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Evaluation of severity of periodontal disease in patients with periodontitis using periodontal risk assessment (PRA): A single institutional study

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Abstract
Background: Periodontal disease is a heterogeneous group of disorders affecting the periodontium, the most common of which are gingivitis and chronic periodontitis. Substantial evidence indicates that susceptibility to periodontal disease varies among patients and is the function of both acquired and intrinsic risk factors. The process of predicting an individual's probability of periodontal disease is called periodontal risk assessment.
Aim & Objectives: The purpose of this study is to identify the severity of periodontitis in case records of patients who visited the dental college using PRA.
Methodology: 100 samples were collected consisting of patients with periodontitis. Data is collected from periodontal case sheets and periodontal charting and added into the PRA tool to gain the result. Results obtained are compiled and correlation is made between periodontal risks and demographic data of the patients.
Results: In this study, from the overall results, patients with medium risk is 63% and high risk is 37%. Based on age group, the number of people with the highest number of medium risk are in the age group of 31-40 and 41-50 (77%) and high risk in the age group of 61-70 (75%). Based on gender, male had the higher risk of the disease compared to females (40%). Based on ethnicity, Indians showed a higher risk of the disease compared to the other communities (59% medium risk and 41% high risk).
Conclusions: From the data analysed, periodontal risk assessment does not depend on one factor and depends on multiple factors, which includes BOP%, PPD ≥5, number of tooth loss, percentage of BL/Age, Systemic/ General disease and environmental factors.

Keywords: Risk assessment, periodontitis, maintenance, risk evaluation, reinfection

Introduction

1. Background

Periodontal disease is a heterogeneous group of disorders affecting the periodontium, the most common of which are gingivitis and chronic periodontitis. Substantial evidence indicates that susceptibility to periodontal disease varies among patients and is the function of both acquired and intrinsic risk factors. The process of predicting an individual's probability of periodontal disease is called periodontal risk assessment. [1]

There are various risk assessment models such as Periodontal Risk Calculator (PRC), Periodontal Risk Assessment (PRA), Modified PRA, Periodontal Risk Assessment Diagram Surface (PRAS), UniFe and Dento Risk. [1] The chosen model that will be applied for this study is Periodontal Risk Assessment (PRA).

PRA is an expansion of the periodontal risk assessment model by Lang and Tonetti (Lang and Tonetti, 2003). [2] (figure 1) The subject risk assessment is defined by numerous components which are: 1) Full mouth Bleeding On Probing. 2) Number of residual periodontal pockets more than or equals to 5mm. 3) Number of lost teeth. 4) Percent of alveolar bone loss in relation to the patients' age. 5) Systemic and/or genetic predispositions. 6) Smoking. The aggregate sum of these factors provides an individualized total risk profile for the patient. [3]

The PRA provides an assessment of risk for patients during the supportive, post-treatment phase, after active therapy has been completed. Several adaptations to the PRA have been proposed suggesting that the other risk assessment methods was too complicated for the practitioner to implement in clinical practice. The ease of interpretation was embodied in the format of the risk diagram itself which was colour coded to low-, medium- and high-risk zones. Patients with little or no periodontal breakdown are assumed to be at low-risk for future diseases, whereas patients presenting with more severe tissue destruction are considered to be at the higher risk for future diseases. [1]

This model was based on cumulative and retrospective data where information is gathered to assess the current risk for a patient, unlike other models where status is assessed and future risk is predicted. Incorporation of risk for oral disease into clinical practice, in the broadest sense, has the potential to substantially alter the traditional approach to oral health care delivery. The goal of risk assessment is the long-term retention of teeth via early intervention, and directed therapy. [1]

Previous studies show that PRA was not done till date in Malaysia. Moreover, there was no research on how severe the risk of periodontitis is in a specific community.

Periodontal risk assessment model is based on a multifactorial graphic composed of 6 vectors representing

each factor. The PRA is as an online periodontal tool free of charge by the Clinical Research Foundation and the University of Bern at http://www.perio-tools.com/PRA/en/index.asp.

Aims & objectives (general & specific)

The general objective is to assess the periodontal risk among the recorded case sheets of the patients visiting Penang International Dental College (PIDC) using PRA.

The specific objectives are

a. To evaluate the periodontal risk assessment among patients diagnosed with periodontitis (PRA)
b. To find the correlation between age and PRA
c. To find the correlation between ethnicity and PRA
d. To find the correlation between gender and PRA

Methodology

1. Materials & methods

A research study was designed and conducted in a dental school to assess the risk of periodontal disease in the patients who have visited for treatment. The study was reviewed and approved by the Institutional Review (****/IRB/SRP/11/20). A total of 100 patients with charting of the periodontal status was performed and those who met the inclusion criteria were enrolled in the study. Parameters recorded were- percentage of sites with bleeding on probing (BOP), number of sites with probing pocket depths (PPD) ≥ 5mm, number of the teeth lost, bone loss (BL)/age ratio, Clinical attachment loss(CAL)/age ratio, diabetic and smoking status, dental status, systemic factors like diabetes were assessed. All the risk factors were plotted on the radar chart in the PRA model and periodontal risk were categorized as low, medium and high risk.

2. Type of Study

This is a retrospective study.

3. Patient selection

Periodontal case sheets taken during the year 2020-2021 were collected and data was compiled.

Inclusion criteria

1. Patient with periodontal case sheets diagnosed as local or generalised periodontitis, recorded as periodontitis
2. Patient above 18 years of age

Exclusion criteria

1. Patients identified with good periodontal health.
2. Patient identified with gingivitis.
3. Patients identified with other forms of nicotine intake (e.g vaping).

Sample size calculation

$$n = \left(\frac{(Z_{\alpha/2})(\sigma)}{E}\right)^2$$

n = Sample size
Z = Standard error
σ = Standard deviation
E = Margin of error

4. Methodology

The investigators collected the periodontal case sheet and periodontal charting from the year of 2020 to 2021. Data were collected through periodontal case sheet records of patients that visited PIDC and periodontal charting for the past one year. Data obtained were entered into the Periodontal Risk Assessment tool online and results were generated. Periodontal risk assessment and demographic data of the patient was analyzed. (age, gender, ethnicity).

5. Data entry

Data collected was compiled and manually calculated using a bar graph. A correlation between periodontal risk assessment and demographic data of the patient was done with age, gender and ethnicity.

The periodontal case sheets were divided and categorized according to the age into 7 groups: 19-20, 21-30, 31-40, 41-50, 51-60, 61-70, 71-80. Online PRA was assessed and The status of risk for periodontitis was identified among the patient and categorized as low, medium and high. Four ethnic groups were identified from the cases recorded: Malay, Chinese, Indian, Foreigner and each ethnicity was correlated with PRA. Another categorisation is based on gender in which low, medium and high risk PRA is correlated.

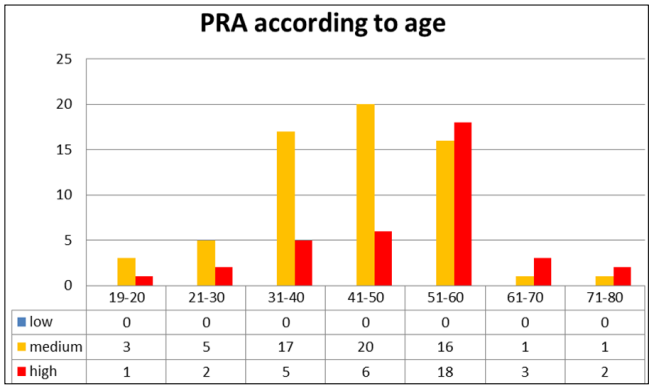
Results

1. Age group

According to the age group in this study, 3 people (75%) in the age of 19-20 have medium risk of periodontitis and 1 person (25%) have high risk of periodontitis. For patients with age of 21-30, 5 patients (71%) have medium risk of periodontitis and 2 patients (29%) have high risk of periodontitis. For the age group of 31-40, 17 patients (77%) have medium risk and 5 patients (23%) have high risk of periodontitis. For the age group of 41-50, 20 patients (77%) have medium risk and 6 patients (23%) have high risk of periodontitis. In the age group of 51-60, 16 patients (47%) have medium risk and 18 patients (53%) have high risk of periodontitis. Meanwhile, among people with age of 61-70, 1 patient (25%) have medium risk and 3 patients (75%) are categorised into high risk of periodontitis. For the oldest age group which is 71-80, 1 patient (33%) is medium risk and 2 patients (67%) are high risk. (graph 1; table 1)

Table 1: PRA according to age

Age group	11-20	21-30	31-40	41-50	51-60	61-70	71-80
Total patients	4	7	22	26	34	4	3
Low	0	0	0	0	0	0	0
Medium	75%	71%	77%	77%	47%	25%	33%
High	25%	29%	23%	23%	53%	75%	67%



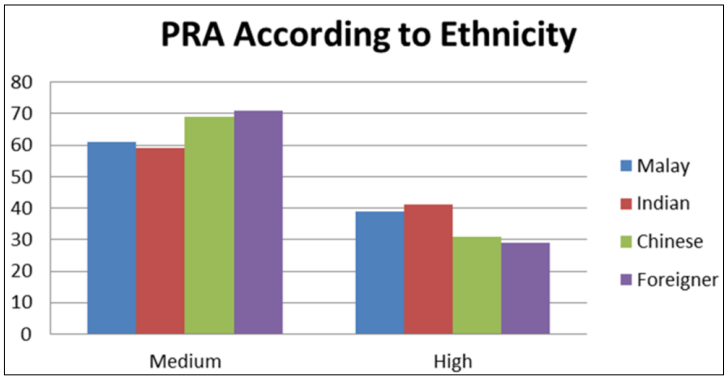
Graph 1: PRA according to age

2. Ethnicity

According to ethnicity, 11 (61%) of Malay patients are categorised into medium risk and 7 patients (39%) of them are high risk. Among the Chinese, 18 patients (69%) are medium risk and 8 patients (31%) are high risk meanwhile among Indians, 29 patients (59%) are categorised as medium risk and 20 patients (41%) are having high risk of periodontitis. Among the foreigners, 5 patients (71%) of them have medium risk of periodontitis and 2 patients (29%) have high risk of periodontitis. (graph 2, table 2)

Table 2: PRA according to ethnicity

Ethnicity	Malay	Chinese	Indian	Foreigner
Total number:	18	26	49	7
Low	0	0	0	0
Medium	61% (11)	69% (18)	59% (29)	71% (5)
High	39% (7)	31% (8)	41% (20)	29% (2)



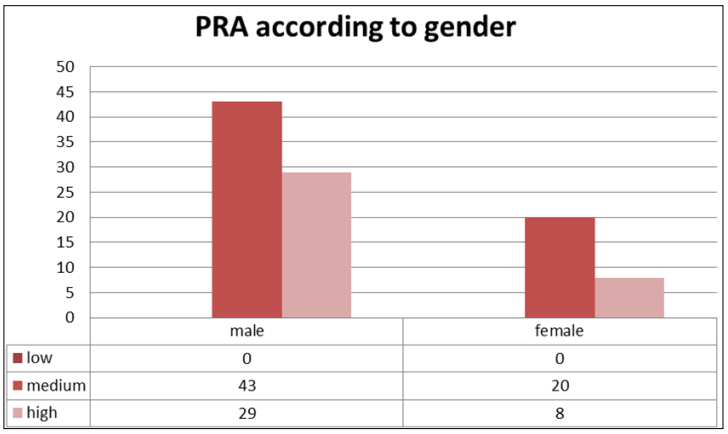
Graph 2: PRA according to ethnicity

3. Gender

Based on gender, among the male patients, 43 patients (60%) of them have medium risk and remaining 29 patients (40%) are high risk. For female patients, 20 patients (71%) are categorised as medium risk and 8 patients (29%) are categorised as high risk. (Graph 3; table 3)

Table 3

	Male	Female
Total patients	72	28
Low	0	0
Medium	60% (43)	71% (20)
High	40% (29)	29% (8)

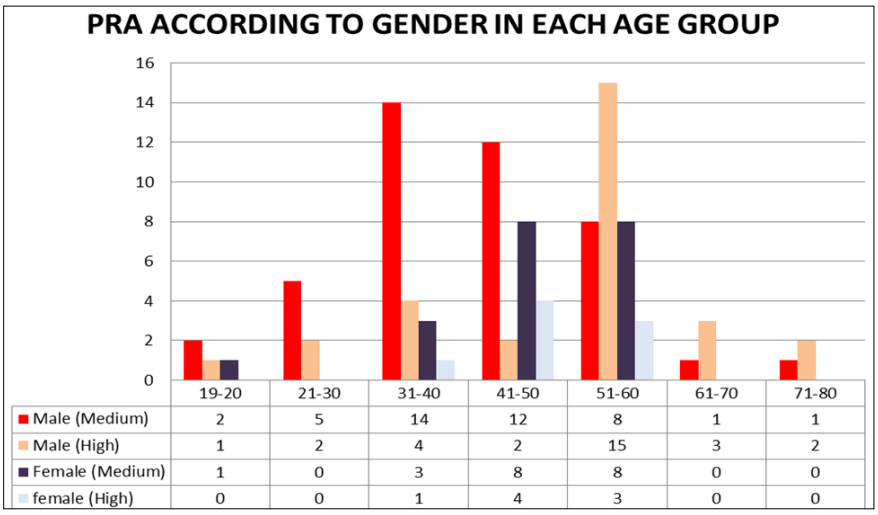


Graph 3: PRA according to gender

Based on gender in each group, in the male category, the highest number of patients having medium risk is age group 31-40 whereas in the high category is age group 51-60.
In the female category, the highest number of patients having medium risk is in the age group 41-50 and 51-60 while the age group of 41-50 has the highest number of people in the high category. (Graph 4; Table 4)

Table 4: PRA according to gender in each age group

	Male (Medium)	Male (High)	Female (Medium)	Female (High)
19-20	67%	33%	100%	0%
21-30	71%	29%	-	-
31-40	78%	22%	75%	25%
41-50	86%	14%	67%	33%
51-60	35%	65%	73%	27%
61-70	25%	75%	-	-
71-80	33%	67%	-	-



	19-20	21-30	31-40	41-50	51-60	61-70	71-80
Male (Medium)	2	5	14	12	8	1	1
Male (High)	1	2	4	2	15	3	2
Female (Medium)	1	0	3	8	8	0	0
female (High)	0	0	1	4	3	0	0

Graph 4: PRA according to gender in each age group

Discussion

In this study, an evaluation of periodontal risk assessment was made using the factors: BOP%, PPD more than or equal to 5, number of tooth loss, BL/Age, Systemic/ General disease and environmental factors.

1. Bleeding on probing (BOP)

BOP is determined by light probing to the bottom of the pocket with a standardized periodontal probe. BOP is measured at four sites per tooth (mesio-buccal, mid-buccal, disto-buccal, and mid-oral). This is best done by quadrants, buccal measurements first, followed by oral. The bleeding on probing score comprises the number of positive sites divided by the total number of sites multiplied by 100.

In the data analysed, from the recorded BOP it reveals that the number of sites involved were 30 to 192 based on the number of teeth present.

From the results, it was analyzed despite the BOP being high; the risk was medium provided other risk factors were normal. This suggests that BOP may not be a good indicator for clinical attachment loss and risk assessment but studies suggest its absence is an excellent negative predictor of future attachment loss. (4) BOP alone cannot be taken as a risk indicator and risk assessment is multifactorial.

2. Probing pocket depth

Four sites per tooth are gently probed (mesio-buccal, mid-buccal, disto-buccal, and mid-lingual). The number of pockets of 5mm or deeper are noted. Individuals with up to 4 residual pockets may be regarded as patients with a relatively low risk, while patients with more than 8 residual pockets as individuals with high risk for recurrent disease. From the data analysed, the number of sites with probing depth ≥ 5mm ranges from zero and the highest is 29.

All the case sheets recorded with highest numbers of sites with probing depth ≥ 5mm had a high PRA, suggesting it to be one of the prime factors for assessing risk. On the other hand, case sheets that recorded 0 sites had also high risk, suggesting that 'number of sites with probing depth ≥ 5 mm' alone cannot be taken as an risk indicator and risk assessment is multifactorial.

3. Number of teeth loss

Individuals with up to 4 teeth lost may be regarded as patients in a low risk category, while patients with more than 8 teeth lost may be considered as being in a high-risk category.

In the data analysed, the least number of tooth lost is zero and highest number is 16. All the case sheets recorded with the highest number of teeth loss had a high PRA, suggesting it to be one of the prime factors for assessing risk. On the other hand, case sheets that had 0 teeth loss had also high risk, suggesting that 'number of teeth lost' alone cannot be taken as an risk indicator and risk assessment is multifactorial.

4. Systemic disease

In assessing the patient's risk for disease progression, systemic factors such as diabetes mellitus, is a risk indicator for recurrent disease in the functional diagram of risk assessment. In this case, directly the area of high risk is marked for this vector, without taking into consideration the severity of the systemic conditions. If not known or absent, systemic factors are not taken into account for the overall evaluation of risk. This study showed all patients with systemic disease had high PRA.

5. Environmental factors

In assessing the patient's risk for disease progression, environmental factors such as smoking must be considered for periodontal disease progression in the functional diagram of risk assessment. In spite of the paucity of available evidence relating cigarette smoking to impaired outcomes during supportive periodontal therapy (SPT), it seems reasonable to incorporate heavy smokers (those who smoke greater than or equal to 25 or more cigarettes a day) (5) in a higher risk group during maintenance. While non-smokers (NS) and former smokers (FS; An adult who has smoked at least 100 cigarettes in his or her lifetime but who had quit smoking at the time of interview) have a relatively low risk for recurrence of periodontitis, the heavy smokers are definitely at high risk. Occasional smokers (OS; <10 cigarettes a day) and moderate smokers (MS; 10-19 cigarettes a day) may be considered at moderate risk for disease progression.

From the data analysed, it was found all heavy smokers had high PRA. On the contrary, 34 non smokers too had high risk suggesting environmental factors alone is not taken as an risk indicator and risk assessment is multifactorial.

6. BL/Age

Percentage of bone loss relating to the age of patient was calculated using the data of mean attachment level that is obtained from the periodontal charting. In this study, we consider clinical attachment loss level because according to previous study, in general, significant attachment loss preceded bone loss by 6 to 8 months. At 4 mm, attachment loss was found to predict subsequent bone loss with a true positive ratio of 60% and a false positive ratio of 5%, indicating a high degree of predictive discrimination. (Goodson JM *et al*., 1984) [6]. So a calculation was made in our study, where 1 mm of CAL loss was calculated to be 10% bone loss.

All the case sheets recorded with the highest bone loss: age had a high PRA, suggesting it to be one of the prime factors for assessing risk. On the other hand, 11 case sheets that showed low bone loss: age (<10%) had also high risk, suggesting that 'bone loss: age' alone cannot be taken as a risk indicator and risk assessment is multifactorial.

From the discussion above, it is found out that all the analysed factors: BOP%, PPD ≥5, number of tooth loss, BL/Age, Systemic/ General disease and environmental factors are to be correlated when evaluating a patient for periodontal risk assessment**.**

When the data was evaluated, the prevalence of high risk is more predominant in age groups 51-60, 61-70 and 71-80 because increased age has been proven to significantly influence the occurrence and severity of periodontitis. (Wulandari *et al*., 2022) [7].

Based on the comparison of gender, male patients have higher risk of periodontal disease than female patients cumulatively because of the multifactorial risk factors taken into consideration in the evaluation of periodontal risk assessment. According to a study by Lipsky, 2021, it showed that men are more prone to periodontal diseases due to a combination of biological and gender related reasons including immune system factors, hormone differences, poorer oral hygiene behaviors, and greater tobacco use. [8]

Out of different ethnicities of patients visiting PIDC, Indians have the highest risk for periodontitis followed by Malay, Chinese and foreigners. This was contrary to the other Malaysian studies (N.S Abdullah *et al*., 2013) where it was identified the Chinese population had higher prevalence of periodontitis.[9] The reason could be due to the majority of the patients visiting PIDC are Indians.

Out of the 100 case sheets, the number of cases identified with low risk were zero, medium were 63 and high were 37.

A recent study done by Saleh *et al*, 2022 aimed to validate the association of different risk categories of four PRATs (Staging and grading; Periodontal Risk Assessment (PRA); Periodontal Risk Calculator; and PerioRisk) with periodontal related tooth loss (TLP), and to compare their prognostic performance. All PRATs displayed very good predictive capability of TLP. PerioRisk showed the best discrimination and model fit, followed by PRA. [10]. A suggestion of estimating the risk in the first visit of patients by online PRA helps the clinician to predict the future tooth loss and patient to understand the disease.

A systematic review by Lang *et al*., 2015 concluded that in treated populations, results of patient-based risk assessments, for example periodontal risk assessment (PRA), predicted periodontitis progression and tooth loss in various populations. Additional research on the utility of risk assessment and results in improving patient management are needed. [11]

Conclusion

Risk assessment involves identifying factors that may predispose patients to develop periodontitis or influence the progression of existing diseases. In either case, a modification of the patient's prognosis and treatment plan is to be made by the clinician by assessing the risk. In addition to assessing the factors that contribute to the risk, the patients should also be informed about the risk and appropriate intervention strategies to be implemented.

From the present study, it has been found the number of cases identified with low PRA were zero; medium is 63 and high is 37.

From the data analysed, periodontal risk assessment does not depend on one factor and depends on multiple factors, which includes BOP%, PPD ≥5, number of tooth loss, BL/Age, Systemic/ General disease and environmental factors. A major emphasis has to be made on recording these factors while the patient is especially on patient's initial and maintenance phase and educating patients regarding the importance of keeping these 6 factors in check.

It was also found that elderly individuals had a higher risk compared to the middle and younger age group. The males had higher PRA recorded than females. Among patients visiting PIDC, Indians had a higher risk compared to the other ethnicities.

Information and education about the risk related to periodontitis is to be emphasised more on the groups that were identified to be at higher risk.

Limitations

1. A limited number of data was collected due to time constraint and inadequate sample
2. The samples are recruited from patients visiting PIDC and do not represent the whole population.
3. This study relies on the accuracy of written records. Hence, data quality is limited

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