The Evidence-based Periodontal Risk Assessment (PRA) Tool for Nonsurgical Periodontal Therapy in a Comprehensive Periodontal Management by Risk Assessment (PEMBRA)

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ABSTRACT

In the management of periodontitis patients, periodontal risk assessment (PRA) tool is currently being applied during periodontal review (PR). However, an assessment of risk profiles during examination and diagnosis (E&D) may and would effectively assess and diagnose patients' periodontal conditions, provide personalised treatment planning, and render an enhanced patient care through periodontal management by risk assessment (PEMBRA). From a retrospective study on selected records of 81 patients treated for chronic periodontitis, the PRA profiles of the patients were evaluated during E&D and two to three months after completion of nonsurgical periodontal therapy (NSPT) during PR. The results were analysed using SPSS version 24 for descriptive statistics. On E&D, the patients presented with 25.9% localised and 74.1% generalised chronic periodontitis. Of these, 2.5% of low-risk patients on E&D increased to 21% during PR signifying an improvement after the treatment. However, the medium-risk patients have a slight increase from 32% to 35%, and patients with a high risk of 62% were reduced to 43%. The improvement of the risk profiles for both low and high-risk groups was mostly contributed by the reduction in the plaque score, percentages of bleeding on probing (BOP), and probing pocket depth (PPD) ≥ 5 mm. This evidence-based evaluation of PRA tool during E&D and PR is important for

PEMBRA as it encouraged the clinicians to adopt periodontal management through basic periodontal examination, detailed periodontal charting, radiographic interpretation, tooth per tooth prognosis, diagnosis, and targeted NSPT.

Keywords: Nonsurgical periodontal therapy; periodontal management by risk assessment; retrospective; risk factors

INTRODUCTION

National Oral Health Surveys of Malaysian Adults revealed increments in the percentage of periodontal patients (OHD-MOH, 2004; 2013). With advances in medical technology and the rise of an ageing population, the need for future periodontal management increases. Periodontal disease affects the supporting tissues of teeth and it was classified into gingival diseases and conditions, periodontitis, other conditions affecting the periodontium, and peri-implant diseases and conditions (Caton *et al.*, 2018). A study reported that periodontal disease prevalence declined from 92.8% in 1990 to 87.2% in 2000 but raised sharply to 94.0% in 2010 signifying the substantial clinical burden of periodontal disease (Mohd-Dom *et al.*, 2013).

The accepted management for periodontal disease can be divided into nonsurgical periodontal therapy (NSPT), surgical therapy, and supportive periodontal therapy (SPT) (Kwon *et al.*, 2020). SPT carries the utmost importance for the maintenance of periodontal health. Periodontal risk assessment (PRA) has been used to assess the individual risk for recurrence of periodontal disease. Risk assessment was defined as the likelihood of adverse events to occur because of exposure to specified health hazards (AAP, 2008). It is a way of examining risks so that they may be managed, avoided, or reduced. PRA evaluates six aspects of risk factors for periodontal disease, namely the percentage of bleeding on probing (BOP), number of probing pocket depth (PPD) ≥ 5 mm, number of tooth loss excluding the third molars (Tooth loss), percentage of alveolar bone loss (BL/Age) related to patient's age, systemic and/or genetic predispositions

(Syst./Gen.), and environmental factors primary consumption of tobacco (Envir.) (Lang & Tonetti, 2003). The six risk factors were designated into a spider-web PRA which would classify the patients as having low, medium, or high risk of getting periodontal disease. There has been increasing focus on the development of a more sensitive and specific diagnostic test that would allow clinicians to determine and monitor active disease (Tenenbaum *et al.*, 2005). Recent interest in the biomarkers validation for the diagnostic use approach has been reported however it is still in the very early stage of implementation (Rakic *et al.*, 2021). While PRA is proven to be beneficial for the maintenance of periodontal treatment, attempts to improve the ability to predict future disease progression have also been studied. Hence, the application of Periodontal Management by Risk Assessment (PEMBRA) (Mullins *et al.*, 2016).

The suggested pathway for PEMBRA recommended Good Practitioner's Guide to Periodontology 2016 which is the screening of periodontal patients using Basic Periodontal Examination (BPE) (BSP, 2016). A full mouth periodontal charting as a standard of care for patients with BPE 3 and 4 is done to record overall oral conditions relating to periodontal health or disease. The chart should record PRA parameters with details of systemic and environmental factors meant for early intervention of diabetic control and smoking cessation programmes. Radiograph investigation, being an aid to diagnosis and prognosis is invaluable for PEMBRA. Once the disease has been diagnosed and classified, appropriate evidence-based treatment is thus managed (Kwok & Caton, 2007). One of the key aspects of successful periodontal

management is patient engagement. If the patient understands their current condition, what factors have contributed to it, and what they can do to improve their periodontal health, they are more likely to comply with the recommendations. Patients should take responsibility for oral hygiene maintenance. Patient education and motivation, complemented by visual aids in innovative ways would encourage behaviour changes in patients. A complete PEMBRA with systematic NSPT contributes to successful periodontal management (Patel, 2020).

Various risk assessment tools, PRA among others, have been reported to provide an effective and logical system to stratify patients based on treatment needs. These tools have displayed very good predictive capabilities (Saleh *et al.*, 2022). As the guideline PRA is to be conducted during PR, and not during E&D, the benefits of the risk assessment of the periodontal status of the patient on the first time the patient is seen were not being studied for a more comprehensive treatment planning for the patient. Thus, by performing PRA during E&D and before NSPT, clinicians would be able to predict the risks for the individual's needs and conduct disease management. Accurate periodontal clinical decisions can be made and the need for complex therapy and health care costs will be reduced, hastening the transition from repair to wellness (Sujai *et al.*, 2015). The aim of this study was to evaluate the risk factors in PRA during E&D and explore the use of PRA for PEMBRA. The findings of this study could be applied as a reference for future PEMBRA in the comprehensive management of periodontal patients.

MATERIALS AND METHODS

This retrospective study reported records of 81 subjects (42 males and 39 females) with a mean age of 48.5, treated for periodontitis at the Centre of Periodontology Studies, Faculty of Dentistry, Universiti Teknologi MARA (UiTM), Malaysia. The records were studied for a two-month period of an elective research project, from October 2016 to November 2016. It was a convenient sampling of records of patients treated by the clinical dental students during their periodontal clinic sessions. Approval for the study was obtained from UiTM Research Ethics Committee [Ref. no.: 600-IRMI (5/1/6)REC/96/16]. Patients' records were selected based on the diagnosis stated as localised or generalised periodontitis. For this study, localised periodontitis was diagnosed when the patient has less than 30% of sites with periodontal destruction and generalised periodontitis was when periodontal destruction was more than 30% (Wiebe & Putnins, 2000). The degree of severity was reported as mild when the clinical attachment loss (CAL) was up to 2 mm (PPD ≤ 5 mm), moderate when CAL was 3 mm to 4 mm (PPD, 6 mm to 7 mm) and severe when CAL ≥ 5 mm (PPD ≥ 8 mm). The records of patients with six PRA parameters were selected as described by Lang & Tonetti (2003) and stated on the records during E&D and two to three months later after completion of NSPT during PR. The standard guideline for the students on NSPT was oral hygiene instruction and motivation, scaling full mouth and root debridement on PPD ≥ 5 mm, and removal of plaque retentive elements. During PR, a complete periodontal examination was done with PRA recording and further treatment planning for the patients. The parameters of the risk factors were evaluated for E&D and PR. Patients with relatively low risk would appear as profiles in the inner circle of the spider web (Fig. 1), moderate risk as parameters in between the two bold rings (Fig. 2), and the high risk would be recorded outside the periphery of the second ring in bold (Fig. 3).

The results were analysed using SPSS version 24 for descriptive statistics for each risk factor from E&D and PR. A comprehensive evaluation of PRA provided an individualised risk profile of low, medium, and high risk. The inclusion criteria were patients aged 18 years old to 65 years old
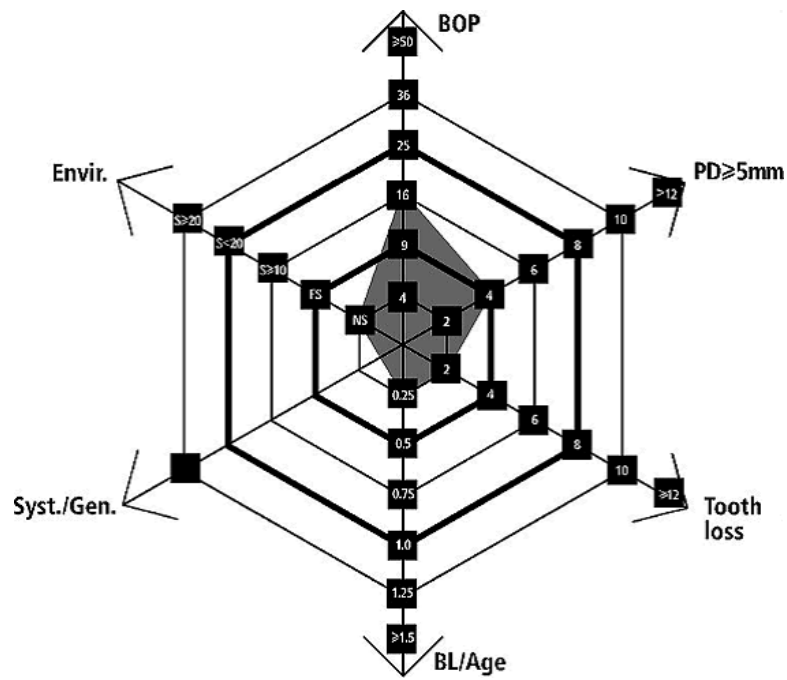
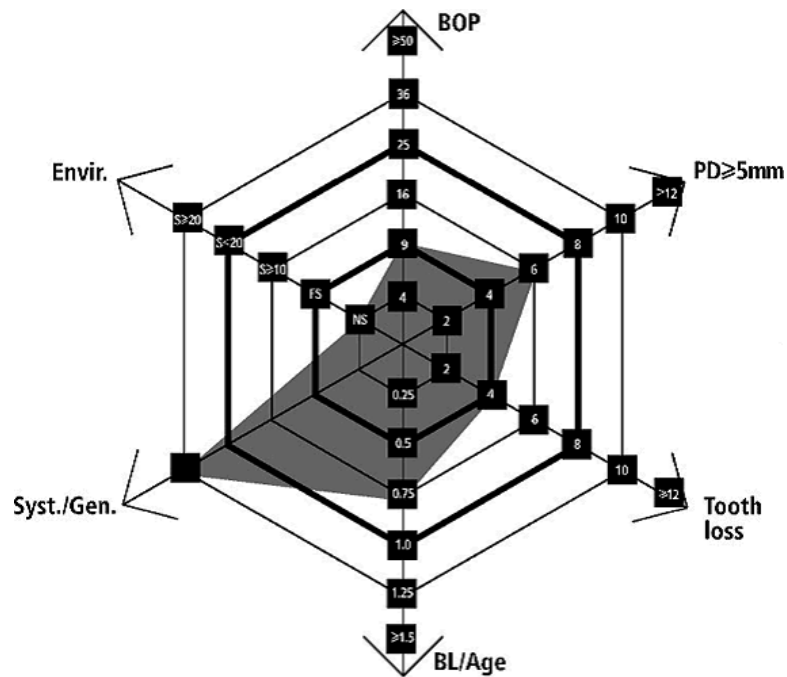**Fig. 1** Functional diagram of low-risk patient.

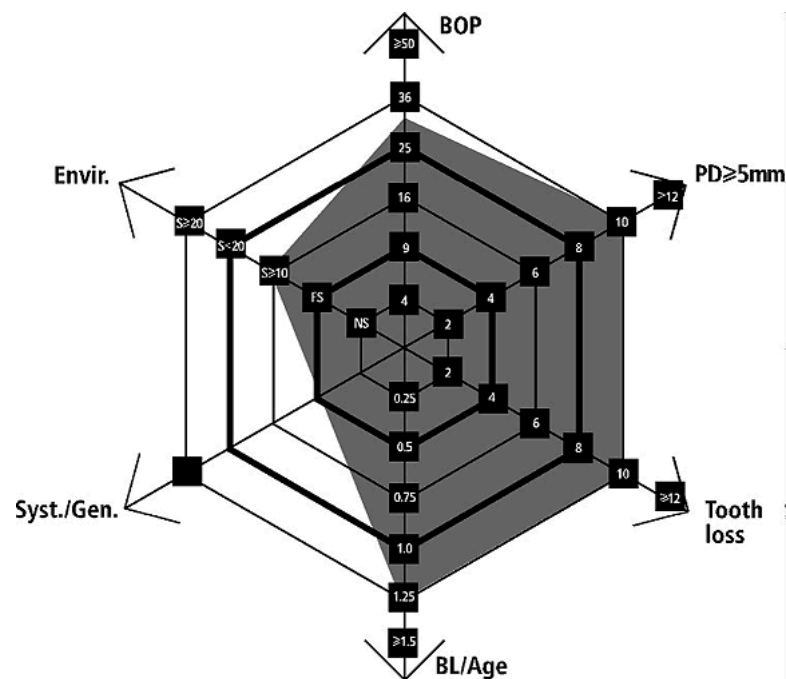**Fig. 2** Functional diagram of medium-risk patient.

Fig. 3 Functional diagram of high-risk patient.

and BPE with code 3 and 4. Exclusion criteria were subjects with PPD ≥ 9 mm and confirmed pregnancy.

RESULTS

A total of 81 periodontal patients' records were analysed in this study. The mean value for plaque score was recorded as 58.3% during E&D and reduced to 34.7% during PR. In Fig. 4, 25.9% of the patients had localised chronic periodontitis (LCP) and 74.1% with generalised chronic periodontitis (GCP) during E&D. On PR, LCP was 56.7% (30.9% increment) and GCP was 43.2% (30.8% reduction).

For severity of periodontitis, there were 46% of patients with the mild stage of periodontitis, 37% with moderate stage and 17% with advanced stage during E&D. On PR, 12.3% of the patients became periodontally healthy after NSPT (BOP ≤ 20% and plaque score ≤ 10%) and 16% reduction on moderate stage; however, 17% with advanced stage remained the same (Fig. 5).

Fig. 6 showed 2.5% of patients presented with low risk, 32% with medium risk, and 65% with high risk during E&D. There was a reduction in the percentage of the high-risk patients to 43% and as expected, an increment of low-risk patients from 2.5% to 21% with just a small change in the medium-risk group.

For BOP, patients with BOP ≥ 25% indicated high risk. During E&D, 84% of patients presented with high-risk categories which reduced to 38.3%, and low-risk patients increased from 2.5% to 10% during PR. The percentages of medium-risk patients seemed to increase due to the high-risk group becoming better after NSPT (Fig. 7).

During E&D, 60% of the patients at low risk had only 4 sites with PPD ≥ 5 mm, 21% with medium risk (4 to 8 sites with PPD ≥ 5 mm) and 18.6% with high risk (≥ 8 sites with PPD ≥ 5 mm). The low-risk group increased to 68%, the medium-risk group dropped to 8.6% but the high-risk group remained almost the same at 18.6% during PR (Fig. 8). The number of tooth loss due to periodontal disease could not be determined precisely (Fig. 9). Of those with
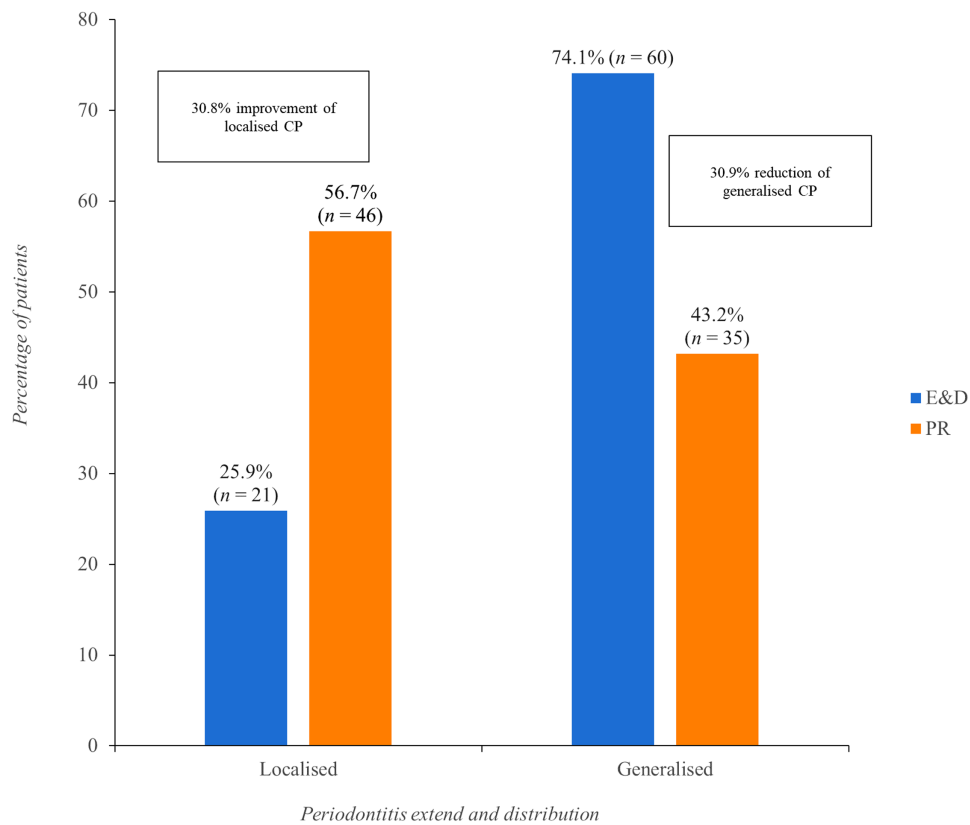
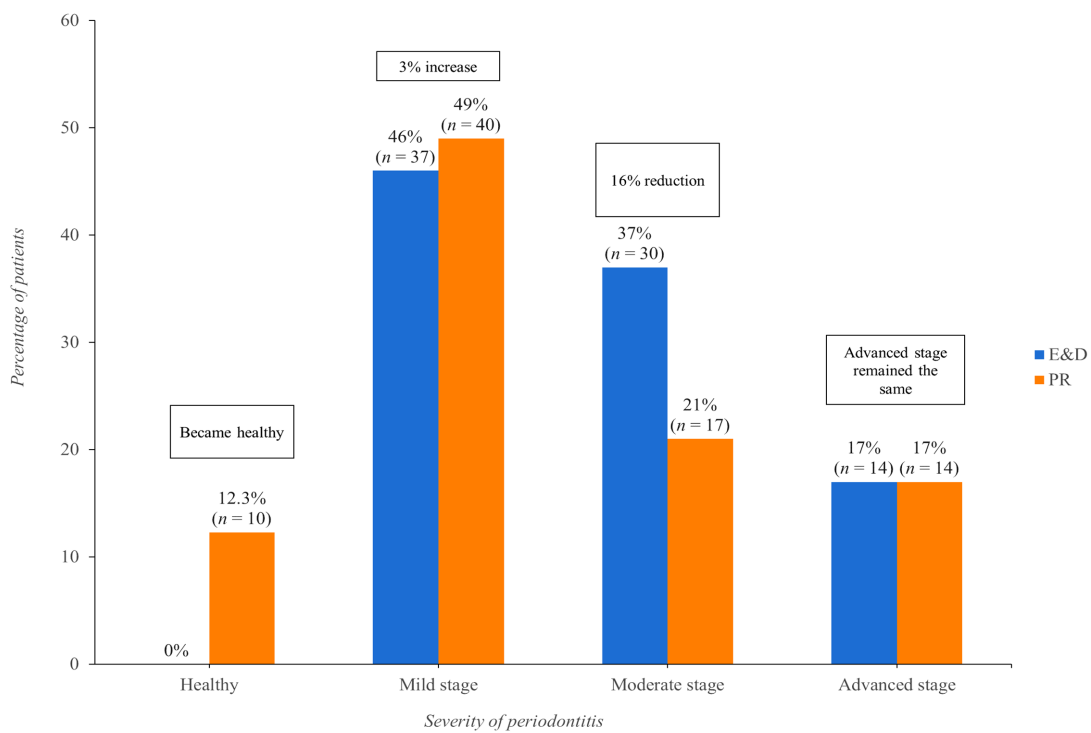**Fig. 4** The periodontitis extend and its distribution.

Fig. 5 The severity of periodontitis in stages.
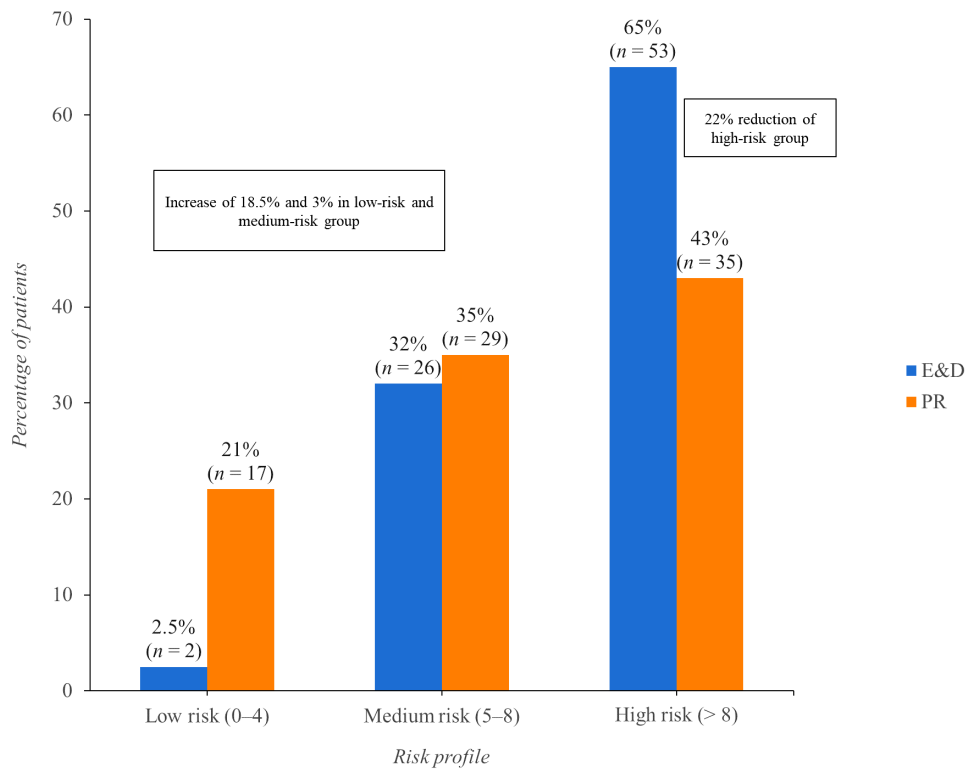
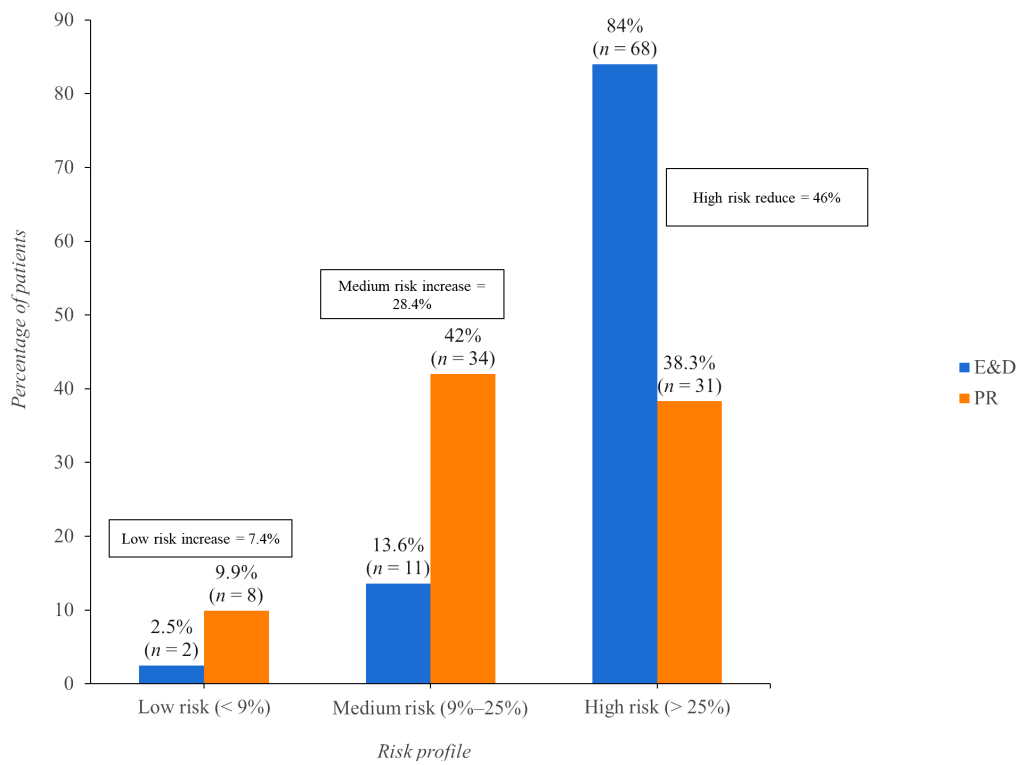**Fig. 6** The risk profiles in E&D and PR.

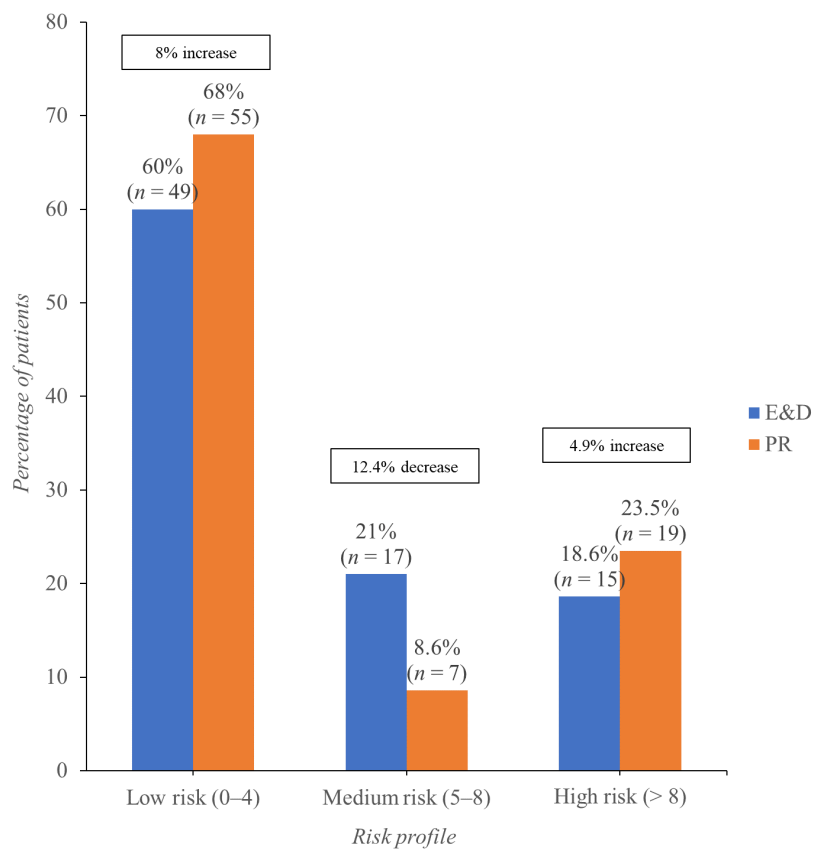**Fig. 7** Percentage BOP according to risk profiles.

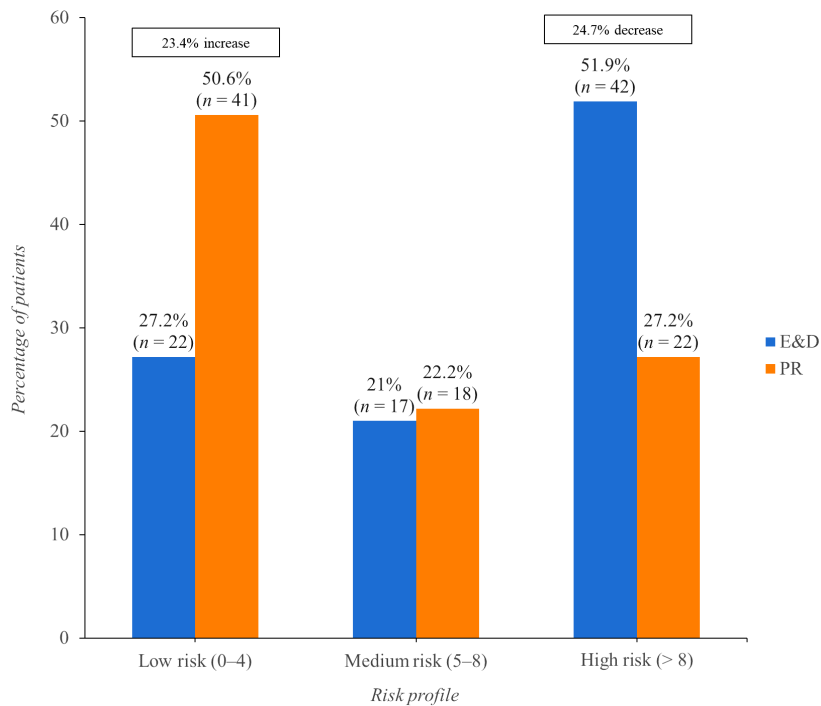**Fig. 8** PPD ≥ 5 mm according to risk profiles.

Fig. 9 Number of tooth loss per age according to risk profiles.

records, during E&D, 27.2% has 4 or less tooth loss (low risk), 21% with 4 to 8 tooth loss (medium risk), and 51.9% with ≥ 8 teeth loss (high risk). On PR, the percentages of low-risk patients increased to 50.6%, patients with medium risk remains almost the same at 22.2%, and those with high risk reduced to 27.2%, respectively.

The extent of alveolar BL concerning the patient's age presented with 43% at low risk (BL/age = 0.5), 40% at medium risk (BL/age = 1.0), and 17% at high risk (BL/age = ≥ 1.0) during E&D. Only one orthopantomogram (OPG) from each patient was taken, and comparison could not be made during the two-month period of this study when the retrospective data was recorded. There were 11% ($n = 9$) of patients presented with diabetes mellitus while the rest (89%) were medically fit and healthy. Out of the 17% of patients with advanced periodontitis ($n = 14$), only one patient has diabetes mellitus, while the other 13 patients were medically fit and healthy. The diabetes mellitus could not be determined whether it was controlled or uncontrolled as there was no information recorded. The number of cigarettes smoked per day was recorded. In this study, low risk (non-smokers or former smoker) was 81.5% and 83 % for E&D and PR, medium risk (occasional smoker or smoke 10 to 19 cigarettes a day) at 18.5% and 17.3% and none grouped in high risk is a heavy smoker (smoke more than one pack per day).

DISCUSSION

The differences in PRA for E&D and PR were on the modifiable risk factors which were the percentage BOP, the number of PPD ≥ 5 mm, diabetes mellitus, smoking, and tooth loss. Meanwhile, the non-modifiable risk factors such as BL/age would remain the same in a short study period of two to three months. The modifiable risk factors could be targeted during E&D and relooked again, during PR in the holistic PEMBRA so that early interceptive

procedures can be undertaken to achieve better outcomes. The improvement in the number of patients diagnosed with localised and generalised periodontitis, mild and moderate periodontitis is attributed to the success of treatment and patients' compliance during NSPT. However, there was no improvement in the percentage of patients with advanced periodontitis that could be achieved within this short period of study. The absence of improvement might be due to the lack of patients' compliance in oral hygiene practice (Axelsson & Lindhe, 1981), or the lack of skills among dental students in managing cases with advanced stages of periodontitis that require periodontal surgery to reduce the PPD.

In a recent long-term study on PRA on SPT by Sonnenschein *et al.* (2020), patients that started with 10% of patients with low risk were improving to 55.3%, and 58% of the moderate-risk patients were improving to 71.9%. The high-risk patients of 25.3% had not changed their initial risk and the non-adherent patients were in this group (18% to 43%). This study concluded that a high level of adherence to SPT intervals based on PRA influences the periodontal status of the patients. Our study reported an improving trend even though it was only for a duration of two months. Percentage BOP for the high-risk group in our study reduced from 84% to 38.3% with 10% achieving healthy gingival condition (BOP < 20%).

Reduction of inflammation of the periodontium due to lesser bacterial load leads to beneficial clinical changes (Newbrun, 1996). Patients in our study had a low level of plaque control initially but improved significantly with the motivation and oral hygiene instruction during NSPT. Identifying the individualised risk profiles for the patients has benefited them in improving their oral home care practices. As in this study, the improvement of the low-risk group with PPD ≥ 5mm during E&D to PR from 60% to 68% and became static for the high-risk group indicated the success of NSPT for PPD reduction. One study stated that

the reduction appeared to be dependent on the severity of periodontal disease, tooth type, and furcation involvement in E&D (Van der Weijden *et al.*, 2019). However, our study did not record the reduction of severity specifically referring to tooth type and furcation of the involved teeth. The high-risk group might not have shown improvement over the two months period and there might be cases that require surgical intervention to achieve periodontal health.

The radiographic evidence of BL forms an essential part of the clinical record of the patients, but they only provide retrospective evidence of the disease progress and it does not rule out the possibility of rapidly progressing lesions. For this study, the OPG was taken during E&D only, thus no comparison could be made. Reasons for the tooth loss due to periodontal disease could not be determined due to the lack of data. On PR, the number of teeth lost less than four was increased by 86% indicating teeth were removed during NSPT. The type of treatment did not significantly affect tooth retention rather the initial diagnosis became the important variable (Grossi *et al.*, 1995). Besides that, another study has reported compliance, age, and gender were major factors in tooth loss (McLeod *et al.*, 1997). However, none of these was recorded as reasons for tooth loss in this study. The reduction of the high-risk patients on tooth loss on PR could be due to the removal of teeth involved periodontally during NSPT. On diabetic risk factors, poorly controlled diabetics respond less successfully to periodontal therapy (Westfelt et al., 1996) but for our study, the risk factors have not been fully explored during E&D and further management on the 14 patients with diabetes was not known. The same went for smoking even though many studies have reported that smoking behaviours have consistently been associated with attachment loss and higher probing depth (Löe, 1993; Albandar *et al.*, 2000; Tomar & Asma, 2000; Razali *et al.*, 2005; Johnson & Guthmiller, 2007) and contributed to a high-risk group for PRA. However, the records for both parameters

could not be comprehensively included for analysis in this study. As seen in this study, the risk profiles for patients with advanced periodontitis did not change after NSPT. There could be other factors that need to be targeted to reduce the risk. The increase of the number of PPD ≥ 5 mm suggested either the inability of clinicians to perform good removal of aetiological factors or the inability of the patients to perform good oral hygiene practice during NSPT, or the presence of deeper pockets more than 7 mm which did not resolve after NSPT. By knowing these possibilities and having risk profiling done, a risk-based treatment plan can be done with the reduction of risk as one of the treatment goals.

LIMITATION OF THE STUDY

Inter-examiner variability and subjectivity of the parameters and the lack of skills among the students in determining the factors might result in inaccurate risk profiling. The dependency of the parameters on the patient's history taking might not be accurate as some might not disclose their real and updated medical conditions. There were also no detailed records of other NSPT being carried out that might contribute to the success or failures of NSPT affecting the risk profiles outcome.

RECOMMENDATIONS

A prospective pilot study is recommended to explore the confounding factors of diabetes and smoking as the inclusion criteria which would shed light on the assessment of PRA in PEMBRA. Detailed information on these risk factors may allow for early intervention.

CONCLUSION

The evaluation of PRA tool for periodontal health is important to make sure appropriate management is given to the patient during E&D until the patient is placed on SPT.

The improvement of the risk profiles for both low and high-risk groups was mostly contributed by the reduction in percentage plaque score, percentage BOP, PPD ≥ 5 mm, and removal of teeth affected by periodontitis. The evidence-based evaluation of PRA tool during E&D and PR is important for PEMBRA as it encouraged the clinicians to adopt comprehensive periodontal care management for the patient.

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REFERENCES

Albandar JM, Streckfus CF, Adesanya MR, Winn DM (2000). Cigar, pipe, and cigarette smoking as risk factors for periodontal disease and tooth loss. *J Periodontol*, **71**(12): 1874–1881. https://doi.org/10.1902/jop .2000.71.12.1874

American Academy of Periodontology (AAP) (2008). American Academy of Periodontology statement on risk assessment. *J Periodontol*, **79**(2): 202. https://doi.org/10.1902/jop.2008.082001

Axelsson P, Lindhe J (1981). The significance of maintenance care in the treatment of periodontal disease. *J Clin Periodontol*, **8**(4): 281–294. https://doi.org/10.1111/j.1600 -051x.1981.tb02039.x

British Society of Periodontology (BSP) (2016). *The Good Practitioner's Guide to Periodontology*, 3rd version. London: British Society of Periodontology, pp. 10–14.

Caton JG, Armitage G, Berglundh T, Chapple ILC, Jepsen S, Kornman KS *et al.* (2018). A new classification scheme for periodontal and peri-implant diseases and conditions – Introduction and key changes from the 1999 classification. *J Clin Periodontol*, **45**(Suppl 20): S1–S8. https://doi.org/10 .1111/jcpe.12935

Grossi SG, Genco RJ, Machtei EE, Ho AW, Koch G, Dunford R *et al.* (1995). Assessment of risk for periodontal disease. II. Risk indicators for alveolar bone loss. *J Periodontol*, **66**(1): 23–29. https://doi.org/ 10.1902/jop.1995.66.1.23

Johnson GK, Guthmiller JM (2007). The impact of cigarette smoking on periodontal disease and treatment. *Periodontol 2000*, **44**(1): 178–194. https://doi.org/10.1111/j.1600 -0757.2007.00212.x

Kwok V, Caton JG (2007). Commentary: Prognosis revisited: A system for assigning periodontal prognosis. *J Periodontol*, **78**(11): 2063–2071. https://doi.org/10.1902/jop .2007.070210

Kwon TH, Lamster IB, Levin L (2020). Current concepts in the management of periodontitis. *Int Dent J*, [Advance online publication]. https://doi.org/10.1111/idj .12630

Lang NP, Tonetti MS (2003). Periodontal risk assessment (PRA) for patients in supportive periodontal therapy. *Oral Health Prev Dent*, **1**(1): 7–16.

Löe H (1993). Periodontal disease: the sixth complication of diabetes mellitus. *Diabetes Care*, **16**(1): 329–334.

McLeod DE, Lainson PA, Spivey JD (1997). The effectiveness of periodontal treatment as measured by tooth loss. *J Am Dent Assoc*, **128**(3): 316–324. https://doi.org/10.14219/ jada.archive.1997.0195

Mohd-Dom TN, Abdul-Muttalib K, Ayob R, Lan YS, Mohd-Asadi AS, Abdul-Manaf MR *et al.* (2013). Periodontal status and provision of periodontal services in Malaysia: Trends and way forward. *Malays J Public Health Med*, **13**(2): 38–47.

Mullins JM, Even JB, White JM (2016). Periodontal management by risk assessment: A pragmatic approach. *J Evid Based Dent Pract*, **16**(Suppl): 91–98. https://doi.org/10.1016/j.jebdp.2016.01.020

Newbrun E (1996). Indices to measure gingival bleeding. *J Periodontol*, **67**(6): 555–561. https://doi.org/10.1902/jop.1996.67.6.555

Oral Health Division, Ministry of Health Malaysia (OHD-MOH) (2004). *National Oral Health Survey of Adults 2000 (NOHSA 2000): Oral Health Status, Impacts and Treatment Needs of Malaysian Adults*. Putrajaya: OHD-MOH.

Oral Health Division, Ministry of Health Malaysia (OHD-MOH) (2013). *National Oral Health Survey of Adults 2010 (NOHSA 2010)*. Putrajaya: OHD-MOH.

Patel A (2020). A new approach to periodontal management. *Br Dent J*, **228**(4): 233–234. https://doi.org/10.1038/s41415-020-1337-9

Rakic M, Pejcic N, Perunovic N, Vojvodic D (2021). A roadmap towards precision periodontic. *Medicina (Kaunas)*, **57**(3): 233. https://doi.org/10.3390/medicina5703 0233

Razali M, Palmer RM, Coward P, Wilson RF (2005). A retrospective study of periodontal disease severity in smokers and non-smokers. *Br Dent J*, **198**(8): 495–498. https://doi.org/10.1038/sj.bdj.4812253

Sujai GVNS, Triveni VS, Barath S, Harikishan G (2015). Periodontal risk calculator versus periodontal risk assessment. *J Pharm Bioallied Sci*, **7**(Suppl 2): S656–S659. https://doi.org/10.4103/0975-7406.163593

Saleh MHA, Dukka H, Troiano G, Ravidà A, Qazi M, Wang HL *et al.* (2022). Long term comparison of the prognostic performance of PerioRisk, periodontal risk assessment, periodontal risk calculator, and staging and grading system. *J Periodontol*, **93**(1): 57–68. https://doi.org/10.1002/JPER.20-0662

Sonnenschein SK, Kohnen R, Ruetters M, Krisam J, Kim TS (2020). Adherence to long-term supportive periodontal therapy in groups with different periodontal risk profiles. *J Clin Periodontol*, **47**(3): 351–361. https://doi.org/10.1111/jcpe.13252

Tenenbaum HC, Tenenbaum H, Zohar R (2005). Future treatment and diagnostic strategies for periodontal diseases. *Dent Clin North Am*, **49**(3): 677–694. https://doi.org/10.1016/j.cden.2005.03.006

Tomar SL, Asma S (2000). Smoking-attributable periodontitis in the United States: Findings from NHANES III. National Health and Nutrition Examination Survey. *J Periodontol*, **71**(5): 743–751. https://doi.org/10.1902/jop.2000.71.5.743

Van der Weijden GAF, Dekkers GJ, Slot DE (2019). Success of non-surgical periodontal therapy in adult periodontitis patients: A retrospective analysis. *Int J Dent Hyg*, **17**(4): 309–317. https://doi.org/10.1111/idh .12399

Westfelt E, Rylander H, Blohmé G, Jonasson P, Lindhe J (1996). The effect of periodontal therapy in diabetics. Results after 5 years. *J Clin Periodontol*, **23**(2): 92–100. https://doi.org/10.1111/j.1600-051X.1996. tb00540.x

Wiebe CB, Putnins EE (2000). The periodontal disease classification system of the American Academy of Periodontology: An update. *J Can Dent Assoc*, **66**(11): 594–597.