New Attempts to Modify Periodontal Risk Assessment for Generalized Aggressive Periodontitis: A Retrospective Study

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Background: Periodontal risk assessment (PRA) model was designed for risk evaluation of treated patients with periodontal disease. However, its use on generalized aggressive periodontitis (GAgP) had been scarcely reported. This study aims to investigate the association of original PRA/modified PRA (MPRA) and compliance of periodontal maintenance with long-term treatment outcomes of Chinese patients with GAgP.

Methods: Eighty-eight patients from a GAgP cohort, who completed active periodontal treatment (APT) and accepted reevaluation 3 to 11 years (mean of 5.5 years) afterward, were enrolled. PRA was modified (three strategies involving replacement of bleeding on probing with bleeding index >2, counting sites with probing depth ≥6 mm and changing method of bone loss [BL] calculation) to classify patients into different risk groups based on data at the first recall after APT. PRA and three MPRA models were investigated regarding long-term association with tooth loss (TL) and alteration of bone level (ΔBL).

Results: Based on original PRA, 87 patients (98.8%) had a high-risk profile. According to three MPRA models, annual TL per patient values were greater in high-risk groups than in low-to-moderate risk groups (MPRA-1, 0.20 ± 0.33 versus 0.04 ± 0.14; MPRA-2, 0.18 ± 0.32 versus 0.05 ± 0.14; MPRA-3, 0.17 ± 0.32 versus 0.05 ± 0.15; $P < 0.05$). By MPRA-1, irregular compliers with low-to-moderate risk profile had greater ΔBL (0.027 ± 0.031, indicating bone increment) than those with high risk (–0.012 ± 0.064, tendency for BL). For regular compliers, no significant differences of annual TL or ΔBL were found between risk groups.

Conclusions: MPRA models could be used for evaluating the long-term outcomes of Chinese patients with severe GAgP, especially irregular compliers. High-risk patients of MPRAs exhibited more TL and less bone fill than low-to-moderate risk ones. *J Periodontol 2013;84:1536-1545.*

KEY WORDS

Aggressive periodontitis; compliance; risk factors; tooth loss; treatment outcome.

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In the past decades, some studies had found that aggressive periodontitis (AgP) is microbiologically and histopathologically different from chronic periodontitis (CP).[1-4] Although patients with AgP have to be considered at high risk for recurrence after therapy,[5,6] some clinical studies had shown that they could have long-term beneficial treatment outcomes.[7,8]

Treatment outcomes can be unequal among individuals with AgP. Bäumer et al.[9] reported 47.6% of the responding AgP cohort lost teeth during 10.5 years of supportive periodontal treatment (SPT). Another study by Kamma and Baehni[10] reported that additional clinical attachment loss (AL) and tooth loss (TL) were observed in some compliant patients with early-onset periodontitis (a former term for AgP). Periodontists are obligated to identify a subgroup of treated patients with AgP still at risk for recurrence. Several factors, such as smoking, age, diabetes mellitus, and erratic maintenance, are identified as risk factors for progression.[11-13]

For the purpose of facilitating risk evaluations after active periodontal treatment (APT), Lang and Tonetti[14] proposed a hexagonal model, known as periodontal risk assessment (PRA), in which clinicians can classify patients into three risk groups by integrating six

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items. Longitudinal studies had validated its predictive value for TL and recurrence after APT.[11,15] However, a study including 30 patients with CP or AgP had shown that 29 of them were labeled as having a high-risk profile according to original PRA, and its inability to stratify patients into groups inspired the researchers to modify it by applying "PRA diagram surface scores."[16] Another study used PRA for AgP exclusively, yet significant predictive value was confirmed only if interleukin-1 (IL-1) composite was excluded.[17] To the best of our knowledge, clinical research applying PRA on Asian patients with AgP is still missing. If similar problems are raised in such situations, certain modifications are required.

The success in treating patients with CP or AgP depends on the maintenance program,[18-20] yet it is reported that patients who irregularly complied with SPT had compromised outcome.[9,18,21] Compliance is also suggested to be an important consideration when using PRA on risk evaluation.[15,16,20]

The present study attempts to modify PRA for Chinese patients with generalized AgP (GAgP) and to investigate the association of original PRA/modified PRA (MPRA) with long-term TL and bone level change, with or without the consideration of SPT compliance.

MATERIALS AND METHODS

Study Population

From 1999 to 2008, 158 patients (53 males and 105 females; mean age: 27 years) who were diagnosed as having GAgP and received periodontal treatment at the Department of Periodontology, Peking University School and Hospital of Stomatology, were recalled from June 2010 to March 2012. They were reevaluated 3 to 11 years after periodontal treatment. All patients belonged to the Han race, which makes up the majority of the Chinese population. Patients had been enrolled in an etiologic study of an AgP cohort.[22-24] The program was approved by the Ethics Committee of the Peking University Health Science Center. All patients were informed and provided written consent to join the study.

GAgP was defined according to the classification proposed at the International Workshop for the Classification of Periodontal Diseases and Conditions.[25] At baseline, additional inclusion criteria were as follows: 1) 14 to 36 years old; 2) at least six teeth affected with probing depth (PD) ≥5 mm and AL ≥3 mm with radiographic evidence of interproximal bone loss (BL) >33.3%; and 3) at least 20 teeth remained. Other considered factors included the following: 1) family aggregation; 2) rapid progression; and 3) imbalanced relationship among local factors and periodontal breakdown.

Exclusion criteria were as follows: 1) history of periodontal or antimicrobial therapy within 6 months or history of orthodontic therapy; 2) systemic disease (e.g., diabetes mellitus, nephrosis, hepatopathy, hypertension, neutropenia); 3) pregnancy; or 4) taking medication known to affect periodontium.

Experimental Design

At the first visit before therapy, noted as T0, each patient completed a questionnaire involving dental history, smoking status (time and dose), and general condition. Periodontal examination was then performed. Full-mouth periapical radiographs were taken using the bisecting-angle technique. The subsequent non-surgical periodontal treatments consisted of oral healthy instruction, scaling and root planing (SRP) combined with antimicrobial agents (0.2 g metronidazole and 0.5 g amoxicillin, three times per day for 7 days),[26] and minor occlusal adjustment. Local anesthesia was applied when indicated. Thereafter, patients exhibiting residual PD >5 mm or infrabony pocket were advanced to the surgical phase, during which a modified Widman flap or bone-graft procedure was performed. The non-surgical and surgical management, completed within 1 year, comprised APT. When surgical management was 1) not recommended, 2) refused by patients, or 3) accomplished, APT ended.

At the first recall after APT, defined as T1, periodontal status was reevaluated, and SPT was recommended two to four times per year. SPT included enhanced individual plaque control and SRP. The final recall, at least 3 years after T1, was noted as T2. At T2, patients were reassessed by periodontal charting and full-mouth periapical radiographs. Follow-up questionnaires containing dental history, smoking status, and general condition were obtained. Those who had SPT treatment, at the Department of Periodontology or in private practice, at least once a year were recognized as regular compliers. Others who missed SPT at any year were irregular compliers.

Clinical Evaluation

Periodontal examinations were performed in T0, T1, and T2 by three examiners (HM, LX, and LZ) who were calibrated[24] using a Williams periodontal probe. PD was measured at six sites (mesial, distal, and middle sites of the buccal and lingual sides) per tooth. The highest bleeding index (BI) values[27] of the buccal and lingual surfaces were recorded 30 seconds after probing. The percentage of BI >1 (also known as bleeding on probing [BOP]) and BI >2 was calculated, written as BOP (%) and BI >2(%). The third molars were

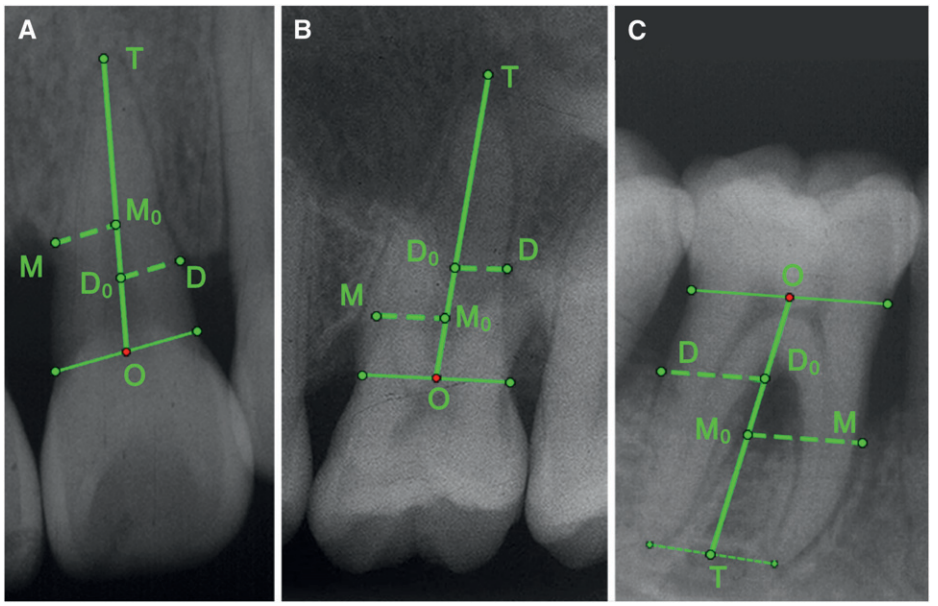

Figure 1.
*Measurement of RBH on single-rooted teeth **(A)**, maxillary molars **(B)**, and mandibular molars **(C)** on periapical radiographs. O = median point of cemento-enamel junction (CEJ) line; T = apical tip; M (or D) = lowest point of mesial (or distal) bone defect; M_0 (or D_0) = projecting point of M (or D) on axis; Line MM_0 and Line DD_0 = parallel to CEJ line; RBH = M_0T/OT or D_0T/OT.*

excluded. TL was calculated before, during, and after APT.

Radiographic Measurement

Full-mouth periapical radiographs were taken in T0 and T2. All scanned radiographs were measured. The ratio of residual bone height of interproximal site and full root length was calculated[28] and defined as relative bone height (RBH) (Fig. 1). All measurements were done by one examiner (DL). Self-calibration was performed in four sets of full-mouth radiographs (κ = 0.896, accepted RBH deviation <0.05). The examiner was masked for any information about the patients.

Because normal bone crest is 1.0 to 1.5 mm below the cemento-enamel junction (CEJ) and the distance equals ≈10% of average root length,[29] for each site BL = 1 – RBH/0.9. For each patient, alteration of bone level (ΔBL) was calculated by subtracting average RBH in T0 from that in T2 ($\Delta BL = RBH_{T2} - RBH_{T0}$).

Original and MPRA

All patients were evaluated retrospectively using the original PRA model (Table 1) and three MPRA models (Table 2). Data were derived from the chart and questionnaire in T1 and radiographs in T0.

In three MPRA models, BOP(%) was substituted by BI >2(%). In MPRA-1 and MPRA-2, sites were counted if PD ≥6 mm and they belonged to the four appointed sites (disto-buccal, mid-buccal, mesio-buccal, and mid-lingual). In MPRA-3, sites with PD ≥6 mm from six sites per tooth were regarded. In MPRA-2 and MPRA-3, item 4 was replaced by full-mouth average BL over age. The overall risk group was determined by summing the scores of the six items.

Statistical Analyses

Data processing was conducted using statistical software.‡ Mean and standard deviation (SD) of patients' parameters were calculated and analyzed. The differences among compliance groups or original PRA/MPRA risk profiles in the initial demographic and periodontal parameters were evaluated using Student *t* test for data with normal distribution (e.g., age, mean PD, and BL), using Mann-Whitney *U* test for data with non-normal distribution (e.g., annual TL per patient), or using χ^2 test for dichotomic data (e.g., male proportion).

RESULTS

Patients

A total of 158 patients with AgP who joined the program and finished APT were recalled. Seventeen were not able or not willing to be reexamined. Fifty of them had changed contact numbers and addresses. Three of them were pregnant or breast feeding on the recall day, and therefore radiographs were unattainable. A total of 88 patients with GAgP were included. Mean ± SD duration of observation was 5.6 ± 2.2 years.

Demographic data of T0 are given in Table 3. Three of them were smokers (<20 cigarettes per day, at least 10 years) and did not quit smoking after APT. No one reported any systemic diseases. Thirty-three of them were regular compliers. No statistical differences between regular and irregular compliers could be found in age, sex proportion, mean PD, BL, and TL.

Long-Term Outcome

At T0, all patients (n = 88) had an average of 27.7 teeth. During APT, 44 teeth (in 16 patients) were lost. During SPT, 58 teeth (in 23 patients) were lost and recognized as SPT-TL. All of the 58 teeth were extracted as a result of terminal loss of

‡ SPSS v.13.0, IBM, Chicago, IL.

Table 1.

PRA for Patients After APT (designed by Lang and Tonetti[14])

Item	Low Risk	Moderate Risk	High Risk
1) BOP (%)	≤9	10 to 25	>25
2) PD ≥5 mm sites	≤4	5 to 8	>8
3) TL (deducted from 28 teeth)	≤4	5 to 8	>8
4) BL (worst posterior site)/age	<0.5	0.5 to 1.0	>1.0
5) Smoking	Former or non-smoker	<20 cigarettes/day	≥20 cigarettes/day
6) Systemic and genetic aspect	No	—	Yes
Overall risk group	No more than one moderate-risk item and no high-risk items	No more than two moderate-risk items or one high-risk item	More than two moderate-risk items or more than one high-risk item

periodontal support or increased mobility (recorded in patients' notes or self-reported). Mean SPT-TL was 0.66 teeth per patient, and annual SPT-TL was 0.11 teeth per patient. Sixty-five patients (73.9%) had no TL, 12 patients (13.6%) lost one tooth, and 11 patients (12.5%) lost more than one tooth.

Comparing the radiographic parameters of the final visit (T2) to the first visit (T0), mean ΔBL ranged from –0.144 to 0.120. Sixty-six patients (75.0%) had positive ΔBL, which indicated bone increment tendency, whereas the other 22 (25.0%) patients displayed negative ΔBL.

PRA and MPRA

The risk analyses of PRA/MPRA in T1 are shown in Figure 2.

With regard to original PRA, 87 patients (98.9%) were categorized as high risk. Up to 93.2%, 72.7%, and 100.0% patients were labeled high risk in item 1 (BOP%), item 2 (PD ≥5 mm), and item 4 (BL worst/age), respectively, whereas 94.3% and 96.6% had a low-risk profile in item 3 (TL) and item 5 (smoking), respectively. The score of BL (worst)/age ranged from 1.27 to 5.08 (mean ± SD, 2.81 ± 0.82; tertiles, 2.3 and 3.1).

Thirty-nine (44.3%), 42 (47.7%), and 44 (50.0%) patients were classified as having a high-risk profile according to MPRA-1, MPRA-2, and MPRA-3, respectively. BI >2(%) was a modified item, in which the percentages of high-, moderate-, and low-risk groups were 60.2%, 19.3%, and 20.5%. The percentages of the three risk profiles according to various modified items are shown in Figure 2.

To highlight long-term results of high-risk patients, low and moderate risk were merged. The comparisons of SPT-TL rate, using Mann-Whitney *U* test, are shown in Table 4. Patients with high-risk profiles lost pronouncedly more teeth than those with low-to-moderate risk profiles (MPRA-1, $P < 0.001$; MPRA-2, $P = 0.004$; MPRA-3, $P = 0.009$). When compliance and risk profile of MPRA were combined, irregular compliers with high-risk profiles lost more teeth than those with low-to-moderate risk profiles (*P* value in three MPRAs were 0.006, 0.016, and 0.039, respectively). For regular compliers, difference of annual SPT-TL between the high-risk group and the low-to-moderate risk group of each MPRA model was statistically insignificant.

Analyses of ΔBL, using Student *t* test, are shown in Table 4. Patients with high-risk profiles experienced considerably lower ΔBL than those with low-to-moderate risk profiles (*P* value in three MPRAs were <0.001, 0.037, and 0.025, respectively). Additionally, if compliance was considered, statistical significance of ΔBL between risk groups could only be detected in irregular compliers of MPRA-1 ($P = 0.005$).

DISCUSSION

This study is derived from etiologic research of AgP performed at the Department of Periodontology, Peking University School and Hospital of Stomatology since 1999. After APT and SPT, long-term beneficial outcomes had been achieved, because 75.0% of the patients (66 of 88) gained more bone increment than loss during observation. However, 23 patients experienced additional TL during SPT. Annual SPT-TL of regular compliers was 0.04 teeth per year per patient, whereas the rate was considerably greater (0.16 teeth per year per patient) among irregular compliers. The result is in agreement with a retrospective study on 86

Table 2.

Three MPRA Models for Patients with AgP After APT

Model/Items	Risk Profile (score)		
	Low (score: 0)	Moderate (score: 1)	High (score: 2)
MPRA-1			
BI >2 (%)*	≤9	10 to 25	>25
PD ≥6 mm (four sites per tooth)*	≤4	5 to 8	>8
TL	≤4	5 to 8	>8
BL (worst posterior site)/age	<0.5	0.5 to 1.0	>1.0
Smoking	Non-smoker or former smoker	<20 cigarettes/day	≥20 cigarettes/day
Systemic disease*	No	—	Yes
Overall risk group*	Total score ≤2	3 ≤ total score ≤ 4	Total score ≥5
MPRA-2			
BI >2(%)*	≤9	10 to 25	>25
PD ≥6 mm (four sites per tooth)*	≤4	5 to 8	>8
TL	≤4	5 to 8	>8
BL (mean)/age*	<0.75	0.75 to 1.25	>1.25
Smoking	Non-smoker or former smoker	<20 cigarettes/day	≥20 cigarettes/day
Systemic disease*	No	—	Yes
Overall risk group*	Total score ≤1	2 ≤ total score ≤ 3	Total score ≥4
MPRA-3			
BI >2(%)*	≤9	10 to 25	>25
PD ≥6 mm (six sites per tooth)*	≤5	6 to 9	>9
TL	≤4	5 to 8	>8
BL (mean)/age*	<0.75	0.75 to 1.25	>1.25
Smoking	Non-smoker or former smoker	<20 cigarettes/day	≥20 cigarettes/day
Systemic disease*	No	—	Yes
Overall risk group*	Total score ≤1	2 ≤ total score ≤ 3	Total score ≥4

* Modified items.

patients with AgP (mainly white) with an average of 10.5 years of follow-up.[9] In that study, regular compliers lost 0.08 teeth per year per patient, whereas irregular compliers lost 0.15 teeth per year per patient.

Because long-term treatment outcome varies, periodontal evaluation turned out to be a challenging and important process. PRA was created to facilitate risk evaluation.[14] Several studies had validated its predictive value[11,15,17] or argued its limitations.[16,17,30,31] Anyone who attempts to modify the PRA model should bring long-term data to support its prognostic value.

Modified models should contain relevant factors, whose data are easily obtained. IL-1 composite genotype had controversial association with AgP in Asian studies,[22,32] and its detection is not a regular procedure. A recent study showed that exclusion of IL-1 genotype data improved the predictive value of PRA.[17] Thus, IL-1 genotype data were also excluded in the MPRAs. In other items, modification of threshold is not a simple multiplying of number but a procedure aiming to stratify patients who represent periodontal outpatients.

AgP is an infrequent periodontal disease characterized by non-contributory medical history, rapid AL and bone breakdown, and familial aggregation.[33] Although age is no longer a prerequisite for diagnosis of AgP because previous radiographic evidence to prove rapid breakdown of periodontium are unobtainable for most older patients at the first visit, young patients with severe baseline status are believed to be affected by AgP.[9] Systemic disease may contribute to onset or progression of periodontitis,[34-36] and thus systemically unhealthy patients were excluded from baseline.[24] Smoking is a notable risk factor for onset of periodontitis.[37,38] Therefore, from the beginning, non-smokers were more favorable for this study. Young patients with only some teeth remaining might have been referred to prosthodontists or implant dentists for a complete denture or full-mouth implant, so these patients were also excluded. Because of the main attributes of AgP and initial inclusion criteria of the study, slight or no differences could be found in baseline TL, smoking status, or systemic conditions among patients.

Table 3.

Demographic and Periodontal Status of Whole Patients with AgP (n = 88) and Subgroups Stratified by Compliance at T0

	Total	Regular Compliers	Irregular Compliers	*P* Value
Total	88	33	55	
Male, n (%)	30 (34.1%)	12 (36.4%)	18 (32.7%)	0.728*
Age (years ± SD)	27.0 ± 4.9	26.7 ± 5.6	27.2 ± 4.6	0.639†
Periodontal status (T0)				
Mean PD (mm)	4.8 ± 1.0	5.0 ± 0.9	4.8 ± 1.1	0.344†
Mean BL	0.30 ± 0.13	0.30 ± 0.12	0.30 ± 0.13	0.995†
Mean missing teeth	0.8 ± 1.2	0.6 ± 0.9	0.9 ± 1.4	0.553‡

* χ^2 test.
† Student *t* test.
‡ Mann-Whitney *U* test.

BOP or BI reflects the inflammatory status of the gingiva. Combined with the presence of deep pockets, BOP >30% is known as a risk factor for TL.[35] The present study suggests that the prevalence of BOP was still high even after APT in Chinese patients with AgP. This result is similar to another Chinese study,[39] in which 82 of 97 patients had BOP >30% after periodontal treatment. If BI >2% is considered instead, without changing threshold of each degree, only 60.2% of the patients in the present study have a high-risk profile. BI >2% may be a better clinical indicator for Chinese patients with AgP.

Different observers perform full-mouth probings following different schemes. For instance, in some clinical studies and epidemiologic studies, PDs were measured in four sites for each tooth.[11,40,41] In contrast, some other observers preferred a six-site scheme.[9,24,42] The authors did not specifically point out which scheme should be used in PRA,[14] whereas the probing schemes of each MPRA are clearly noted in the present study. Because prevalence of sites with PD ≥5 mm was still high after APT in the patients as a result of severe periodontal breakdown, and residual sites with PD ≥6 mm are known as incompletely treated sites,[35] only sites with PD ≥6 mm were counted in MPRAs.

The score of BL/age represents the rate of periodontal breakdown in a patient's lifetime. BL of the worst posterior site can be conveniently measured, and it reflects history of breakdown of the entire dentition if bone was lost evenly among teeth. However, as Lang and Tonetti argued,[14] this score might overestimate the patient's rate of progression if isolated advanced bone lesions present. Because most patients with AgP, especially LAgP, feature rapid alveolar BL mainly in first molars,[43] the worst posterior site cannot truly represent full-mouth periodontal status. In addition, patients with AgP were relatively young in the present study, and scores of BL (worst)/age were so high that high-risk patients could not be separated from the others. Therefore, in MPRA-2 and MPRA-3, average BL in relation to age is applied with thresholds altered. However, the measurement of full-mouth BL is quite time-consuming. In the present study, it should be noted that full-mouth radiographic examination is not routine at T1. Using T0 radiographic data at the T1 evaluation may bring in slight bias. Still, T0 radiographs contain general information regarding individual periodontal breakdown.

In light of three MPRAs, although criteria for classification vary, high-risk groups had greater annual SPT-TL. It is similar to research on CP/AgP patients using MPRA score.[16]

Some studies have regarded TL as the "true end point" relevant to efficacy of dental treatment.[11,44] However, some young patients with AgP were reluctant to have some hopeless teeth extracted, i.e., TL partially reflected progression of periodontitis. For that reason, alteration of BL was applied for evaluating long-term outcome. An early study by Wennstrom et al.[8] showed that affected sites of patients with juvenile periodontitis (a former term for AgP) gained remarkable bone increment 6 months after surgical treatment (mean of 1.75 mm) or non-surgical treatment (mean of 1.35 mm), and the beneficial outcome was retained during 5 years of regular management. In the present study, radiographic assessment of ΔBL (T2-T0) should be regarded as combined effects of APT and SPT, and it was questioned whether high-risk patients of MPRA (in T1) exhibited poorer bone fill after APT and worse bone stability during SPT, with or without the combined effect of

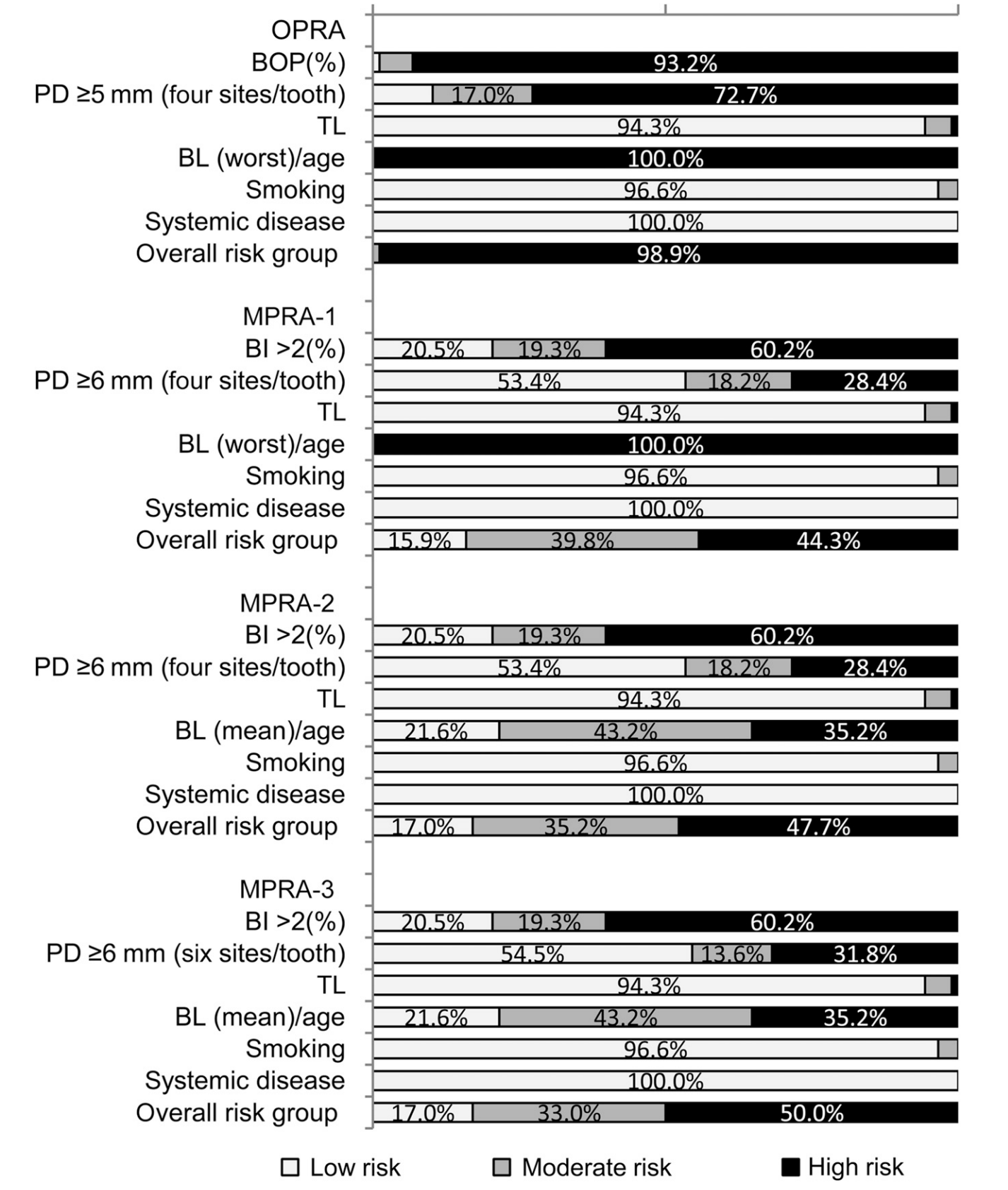

Figure 2.
Patient proportion in each risk group for each item and in overall evaluation according to PRA and three MPRA models. OPRA = original PRA.

Table 4.
Analysis of Annual TL (TL per patient per year) During SPT and ΔBL (T0 to T2) Regarding MPRA Models and Compliance

	Total Patients			Regular Compliers			Irregular Compliers		
	n	Annual TL ± SD	Mean ΔBL ± SD	n	Annual TL ± SD	Mean ΔBL ± SD	n	Annual TL ± SD	Mean ΔBL ± SD
Total	88	0.11 ± 0.25	0.020 ± 0.052	33	0.04 ± 0.12	0.043 ± 0.035	55	0.16 ± 0.30	0.006 ± 0.056
MPRA-1									
Low to moderate	49	0.04 ± 0.14*	0.037 ± 0.034†	25	0.03 ± 0.12	0.048 ± 0.035	24	0.05 ± 0.15*	0.027 ± 0.031†
High	39	0.20 ± 0.33	–0.003 ± 0.061	8	0.08 ± 0.12	0.030 ± 0.031	31	0.24 ± 0.36	–0.012 ± 0.064
MPRA-2									
Low to moderate	46	0.05 ± 0.14*	0.030 ± 0.038†	21	0.04 ± 0.13	0.045 ± 0.034	25	0.05 ± 0.15*	0.018 ± 0.037
High	42	0.18 ± 0.32	0.007 ± 0.062	12	0.05 ± 0.10	0.040 ± 0.036	30	0.24 ± 0.36	–0.006 ± 0.065
MPRA-3									
Low to moderate	44	0.05 ± 0.15*	0.032 ± 0.038†	21	0.04 ± 0.13	0.045 ± 0.034	23	0.06 ± 0.15*	0.019 ± 0.038
High	44	0.17 ± 0.32	0.007 ± 0.060	12	0.05 ± 0.10	0.040 ± 0.036	32	0.22 ± 0.36	–0.005 ± 0.064

* Compared with high-risk groups using Mann-Whitney *U* test ($P < 0.05$).
† Compared with high-risk groups using Student *t* test ($P < 0.05$).

compliance. The present result suggests rational modifications in that MPRAs manifested significant association with ΔBL, because patients with low-to-moderate risk profile had a greater tendency of bone fill than the high-risk group.

For irregular compliers, high-risk patients of MPRAs had higher annual SPT-TL and lower bone fill. In contrast, for regular compliers, differences of SPT-TL and ΔBL between risk groups were relatively small. However, it is still too early to draw the conclusion that long-term outcome of regular compliers was independent from risk profile, because only a small group of regular compliers are included in the present study (n = 33). A recent study[20] with 75 regular compliers found that incidence of TL was higher in regular compliers with a high-risk profile (18.6%) than those with moderate-risk (4.0%) and low-risk (0.0%) profiles according to original PRA. It should also be noted that MPRAs were designed for quantitative recognition of patients with AgP who had greater odds of progression. Patients with AgP with lower risk profiles still require careful management during SPT.

The dropout rate of the present cohort (44.3%) resulted in risk of bias. It is similar with the situation that Bäumer et al.[9] reported (an AgP cohort in which 52% dropped out). Although two to four SPT sessions every year is proposed in the present study, most patients followed that instruction on the first 1 to 3 years and then failed. Hence, "regular" was redefined as "at least one SPT a year." It should be noted that young patients with AgP, who are commonly confronted with economic, occupational, or educational issues, often refuse to join a long-term program or adhere to strict periodontal management.

CONCLUSIONS

Three MPRA models, which include the different methods of PD ≥6 mm, BI ≥2 counting, and BL calculation, more effectively stratify Chinese patients with AgP into different risk groups. High-risk patients of MPRAs experienced more TL and less bone fill. MPRA-1 could be used for quick radiographic and clinical evaluation. MPRA-2 could be used if full-mouth BL could be measured. MPRA-3 is recommended if the six-site scheme and full-mouth radiographic measurement are applied.

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