Modified Periodontal Risk Parameters (MPRP) for Periodontal Management by Risk Assessment (PEMBRA): A Pilot Study

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Abstract

The distribution of periodontal disease increases with age with severe periodontitis affecting 11% of the world's population. The exposure to periodontal risks can be assessed using the parameters of PRA and PRC examined in PEMBRA. This prospective pilot study as a follow-up of a retrospective study combined the parameters as MPRP and grouped the parameters into low, medium, and high-risk during E&D. Eighteen periodontitis patients with BPE 3 and 4 were selected.

Clinical examination recorded parameters in MPRP. Descriptive analysis was performed and the parameters were analysed using SPSS version 24. The average age of the patients was 49 years old. The low risk was recorded in 5.6% of patients with plaque score:6%, BOP:10%, and PPD:1-3 mm. The medium risk was 22.2% with plaque score:38%±8.8, BOP:13.1%±3.1, PPD: ≥5 mm 7±4, tooth loss:3±3 and alveolar bone loss:0.79±0.2, and the high-risk at 72.2% with the plaque score:49.6%±14.6, BOP:43.8%±21.0, PPD ≥5 mm:5±10, tooth loss:5±6 and alveolar bone loss 0.9±0.3. 88.9% were non-diabetic, 83.3% were non-smokers and none had a history of periodontal surgery.

These results showed MPRP increased with the risks of getting the disease, the assessment of which served as an educational tool for the patient in oral hygiene practice and for clinicians during PEMBRA.

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Introduction

Periodontal disease is a disorder or an infection affecting the supporting tissues of teeth with the most common occurrences being gingivitis and periodontitis[1,2]. The distribution of the disease increases with age among adolescents and an older population from high-income countries[3]. The prevalence of severe periodontitis was approximately 10% of the global population in 2017[4] and in 2019, there were 1.1 billion prevalent cases of severe periodontitis globally with the age-standardised prevalence rate increased by 8.44% worldwide and this, could not be ignored[5]. There are risk factors that affect the susceptibility of the patients to develop periodontal disease, its severity, and the outcome of treatment[6]. Thus, the assessment of the risks has become the pivotal aspect in the management of periodontal disease[7] and may slow down and control the progression of the disease. The risk assessment identifies factors contributing to periodontal disease and predict the potential for patient susceptible to develop the disease, providing proactive and targeted treatment. The American Academy of Periodontology (AAP) believes the clinical use of risk assessment will become a component of all comprehensive individualised dental and periodontal evaluations inclusive of nonsurgical periodontal therapy and as well as Supportive Periodontal Therapy [8,9].

Page et al. (2002) developed a computer-based Periodontal Risk Calculator (PRC) for objective quantitative assessment of risk. The

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model is calculated based on nine factors of mathematically derived algorithms which were the age of the patient, smoking history, medical problems, such as diabetes, history of periodontal surgery, pocket depths, furcation involvements, restorations, or calculus below the gingival margin, radiographic bone height, and vertical bone lesions. The score ranges from 1 to 5, with 1 to 2 being low-risk (LR), 3 to 4 medium-risk (MR), and 5 high-risks (HR). PRC is usually done during examination and diagnosis (E & D) of periodontal patients[10]. Meanwhile, in 2003 Lang and Tonetti, reported on Periodontal Risk Assessment (PRA) describing a functional diagram based on six parameters for the progression of periodontitis. The six parameters are % BOP, no. of sites of PPD ≥5mm, number of tooth loss due to mobility out of 28 teeth, an estimation of the loss of periodontal support in relation to patient's age (bone loss), an evaluation of systemic (diabetic) or genetic conditions and, an evaluation of the environmental or behavioral factor (smoking). The spider-web formed classifies the patients into LR, MR, or HR. However, this PRA is done after treatment to assess periodontal risks for review and further management11,12 (Fig. 1).

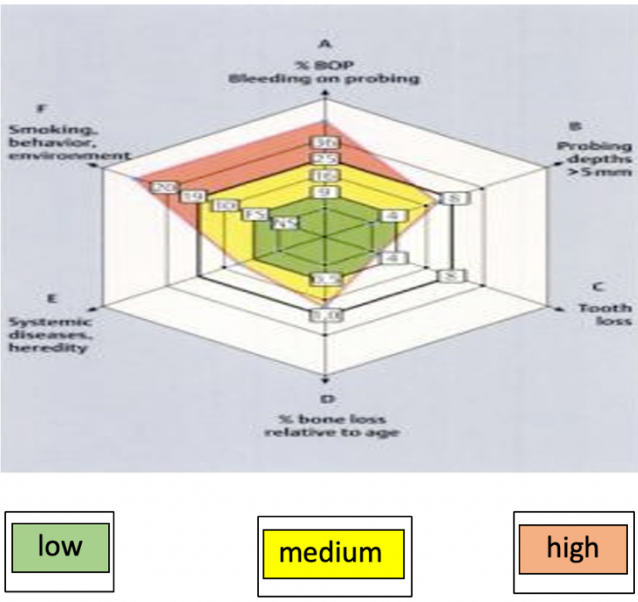

Figure 1. Spider-web PRA.

The study by Elizabeth Koshi et. al. (2012) reported that the use of risk assessment instruments might help to prevent or minimize the development of more advanced periodontal disease [13]. In 2015 study comparing both risk assessment tools suggested a future tool that incorporates mentioned risk parameters to assess the risk factors[14]. However, the latest comparative study of the two-risk assessments concluded PRA and PRC showed a minimal agreement, and recording specific disease severity may result in improved agreement[15]. As concluded by Dhulipalla et.al, evaluating the risk factors accordingly might help in reducing the health care cost of individual treatment and if done before nonsurgical periodontal therapy, clinicians would be able to forecast the future aspect of an individual's periodontal disease for a risk-based management plan[16].

PEMBRA focus on critical risk factors for diagnosis and predicting treatment plan. The criteria were easy to use, the assessment was rapid, the clinical technique minimally invasive, and the accurate diagnosis comprehensive periodontal charting was done[17]. This risk-based treatment approach for low, moderate, and high, categorised the management into mild, moderate, and more drastic or radical approaches with the specific review or supporting care interval, and indicating who should treat the patients as guidelines. Elizabeth Mertz et al. in 2017 used this tool during baseline and follow-up to motivate patients. They found out that with formal training, and knowing how to use the tools, clinicians highly ranked a commitment to evidence-based care and sensed that the tools were helping to improve patient care, health, and experience as motivation[18,19,20]. Thus, the objectives of this research were to identify the periodontal risk parameters from PRA and PRC as MPRP to be used in the E&D of periodontal patients and determine the patients' PEMBRA

Materials and methods

Patients were recruited according to the following inclusion criteria which were the age of 18-65 years old; number of teeth more than 10; patients with the Basic periodontal examination (BPE) of codes 3 and 4. Meanwhile, the exclusion criteria were pregnancy. All patients were provided with written informed consent. The parameters used in the E&D of the patient were based on the previous retrospective study as in PRA. Parameters were also added for categorising diabetes mellitus (DM) into non-DM, controlled, and poorly controlled and history of Non-smoking (NS), smoking <10 cigarettes,

smoking >10 cigarettes, smoking >20 cigarettes. Additional parameters were the number of teeth with subgingival restorations, history of periodontal surgery, and furcation with one and two sites involvement.

Patients were categorised into LR, MR, and HR. Results obtained from this pilot study could determine the most appropriate and effective parameters. Intra and inter-calibration of two examiners were carried out. The parameters and the risk group of the patients were analysed using SPSS version 24, and descriptive analysis was performed to get the frequency, percentage, mean and standard deviation (SD).

Results

From the screening of the patients with BPE 3 and 4, 18 patients (9 males and 9 females) were selected as research subjects. On E&D, 5.6% (n=1) patient was categorised in LR, 27.8% (n=4) in MR and 72.2% (n=13) was in HR group. The age of the patients was averaged as 49 years old (Fig. 2).

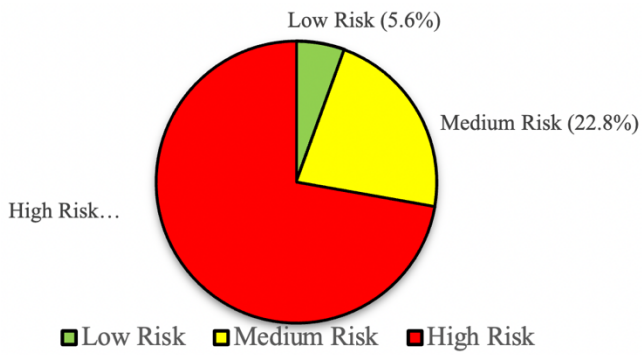

Figure 2. Risk assessment according to low, medium, and high risk.

Table 1 showed the risk parameters according to mean and standard deviation (SD) with % Plaque score (PS): 46.9(13.7), % BOP:35(23), PPD >5mm: 13.1(9.6), tooth loss due to mobility: 4(5) and alveolar bone loss/patient's age: 0.9(0.3). Non-DM patients (88.9%), NS (83.3%), and no involvement of teeth with furcation (77.8%) made up for most of the selected subjects, however, these groups were not specifically identified and analysed in the risk grouping.

Parameters	Frequency	Percentage (%)	SD
% PS			46.9(13.7)
% BOP			35(23)
No. of sites PPD >5mm			13.1(9.6)
No. of tooth loss due to mobility			4(5)
Alveolar bone loss/patient's age			0.9(0.3)
Presence of DM (NonDM)	16	88.9	
Presence of DM (Controlled)	2	11.1	
Presence of DM (Poor controlled)	0	0	
Smoking history (NS)	15	83.3	
Smoking history (<10 cigarettes)	0	0	
Smoking history (>10 cigarettes)	2	11.1	
Smoking history (>20 cigarettes)	1	5.6	
No. of teeth with subgingival restoration			0.33 (0.97)
History of periodontal surgery	0	0	
Furcation involvement (0 sites)	14	77.8	
Furcation involvement (1 site)	3	16.7	
Furcation involvement (2 sites)	1	5.6	

Table1. Risk parameters according to frequency, percentage, mean and standard deviation (SD).

Parameters	LR:Mean(SD)	MR:Mean SD)	HR:Mean (SD)
% Plaque score	16(0)	38 (8.8)	49.6 (14.6)
% BOP	10(0)	13.1 (3.1)	43.8 (21.0)
Number of sites PPD ≥5mm	0	7(4)	15(10)
No. of tooth loss due to mobility		3 (3)	5 (6)
Alveolar bone loss/patient's age		0.79 (0.15)	0.93 (0.30)
No. of teeth with subgingival restoration		0.75 (1.50)	0.23 (0.83)

Table 2. Frequency, mean and SD according to low, medium, and high risk.

Parameters	LR: Frequency (%)	MR: Frequency (%)	HR: Frequency (%)
Presence of DM -nonDM	1(6.25)	4(25.00)	11(68.8)
-controlled	0(0)	1(50.00)	1(50.00)
-poor controlled	0(0)	0(0)	0(0)
Smoking history NS	1(6.67)	3 (20.00)	11(73.33)
-<10 cigarettes	0(0)	0(0)	0(0)
- >10 cigarettes	0(0)	1(100.00)	0(0)
- >20 cigarettes	0(0)	0(0)	1(100.0)
History of periodontal surgery	0(0)	0(0)	0(0)
Furcation involvement	1(16.67)	4(66.67)	1(16.67)

Table 3. Frequency and percentage according to low, medium and high risk (Categorical data).

Table 2 recorded 5.6% of patients at LR with plaque score:16%, BOP:10%, and PPD:1-3 mm. The MR was 22.2% with plaque score:38%±8.8, BOP:13.1%±3.1, PPD: ≥5 mm 7±4, tooth loss:3±3 and alveolar bone loss:0.79±0.2, and the HR of 72.2% with the plaque score:49.6%±14.6, BOP:43.8%±21.0, PPD ≥5 mm:5±10, tooth loss:5±6 and alveolar bone loss 0.9±0.3. table 3 presented 6.25% of non-DM at LR, 25% at MR, and 68.8% at HR with none recorded as poorly controlled DM. The smoking history of the patients when categorised seems inconclusive though when analysed, LR has 6.25%, MR at 25%, and HR at 68.8%.

Discussion

It is very important to differentiate the risk factors from the cause of disease as the presence of risk factors does not necessarily lead to the occurrence or made worst of the disease. They may be modifiable or non-modifiable. As modifiable risk factors are usually environmental or behavioral in nature, they can be changed compared to non-modifiable factors which are usually intrinsic to the individual. From the population survey in Malaysia, 10.6% of subjects with deep pockets were found in the age group 45-54, which the occurrence is the highest compared to the other age group[21]. From our result, the average age of patients with deep pockets was the MR which was 42 years old, and HR at 52 years old and the economic burden of managing these cases of periodontitis at the national level is substantial due to this high prevalence[22].

One of the risk indicators to determine disease outcome was plaque score. In this study, the mean plaque score for LR, MR, and HR was reported as 16.0%, 38.0%, and 49.7% respectively. Interestingly, the plaque score did not vary significantly between ages, but there was a small increase in the percentage of sites with a plaque with increasing age. Since plaque is the main aetiological factor that contributes to periodontal disease and plays a major role in the maintenance of oral hygiene, it thus acts as a positive indicator for periodontal health[23]. Persistent gingival bleeding on probing was associated with an increased risk for periodontal breakdown[24,25]. Thus, BOP being an indicator of tissue inflammatory response to bacterial pathogens is widely used clinically to assess the periodontal condition and disease progression[26].

The % BOP in our study for LR, MR, and HR were 10%, 13.1%, and 43.8%. Specifically, the absence of BOP showed an almost 0% risk for periodontal breakdown, while pockets that constantly bled during follow-up appointments had a 30% risk of losing probing attachment. BOP still represents the most reliable clinical predictor for disease 'activity' during periodontal maintenance[27]. The number of sites of PPD ≥ 5mm renders the extent of progression of the disease and the increase indicated the HR of periodontal disease. In this study, the number of sites with PPD ≥5mm was 7 and the high risks were 15. The severity of periodontitis was significantly associated with deeper pockets for smokers, persons with higher body mass index, bridges and crowns, diabetes, [28] and those who were asthamatic[29] and elderly patients with cognitive impairment[30].

The mean of tooth loss due to mobility in MR was 3 teeth, while in HR was 5 teeth. The reasons for tooth loss were not known, due to the inability of some patients to recall the reasons. Besides tooth loss, the % of bone loss is a risk parameter in many studies. The higher the destruction of alveolar bone loss in relation to age increases the risk of progression of periodontal disease. In our study, the mean of MR is 0.79, while the HR is 0.93. To compare with previous unpublished retrospective studies, the LR was presented with 0 – 0.05, 0.6 – 1.0 categorised as MR, and 1.0 categorised as HR. Even though radiographic evidence of bone loss represented the history of periodontal diseases; however, it does not rule out the possibility of rapidly progressing lesions[31]. In relation to smoking, there is a dose-effect relationship between cigarette smoking and the severity of periodontal disease. Generally, studies showed that cigarette smoking is associated with a twofold to sevenfold increased risk of having attachment loss compared with NS[32,33]. After controlling factors such as age, sex, plaque, and calculus, in a study of 615 American adults, the odds of having a mean probing depth of at least 3.5 mm in selected posterior sextant was reported as five times greater for smokers than for non-smokers[34]. Smoking also has an immunosuppressive effect on the host, adversely affecting the host immune systems[35]. In our study, 6.3% (n=1) non-diabetic and 6.3% (n=1) controlled diabetic was in LR and 25% (n=4) in MR. Due to the small sample size, there is no subject with uncontrolled diabetes. The effect of smoking and DM on periodontal disease in our study could not be conclusively determined when compared to many studies cited.

Both supra and subgingival restorative margins influence the periodontal health in a similar manner with respect to plaque accumulation and increase in pocket depth[36,37]. However, there was no sign of subgingival restoration to the periodontal risks. There were also no subjects presented with a history of periodontal surgery hence the analysis of this parameter was inconclusive due to the small sample size even though studies showed that

surgical procedures were effective in reducing the pocket depth to various levels[38]. Even though 22.2% of subjects have furcation-involved teeth, a study by Nibali et al. (2021) reported that only 8.9% of general dental practitioners felt confident in treating furcation-involved teeth[39]. and believed that teeth were twice as likely to be lost[40] and that regardless of the type of therapy provided or the inability to adequately instrument these areas during the therapy[41] however, the study by Ferreira et al. 2020 showed improvements in probing depth, BOP, and radiographic aspects[42.]

Strength of the Study

Based on the suggestions from the publication that has been accepted on our retrospective study, we increased the number of parameters adapted from PRC which were furcation involvement, history of periodontal surgery, and subgingival restorations. In smoking, we have also specified into NS, smoke <10, >10, and >20 cigarettes per day. For DM, we specified non-DM, controlled, and poorly controlled.

Limitation of the Study

The limitation of the study was the small sample size and short duration of the study.

Recommendation: A specific and detailed record of parameters especially in relation to diabetes and smoking is recommended during E&D. Thus, a more in-depth study of each of these parameters is needed with bigger samples to control the effects of each specific parameter on the disease. The development of a calculator as a web-based tool for a clinical protocol in the application of PEMBRA is recommended for future study.

Conclusions

The identification of periodontal risk parameters is important to diagnose, determine the prognosis, and categorise the patients into the low, medium, and high-risk groups during E&D. Risk assessment of the MPRP served as an educational tool for patients to maintain good oral hygiene practices, and for the clinicians to implement PEMBRA early in the management of the patients.

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Ethics Statement: This study was approved by the Ethics Research Committee of Universiti Teknologi Mara Malaysia (Reference No.600-IRMI (5/1/16).

Declaration of Interest

The authors report no conflict of interest.

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