification of risk factors and risk determinants. Also, in the functional diagram, the presence of a systemic disease is interpreted as a high-risk factor with no evaluation of the current status of the disease. Smoking and diabetes are established risk factors for periodontal disease. The former is assessed in the risk assessment model, but the latter is included in the systemic diseases category. Another shortcoming is that dental factors which may initiate or modify the disease progression are not assessed.

To overcome these limitations, this model has been modified and MPRA and PRAS have been proposed.

In MPRA model, BOP, PPD, tooth loss and CAL/age ratio measure the cumulative status of the periodontal disease, i.e., the present status of the individual. Diabetic status and smoking are the risk factors, and stress and socio-economic factors are the risk determinants, that were added in this new model. The criteria for four factors namely BOP, PD, tooth loss and smoking were retained, but the scoring criteria for these parameters were adapted on the lines of Renvert and Persson, (2004).

In the present study, we found that both PRA and MPRA models showed almost equal number of patients in low, moderate and high risk groups and no statistically significant difference existed between them, which is in accordance to a study by Dhullipalla*et al.* (2015). In contrast to the present study, Shruthi*et al.* (2010) reported fewer cases in low risk group and almost equal number in moderate and highrisk groups when MPRA model was used to assess the risk[10] They contributed this to two reasons namely, the higher number of parameters in the proposed model and also to the criteria used for risk assessment. However, making a direct comparison of the present study to other studies would be inappropriate due to differences in sample size, type of population and characteristics of the population assessed.

When a comparison was made between PRAS score and MPRA, we found higher number of patients having high risk according to PRAS score than with the latter, although this was not statistically significant. The reason for this could be differences in the criteria used for assessment.

Furthermore similar studies with larger sample size are required to validate the results found in the present study.

Conclusion

All three models are equally effective in evaluating the periodontal risk and they can be useful tools for predicting disease progression. Although MPRA considers greater number of parameters than PRA, no statistically significant difference exists between the two in the population studied and within the limitations of this study we observe that PRAS score over estimates the subjects risk which however did not translate into statistical significance.

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