Scientific Research Report

Evaluation of the FDI Chairside Guide for Assessment of Periodontal Conditions: A Multicentre Observational Study

Doaa Adel-Khattab [a,b], *Eduardo Montero* [c*], *David Herrera* [c], *Dan Zhao* [d], *Lijian Jin* [d], *Zahra Al-Shaikh* [b], *Stefan Renvert* [e,f], *Joerg Meyle* [b]

[a] *Faculty of Dentistry, Department of Oral Medicine, Periodontology and Diagnosis, Ain Shams University, Cairo, Egypt*
[b] *Department of Periodontology, Zentrum fuer Zahn-, Mund- und Kieferheilkunde, University of Giessen, Geissen, Germany*
[c] *Etiology and Research of Periodontal and Peri-implant Diseases (ETEP) Research Group, University Complutense of Madrid, Madrid, Spain*
[d] *Faculty of Dentistry, Division of Periodontology & Implant Dentistry, University of Hong Kong, Hong Kong SAR, China*
[e] *Faculty of Health Sciences, Kristianstad University, Kristianstad, Sweden*
[f] *Department of Health, Blekinge Institute of Technology, Karlskrona, Sweden*

ARTICLE INFO

Article history:
Available online 30 January 2021

Key words:
FDI
Chairside guide
Gingivitis
Periodontitis
Score system
Disease severity

ABSTRACT

Objective: There is a need to develop easy-to-use tools to screen for periodontal conditions in daily practice. This study aimed to evaluate the FDI World Dental Federation "Chairside Guide" (FDI-CG) developed by the Task Team of the FDI Global Periodontal Health Project (GPHP) as a potential tool for screening.

Methods: Databases from 3 centres in Germany, Hong Kong, and Spain (n = 519) were used to evaluate the association of the FDI-CG and its individual items with the periodontitis case definitions proposed by the Centers for Disease Control and Prevention (CDC) and the American Academy of Periodontology (AAP) for population-based surveillance of periodontitis.

Results: Statistically significant differences were observed among the databases for the prevalence of periodontitis and the items included in the FDI-CG. The FDI-CG score and its individual components were significantly associated with the periodontal status in the individual databases and the total sample, with bleeding on probing showing the strongest association with severe periodontitis (odds ratio [OR] = 12.9, 95% CI [5.9; 28.0], $P < .001$, for those presenting bleeding on probing >50%), followed by age (OR = 4.8, 95% CI [1.7; 4.2], $P = .004$, for those older than 65 years of age). Those subjects with a FDI-CG score >10 had an OR of 54.0 (95% CI [23.5; 124.2], $P < .001$) and presented with severe periodontitis. A significant correlation was found between the different FDI-CG scoring categories (mild, moderate, and severe) and the categories for mild, moderate, and severe periodontitis using the Centers for Disease Control and Prevention and the American Academy of Periodontology criteria (r = 0.57, Spearman rank correlation test, $P < .001$).

Conclusion: The FDI Chairside Guide may represent a suitable tool for screening the periodontal condition by general practitioners in daily dental practice.

Introduction

Periodontal diseases are a group of conditions, including gingivitis and different stages and grades of periodontitis.[1-3] Apart from modifying factors, gingivitis is a reversible condition and is diagnosed by the presence of gingival inflammation.[2,4-6] Conversely, periodontitis is a multifactorial, destructive,

* *Corresponding author*. Facultad de Odontología, Plaza Ramón y Cajal s/n (Ciudad Universitaria), 28040 Madrid, Spain.
E-mail address: eduardomonterosolis@ucm.es (E. Montero).

https://doi.org/10.1016/j.identj.2020.12.024

inflammatory disease that results from dysbiotic biofilm-associated dysregulated immuno-inflammatory response. Such destructive processes that affect the teeth-supporting structures often occurs in susceptible individuals, eventually leading to tooth loss.[7]

Clinical diagnosis of periodontal diseases is usually based on the measurement of probing depths (PD) and clinical attachment level (CAL), by recording 6 sites per tooth with a millimetre periodontal probe, on the analysis of extent and degree of radiographic alveolar bone loss, or a combination of both. Periodontal examination by assessment of both full-mouth PD and CAL is an accurate diagnostic approach, but it is time-consuming and resource-intensive, because it demands trained examiners to ensure measurement reproducibility. Consequently, the development of simplified and easy-to-use tools with lower cost and resources would be valuable to facilitate population-based studies and for general practitioners in daily dental practice to quickly assess periodontal conditions.

Over the years, different assessment methods have been developed for epidemiological studies, such as the Community Periodontal Index of Treatment Needs (CPITN) and later the Community Periodontal Index (CPI), which can also be used by general dentists.[8,9] The Periodontal Screening and Recording Index (PSR) was developed by the American Dental Association and American Academy of Periodontology (AAP). The Periodontal Screening and Recording Index is derived from the Community Periodontal Index of Treatment Needs and involves probing of all teeth present. The site with the deepest PD, calculus, and bleeding score is assigned to each sextant, followed by categorising subjects into health or gingivitis (PD < 4 mm, 0-2 score), or in need of further periodontal therapy (score 3, PD ≤5.5 mm and ≥3.5 mm; score 4, PD >5.5 mm).[10,11] Many efforts have been made to develop assessment tools merely based on questionnaires without clinical examination, and reasonable results have been documented.[6,12,13] However, because clinical evaluation should always be the reference, a combination of clinical criteria and information from questionnaires may be an efficient way for an initial assessment of the periodontal condition. With this purpose in mind and within the remit of the Global Periodontal Health Project (GPHP) Task Team of FDI World Dental Federation (https://www.fdiworlddental.org/what-we-do/projects/global-periodontal-health-project), a new FDI Chairside Guide on "Periodontal Diseases: Prevention and patient management" has recently been proposed (https://www.fdiworlddental.org/resources/chairside-guides/periodontal-diseases), as a screening tool and practical guideline according to the outcome of disease profile assessment. It consists of (1) the framework of screening tool for gingival/periodontal health, gingivitis, and periodontitis; (2) a scoring system with different items of clinical aspects (plaque levels, bleeding on probing, PD, and number of teeth lost) and risk factors and determinants (smoking, diabetes, and age); and (3) a brief practical guide and recommendations for prevention and patient management on the basis of the outcomes of disease profile assessment.

Thus, the aim of the present study was to evaluate the newly developed FDI Chairside Guide for its suitability and applicability to conveniently assess periodontal conditions in daily practice. As such, the tool could potentially enable general practitioners to get an overview of disease profile and severity, associated with a recommendation for treatment planning, while avoiding major efforts in detailed examination and radiographic assessment. Indeed, the present evaluation has been conducted to evaluate the association of the current tool with the case definitions of periodontitis proposed by the Centers for Disease Control and Prevention (CDC) and the American Academy of Periodontology (AAP).[6]

Material and methods

Available databases from 3 university centres (University of Giessen, Germany; University of Hong Kong, Hong Kong SAR, China; and University Complutense of Madrid, Spain) were used to evaluate the FDI Chairside Guide for assessing overall periodontal conditions in these 3 cohorts with different disease profiles and patient characteristics. The original studies were approved by the local ethics committees in Giessen, Hong Kong and Madrid, respectively.

Periodontitis case definitions

All subjects were segmented into subgroups following the "Disease Profile Assessment" of the FDI Chairside Guide on one hand, and the case definitions reported by Eke et al[6] for their use in population-based studies on the other hand. The details of the latter were as follows:

- Severe periodontitis, if the patient presented ≥2 interproximal sites with CAL ≥6 mm (not on the same tooth) and ≥1 interproximal site with PD ≥5 mm.
- Moderate periodontitis, if the patient presented ≥2 interproximal sites with CAL ≥4 mm (not on the same tooth) or ≥2 interproximal site with PD ≥5 mm.
- No periodontitis or mild periodontitis for all cases without moderate or severe periodontitis, as previously defined.

Scoring of the FDI Chairside Guide

The FDI scoring system depends on 7 items, namely age, smoking, diabetes, tooth loss due to periodontitis, plaque deposits, bleeding on probing (BOP), and PD. Each item can be scored from 0-3, as presented in Table 1. The total score is then calculated and the overall periodontal condition is categorised into 3 levels: 0-5, mild; 6-10 moderate; ≥11 severe (https://www.fdiworlddental.org/resources/chairside-guides/periodontal-diseases).

Study protocol in Giessen

The study protocol was approved by the Ethics-Committee University of Giessen, Germany (94/20). The examination was performed by dentists of the department and recorded using the ParoStatus software tool (ParoStatus.de GmbH, Berlin, Germany). Seven items were recorded: patient age, smoking (dose), diabetes mellitus (HbA1c level), tooth loss due to any reasons except orthodontic treatment, sites with plaque deposits, and PD and sites with BOP, both measured using a

Table 1 – The scoring system of FDI World Dental Federation Chairside Guide.*

Item	Score 0	Score 1	Score 2	Score 3
Age	<35 years old	35-44 years old	45-64 years old	>64 years old
Smoking	No	<10 cigarettes/day	10-15 cigarettes/day	>15 cigarettes/day
Diabetes	No	Well-controlled (HbA1C <7%)		Poorly controlled/ uncontrolled (≥7%)
Tooth loss due to periodontitis	No tooth loss			Teeth lost due to periodontitis
Heavy plaque deposits	<10% of tooth sites	10%-50% tooth sites	>50% of tooth sites	
Bleeding on probing	<10% of tooth sites	10%-50% tooth sites	>50% of tooth sites	
Probing depth	<4 mm	4-5 mm	Localized tooth sites >5 mm	Generalized tooth sites >5 mm

Disease profile assessment.† The total sum is used to calculate the disease profile, as follows:
- MILD final score ≤5.‡
- MODERATE final score = 6-10.
- SEVERE final score >10.

* Resource: https://www.fdiworlddental.org/sites/default/files/media/resources/gphp-chairside_guide_2019-en.pdf
† This scorecard uses the main risk factors, but other risk factors could influence periodontal health as well, such as stress, obesity, excessive alcohol, and sugar consumption. In case of a high bone loss/age rate, smoking habit, or diabetes, consider a high-risk case (Grades B or C), independently of the severity of the disease.
‡ Score other than age only. Low scores may also indicate periodontal health.

PCP-UNC-15 periodontal probe, at 6 sites per tooth. A total of 145 patients aged 20-80 years were randomly selected from the database at the outpatient clinic of the periodontal department from the first appointment record, ranging from 2001 to 2019.

Study protocol in Hong Kong

The data set was retrieved from a clinical study approved by the Institutional Review Board of the University of Hong Kong/Hospital Authority of Hong Kong West Cluster (UW 17-303). Totally, 141 self-reported healthy subjects (aged 35-75 years) willing to participate in the study and fulfilling the inclusion criteria were recruited. Written consent forms were then obtained from all subjects. Full-mouth oral and periodontal examination (6 sites/tooth) were undertaken using a UNC 15 probe by a single examiner. Four clinical parameters were recorded, including PD, BOP, gingival recession (REC), and number of tooth loss due to periodontitis (except third molars). Calculus Index was extracted from dental records instead of plaque levels. Intraexaminer reliability for PD and REC was assessed at site level by employing intraclass correlation coefficient (ICC) absolute agreement (0.76 and 0.91), respectively. The demographic characteristics of the subjects were documented, including evaluation of diabetic status via chairside recordings of HbA1c level, and tobacco use with dose and frequency.

Study protocol in Madrid

The clinical evaluation was performed within the di@bet.es study, a national study designed to determine the prevalence of diabetes mellitus and impaired glucose regulation in the adult population of Spain.[14] By means of clustered sampling, a representative random sample of the Spanish population was selected to participate. With the purpose of determining the incidence of diabetes mellitus, the same population was evaluated again in 2016-2017. The clinical validation of self-reported questionnaires for periodontitis was performed in 18 of the 25 primary health care centres participating in the diabetes mellitus incidence in Spain.[12] In total, 231 patients (aged 26-87 years) signed the informed consent, accepting to participate in the study. One periodontist in training performed a complete periodontal examination (with a UNC-15 probe) including CAL calculated from the records of PD and REC, at 6 sites/tooth in all teeth, with the exception of third molars. BOP was assessed while plaque deposits were not. Glycaemic control and smoking were also registered, although reasons for tooth loss were not explored. The examiner, before the beginning of the study, carried out a calibration session with 5 randomly selected patients, resulting in a reproducibility (intraclass correlation coefficient) of 94% for PD and 89% for REC.

Statistical analysis

Descriptive statistics including means, SDs, percentages, and 95% CIs were calculated. Contingency tables, χ^2 test and analysis of variance (ANOVA) test were used to assess differences among the data sets. Logistic regression analysis was performed to identify significant associations between severe periodontitis, following the case definition of the CDC/AAP, with the outcome of Disease Profile Assessment of the FDI Chairside Guide (either as a continuous or categorical value) and its separated components. A Spearman correlation analyses was performed to measure the strength of the monotonic relationship between the results of the Disease

Profile Assessment (categorised as mild, moderate, or severe) and those according to the CDC/AAP criteria. All analyses were carried out using STATA v.13 (StataCorp, College Station, TX, USA). The level of statistical significance was set at 0.05.

Results

Patient sample

In total, 519 subjects were included in the 3 different databases (147 in Giessen, 141 in Hong Kong, and 231 in Madrid), with a mean age of 54.9 years (SD 14.9) (Table 2). Significant differences were observed among the databases for age and all periodontal items included in the FDI Chairside Guide. Tooth loss due to periodontitis was reported in 36.0% and 45.5% in the Giessen and Madrid cohorts, respectively; while it was significantly lower (29.1%; $P = .006$) in the Hong Kong database. The percentage of subjects in Giessen and Madrid exhibiting >50% of tooth sites with BOP were 22.4% and 39.8%, respectively; while they were just 11.4% in the Hong Kong cohort ($P < .001$). Overall, there were significant differences in the assessment of PD among the 3 datasets ($P < .001$): Notably, Hong Kong cohort demonstrated higher proportions of subjects with PD less than 4 mm or 4-5 mm and lower proportions with PD over 5 mm.

FDI Chairside Guide scores

The mean score for the FDI Chairside Guide was significantly lower (6.3 ± 2.7; $P < .001$) in Hong Kong than that in Giessen (7.5 ± 3.6) or Madrid (7.2 ± 2.8), even considering that the score in Madrid was calculated from 6 items because plaque was not registered. Significant differences ($P < .001$) among databases were also observed when the results of the guide were presented as categories of disease profiles (mild, moderate, and severe). For the entire sample, 34.3% of the subjects presented a "mild" score, 51.5% a "moderate" score, and 14.3% a "severe" score (Table 2).

Table 2 – Characteristics of the participants regarding the different items of the FDI World Dental Federation Chairside Guide.

	Total sample ($N = 519$)	Giessen ($n = 147$)	Hong Kong ($n = 141$)	Madrid ($n = 231$)	P value
Age	54.9 (14.9)	51.0 (17.7)	52.8 (10.4)	58.7 (14.4)	<0.001
<35 years	47 (9.1%)	35 (23.8%)	0 (0%)	12 (5.2%)	
35-44 years	77 (14.8%)	14 (9.5%)	39 (27.7%)	24 (10.4%)	
45-64 years	248 (47.8%)	60 (40.8%)	82 (58.2%)	106 (45.9%)	
>64 years	147 (28.3%)	38 (25.9%)	20 (14.2%)	89 (38.5%)	
Smoking					0.065
No	421 (81.1%)	118 (80.3%)	124 (87.9%)	179 (77.5%)	
<10 cigarettes per day	27 (5.2%)	5 (3.4%)	6 (4.3%)	16 (6.9%)	
10-15 cigarettes per day	25 (4.8%)	8 (5.4%)	7 (5.0%)	10 (4.3%)	
> 15 cigarettes per day	46 (8.9%)	16 (10.9%)	4 (2.8%)	26 (11.3%)	
Diabetes					0.081
No	458 (88.3%)	131 (89.1%)	132 (93.6%)	195 (84.4%)	
Well-controlled (HbA1C <7%)	43 (8.3%)	11 (7.5%)	5 (3.6%)	27 (11.7%)	
Poorly controlled/uncontrolled (≥7%)	18 (3.5%)	5 (3.4%)	4 (2.8%)	9 (3.9%)	
Tooth Loss*					0.006
No tooth loss due to periodontitis	320 (61.7%)	94 (64.0%)	100 (70.9%)	126 (54.5%)	
Tooth loss due to periodontitis	199 (38.3%)	53 (36.0%)	41 (29.1%)	105 (45.5%)	
Heavy Plaque Deposits (Plaque Index)†					<0.001
<10% of tooth sites	43 (14.9%)	2 (1.4%)	41 (29.1%)	NR	
10%-50% tooth sites	99 (34.4%)	42 (28.6%)	57 (40.4%)	NR	
>50% of tooth sites	146 (50.7%)	103 (70.1%)	43 (30.5%)	NR	
Bleeding on Probing					<0.001
<10% of tooth sites	82 (15.8%)	52 (35.4%)	7 (5.0%)	23 (10.0%)	
10%-50% of tooth sites	296 (57.0%)	62 (42.2%)	118 (83.7%)	116 (50.2%)	
>50% of tooth sites	141 (27.2%)	33 (22.5%)	16 (11.4%)	92 (39.8%)	
Probing Depth					<0.001
<4 mm	75 (14.5%)	19 (12.9%)	36 (25.5%)	20 (8.7%)	
4-5 mm	153 (29.5%)	45 (30.6%)	52 (36.9%)	56 (24.2%)	
Localized tooth sites >5 mm	261 (50.3%)	72 (49.0%)	49 (34.8%)	140 (60.6%)	
Generalized tooth sites >5 mm	30 (5.8%)	11 (7.5%)	4 (2.8%)	15 (6.5%)	
FDI Chairside Guide score (continuous)	7.0 (3.0)	7.5 (3.6)	6.3 (2.7)	7.2 (2.8)	0.003
FDI Chairside Guide score (categorical)					<0.001
Mild (0-5)	178 (34.3%)	49 (33.3%)	60 (42.6%)	69 (29.9%)	
Moderate (6-10)	267 (51.5%)	62 (42.2%)	69 (48.9%)	136 (58.9%)	
Severe (>10)	74 (14.3%)	36 (24.5%)	12 (8.5%)	26 (11.3%)	

Data expressed as means (standard deviation [SD]) or n (%). P value indicates differences among the databases.
NR, not registered.

* Causes for tooth loss were not specified in Giessen and Madrid databases.
† For Hong Kong data set, it was recorded as Calculus Index. Plaque index was not recorded in Madrid, so the total sample is 288 for this item.

Table 3 – Periodontal status of the participants, according to the CDC/AAP criteria, in the 3 databases.

	Total Sample ($N = 519$)	Giessen ($n = 147$)	Hong Kong ($n = 141$)	Madrid ($n = 231$)	P value
CDC/AAP Case Definition					<0.001*
No Periodontitis	58 (11.2%)	29 (19.7%)	15 (10.6%)	14 (6.1%)	
Mild Periodontitis	17 (3.3%)	6 (4.1%)	4 (2.8%)	7 (3.0%)	
Moderate Periodontitis	189 (36.4%)	37 (25.2%)	70 (49.7%)	82 (35.5%)	
Severe Periodontitis	255 (49.1%)	75 (51.0%)	52 (36.9%)	128 (55.4%)	

AAP, American Academy of Periodontology; CDC, Centers for Disease Control and Prevention.

* Differences are also statistically significant among the databases, if the No Periodontitis and Mild Periodontitis groups are combined in a single group.

Prevalence of periodontitis following the CDC/AAP criteria

Overall, 88.8% of the participants had periodontitis, with 36.4% exhibiting moderate and 49.1% severe forms of the disease (Table 3). Significant differences existed among the 3 databases, and the prevalence of severe periodontitis was higher in subjects from Giessen (51.0%) and Madrid (55.4%) when compared with those from Hong Kong (36.9%) ($P < .001$).

Table 4 presents the distribution of different forms of periodontitis following the FDI Chairside Guide and CDC/AAP criteria in all subjects. Significant differences were detected for all items of the FDI Chairside Guide along the periodontal status spectrum, with the exception of smoking habits. The subjects without periodontitis or with mild disease were younger ($P < .001$) and presented with a lower number of missing teeth ($P < .001$), while those with severe periodontitis more frequently suffered diabetes (well- or poorly-controlled; $P = .039$), PD ≥5 mm ($P < .001$) and BOP over 50% of tooth sites ($P < .001$). This tendency was also observed when each database was analysed separately (Supplementary Tables 1-3, available online). Importantly, the findings from both the FDI Chairside Guide and the CDC/AAP case definition for the subjects with no periodontitis and mild periodontitis were comparable because 82.8% and 88.2% of the subjects with no periodontitis and mild periodontitis, respectively, presented a mild score (≤5) according to the FDI Chairside Guide. Moreover, 87.8% (65 out of 74) of the subjects with a score >10 of the FDI Chairside Guide were classified as having "severe periodontitis" according to the CDC/AAP criteria.

Association of severe periodontitis with the items and score of FDI Chairside Guide

Table 5 presents the association between each item of the tool and the definition of severe periodontitis by the CDC/AAP in the total sample. In the crude analyses, all items were significantly associated with the definition, with the most severe categories of most items showing the strongest association. Associations between age and severe periodontitis were statistically significant for subjects aged 45-64 years (odds ratio [OR] = 8.3, 95% CI [3.4; 20.3], $P < .001$) and for those older than 65 years (OR = 10.2, 95% CI [4.1; 25.5], $P < .001$). Similarly, smoking was just significant for those smoking more than 15 cigarettes per day (OR = 2.3, 95% CI [1.2; 4.5], $P = 0.009$). In the crude analyses, patients presenting with more than 50% of sites with BOP was the strongest predictor of severe periodontitis (OR = 20.5, 95% CI [10.1; 41.8], $P < .001$).

When including all items in a multivariate model, having diabetes (well- or poorly controlled) was not significantly associated to severe periodontitis anymore, but the other items remained significantly associated, with BOP (OR = 12.9, 95% CI [5.9; 28.0], $P < .001$ for those presenting with BOP >50% of sites), followed by age (OR = 4.8, 95% CI [1.7; 4.2], $P = .004$ for those older than 65 years. Similar results were observed separately in the different databases separately (Supplementary Tables 4-6, available online), and only age was not significantly associated in the Hong Kong database (no subjects <35 years old were included).

Using logistic regression analysis, the score of the FDI Chairside Guide, either considered as a continuous or categorical outcome (mild, moderate, or severe, as previously described), was significantly associated with the definition of severe periodontitis in both the total sample and the individual data sets (Table 6). Overall, those subjects with a score >10 had an OR = 54.0 (95% CI [23.5; 124.2], $P < .001$) and presented with severe periodontitis. Results were significant independently of the database, with Hong Kong showing the highest OR (OR = 649.0, 95% CI [37.7; 11170.1], $P < .001$). A significant correlation was found between the different FDI Chairside Guide categories (mild, moderate, and severe) with the categories for mild, moderate, and severe periodontitis using the CDC/AAP criteria ($\rho = 0.57$, Spearman rank correlation test, $P < .001$).

Discussion

The present investigation has demonstrated a statistically significant association of the FDI Chairside Guide score with severe periodontitis as defined by the CDC/AAP criteria, and this was true for the whole data set (519 patients), as well as for the individual ones. In addition, all individual items of the FDI Chairside Guide were also significantly associated with severe periodontitis, in the crude model, and all except diabetes, in the adjusted model.

The newly developed FDI Chairside Guide aims to help general dentists from all over the world, first, to conduct periodontal screening and categorise patients' disease profile as mild, moderate, or severe based on 7 preselected items, and second, to understand the appropriate protocol of patient management based of the individual disease profile. In addition to the recommended guidance to the clinician in patient management, the guide also has educational aim, as the selected items should be always considered when screening and assessing periodontal diseases. Three of them are determinants (age) or

Table 4 – Prevalence of periodontitis (expressed as number and percentage), according to the FDI World Dental Federation Chairside Guide and the CDC/AAP criteria.

FDI Chairside Guide	No Periodontitis ($n = 58$)		Mild Periodontitis ($n = 17$)		Moderate Periodontitis ($n = 189$)		Severe Periodontitis ($n = 255$)		*P* value
	n	%	*n*	%	*n*	%	*n*	%	
Age									<0.001
<35 years	22	37.9%	8	47.1%	11	5.8%	6	2.4%	
35-44 years	21	36.2%	2	11.8%	29	15.3%	25	9.8%	
45-64 years	9	15.5%	4	23.5%	99	52.4%	136	53.3%	
>64 years	6	10.3%	3	17.7%	50	26.5%	88	34.5%	
Smoking									0.286
No	48	82.8%	12	70.6%	164	86.8%	197	77.3%	
<10 cigarettes per day	3	5.2%	2	11.8%	9	4.8%	13	5.1%	
10-15 cigarettes per day	3	5.2%	1	5.9%	7	3.7%	14	5.5%	
>15 cigarettes per day	4	6.9%	2	11.8%	9	4.8%	31	12.2%	
Diabetes									0.039
No	56	96.6%	17	100%	172	91.0%	213	83.5%	
Well-controlled (HbA1C <7%)	2	3.5%	0	0.0%	12	6.4%	29	11.4%	
Poorly controlled/uncontrolled (≥7%)	0	0.0%	0	0.0%	5	2.7%	13	5.1%	
Tooth Loss									<0.001
No tooth loss	54	93.1%	16	94.1%	134	70.9%	116	45.5%	
Tooth loss (due to periodontitis)*	4	6.9%	1	5.9%	55	29.1%	139	54.5%	
Heavy Plaque Deposits (Plaque Index)†									<0.001
<10% of tooth sites	7	15.9%	1	10.0%	28	26.2%	7	5.5%	
10%-50% tooth sites	14	31.8%	3	30.0%	46	43.0%	36	28.4%	
>50% of tooth sites	23	52.3%	6	60.0%	33	30.8%	84	66.1%	
Bleeding on Probing									<0.001
<10% of tooth sites	29	50.0%	7	41.2%	32	16.9%	14	5.5%	
10%-50% tooth sites	24	41.4%	10	58.8%	135	71.4%	127	49.8%	
>50% of tooth sites	5	8.6%	0	0.0%	22	11.6%	114	44.7%	
Probing Depth									<0.001
<4 mm	38	65.5%	4	23.5%	33	17.5%	0	0.0%	
4-5 mm	17	29.3%	13	76.5%	92	48.7%	31	12.2%	
Localized tooth sites >5 mm	1‡	1.7%	0	0.0%	64	33.9%	196	76.9%	
Generalized tooth sites >5 mm	2‡	3.5%	0	0.0%	0	0.0%	28	11.0%	
FDI Chairside Guide score (categorical)									<0.001
Mild (0-5)	48	82.8%	15	88.2%	94	49.7%	21	8.2%	
Moderate (6-10)	9	15.5%	2	11.8%	87	46.0%	169	66.3%	
Severe (>10)	1	1.7%	0	0.0%	8	4.2%	65	25.5%	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	
FDI Chairside Guide score (continuous)	3.6	2.4	4.1	1.7	6.0	2.3	8.8	2.5	<0.001§

AAP, American Academy of Periodontology; CDC, Centers for Disease Control and Prevention; SD, standard deviation.

* Causes for tooth loss were not specified in Giessen and Madrid databases.
† In Hong Kong, it was recorded as Calculus Index. Plaque index was not recorded in Madrid.
‡ Patients with pseudo-pocketing, one from Madrid, two from Giessen.
§ Differences among all categories, with the exception of Mild periodontitis-No periodontitis.

Table 5 – ORs of the FDI World Dental Federation Chairside Guide items and the CDC/AAP case definition for severe periodontitis in the total sample.

FDI Chairside Guide item	CDC/AAP Severe Periodontitis			
	Crude OR (95% CI)	*P* value	Adjusted OR (95% CI) *N* = 519	*P* value
Age				
<35 years*				
35-44 years	3.3 (1.2-8.8)	0.017	1.8 (0.6-5.5)	0.286
45-64 years	8.3 (3.4-20.3)	<0.001	4.4 (1.6-12.2)	0.005
>65 years	10.2 (4.1-25.5)	<0.001	4.8 (1.7-14.2)	0.004
Smoking				
no*				
<10 cigarettes per day	1.1 (0.5-2.3)	0.891	1.2 (0.5-1.0)	0.709
10-15 cigarettes per day	1.4 (0.6-3.3)	0.373	1.7 (0.7-4.4)	0.245
>15 cigarettes per day	2.3 (1.2-4.5)	0.009	4.1 (1.9-8.9)	0.001
Diabetes				
no*				
Well-controlled (HbA1C <7%)	2.4 (1.2-4.6)	0.010	1.2 (0.6-2.5)	0.677
Poorly controlled/uncontrolled (Hba1c ≥7%)	3.0 (1.0-8.5)	0.040	1.2 (0.4-3.6)	0.804
Tooth loss due to periodontitis†				
no*				
yes	4.1 (2.8-6.0)	<0.001	2.2 (1.4-3.4)	<0.001
Heavy plaque deposits‡				
<10%*				
10%-50%	2.9 (1.2-7.3)	0.020		
>50%	7.0 (2.9-16.7)	<0.001		
Bleeding on probing				
<10%*				
10%-50%	3.7 (2.0-6.8)	<0.001	2.8 (1.4-5.5)	0.003
>50%	20.5 (10.1-41.8)	<0.001	12.9 (5.9-28.0)	<0.001

PD was not included in the regression because of collinearity problems, since PD >5 mm is part of the CDC/AAP definition of severe periodontitis.
AAP, American Academy of Periodontology; CDC, Centers for Disease Control and Prevention; CI, confidence interval; OR, odds ratio; PD, probing depth.

* Reference category; Adjusted OR includes adjustment for age, smoking habit, diabetes, tooth loss due to periodontitis and bleeding on probing;
† Causes for tooth loss were not specified in Giessen and Madrid databases;
‡ In Hong Kong, it was recorded as Calculus Index.

Table 6 – ORs of the FDI World Dental Federation Chairside Guide score and CDC/AAP case definition for severe periodontitis in total sample and each database.

	CDC/AAP Severe Periodontitis							
	Total Sample (*N* = 519)		Giessen (*n* = 147)		Hong Kong (*n* = 141)		Madrid (*n* = 231)	
	OR (95% CI)	*P* value	OR (95% CI)	*P* value	OR (95% CI)	*P* value	OR (95% CI)	*P* value
FDI Chairside Guide score (continuous)	1.7 (1.5-1.8)	<0.001	1.6 (1.4-1.9)	<0.001	2.1 (1.6-2.6)	<0.001	1.6 (1.4-1.8)	<0.001
FDI Chairside Guide score (categorical)								
0-5*								
6-10	12.9 (7.7-21.7)	<0.001	14.9 (5.2-43.0)	<0.001	81.4 (10.7-621.8)	<0.001	7.0 (3.6-13.8)	<0.001
11-19	54.0 (23.5-124.2)	<0.001	54.6 (14.5-204.7)	<0.001	649.0 (37.7-11170.1)	<0.001	27.6 (7.3-104.6)	<0.001

AAP, American Academy of Periodontology; CDC, Centers for Disease Control and Prevention; CI, confidence interval; OR, odds ratio.

* Reference category.

risk factors (smoking and diabetes); 1 represents past disease status (tooth loss); 1 reflects the presence of the primary etiological factor (dental biofilms); and 2 include the severity of periodontal inflammation (BOP and PD):

- Age: both the prevalence and severity of periodontitis increase with age.[15,16]
- Smoking: it is considered as a crucial risk factor for periodontitis,[17] with dose-dependent association.[18-20] Thus, it has been included as 1 of the elements used to define the grade in the current classification of periodontitis.[3]
- Diabetes: diabetes mellitus is recognized as a major risk factor for periodontitis, with approximately 3-fold higher risk, and glycaemic control has been deemed to be important for periodontal risk determination.[18,21-24] It has also

been included as 1 of the elements to define the grade in the current classification of periodontitis.[3]

- Tooth loss due to periodontal diseases: It may reflect the patient's history of oral diseases and trauma.[25] It has been included as 1 of the elements used to define the stage in the current classification of periodontitis.[3]
- Heavy plaque deposits: lack of adequate control of dental biofilms can lead to an imbalance between the microbiota and the host and may result in transient episodes of tissue destruction and, in the long term, attachment loss.[26]
- BOP: it represents an objective clinical inflammatory parameter, and periodontally treated individuals with BOP <10% are considered with low risk for recurrent disease, whereas BOP >25% is an indicator of high risk for periodontal breakdown.[27]
- PD: the pocket represents the actual lesion of periodontitis, and it is measured by assessing its depth by probing. As an example, presence of deep residual pockets during supportive periodontal care is associated with a higher risk for disease progression.[28-30]

The FDI Chairside Guide has been purposely designed as a screening and not as a diagnostic tool for quick and easy use in daily practice. As such, radiographic examination was not included, although it is a must to make a subsequent comprehensive assessment and diagnosis. Therefore, this is one of the reasons why no attempt has been made to correlate it with the recently proposed staging and grading system to classify periodontitis.[31] According to that system, treatment complexity should be evaluated via assessing various clinical conditions (eg, presence of vertical bone defects, furcation involvements, pathological tooth migration, etc.), to define the stage, whereas, to confer a grade, previous examinations or at least radiographs are needed. Thus, for a simplified screening tool like this FDI Chairside Guide, most of these factors aforementioned would not be taken into consideration, although the most important grade modifiers were included (ie, tobacco smoking and glycaemic control). The 2018 World Workshop on the Classification of Periodontal and Peri–Implant Diseases and Conditions also presented a periodontitis case definition to be used in the context of clinical care[3]: (1) presence of detectable interdental clinical attachment loss at ≥2 nonadjacent teeth or (2) buccal or oral CAL ≥3 mm with pocketing >3 mm detectable at ≥2 teeth. However, this definition was proposed for a clinical context because it also includes a series of other conditions for further consideration (such as attachment loss not attributable to malposition of third molars, endodontic lesions draining through the periodontium, or vertical root fractures), and not for surveillance or epidemiological purposes, because it does not differentiate into mild, moderate, or severe periodontitis. Furthermore, it also requires the determination of attachment loss, which is time-consuming and outside the scope of the FDI Chairside Guide. Thus, within the context of validation of different clinical screening tools or self-reported questionnaires, or for epidemiological studies, the CDC/AAP case definition may be more relevant to be referred to for evaluating the FDI Chairside Guide.

The limitations of the present study should be acknowledged. Some of the limitations are related to the databases used because the clinical evaluation of the patients in the 3 centres was not specifically designed to evaluate the FDI Chairside Guide. These databases were available once the guide was developed, and therefore, they were considered convenient to assess the tool. Thus, the information was not comprehensive and reasons for tooth loss were not available in Giessen and Madrid databases; plaque index was not registered in Madrid; and in Hong Kong, calculus index was available instead of plaque index. In addition, the sample population assessed showed a high prevalence of severe disease, and it would have been desirable, for a better evaluation, to include more cases of mild disease and a healthy condition. With regard to the statistical analysis, the presence of PD among the FDI Chairside Guide items and in the CPC/AAP case definitions created collinearity problems that could only be solved by eliminating this item from the logistic regression analysis. Finally, the FDI Chairside Guide and scoring system might be regarded as an oversimplification of complex disease situations. Whereas, on the other hand, it may be sufficient for screening many cases in daily practice, especially in remote areas of the world where access to oral and periodontal care is limited.

The strong points of the present study include the total number of patients examined in 3 different institutions with consistent results, thereby providing the basis for its external validity because the FDI Chairside Guide aims to be used in all type of settings and geographical locations around the world.

Conclusions

Within the limitations of the present study, the present findings support that the FDI Chairside Guide may represent a suitable tool for screening the periodontal condition by general practitioners in daily dental practice. To properly assess the effectiveness of this tool, prospective studies with larger sample sizes in different cohorts worldwide, including costs analyses derived from the time spent to use the guide, are needed.

Acknowledgements

The authors express their gratitude to FDI World Dental Federation for developing and launching its Global Periodontal Health Project (GPHP) that is currently supported by Procter & Gamble. The authors also thank Miss C. Scheibelhut for her valuable support in the statistical analysis of the German data, and Rachael England from the FDI Head Office in Geneva for her excellent support in the GPHP.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of interest

None disclosed.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.identj.2020.12.024.

REFERENCES

1. Caton JG, Armitage G, Berglundh T, et al. A new classification scheme for periodontal and peri-implant diseases and conditions - Introduction and key changes from the 1999 classification. J Clin Periodontol 2018;45(Suppl 20):S1–8.
2. Chapple ILC, Mealey BL, Van Dyke TE, et al. Periodontal health and gingival diseases and conditions on an intact and a reduced periodontium: Consensus report of workgroup 1 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. J Clin Periodontol 2018;45(Suppl 20):S68–77.
3. Tonetti MS, Greenwell H, Kornman KS. Staging and grading of periodontitis: Framework and proposal of a new classification and case definition. J Clin Periodontol 2018;45(Suppl 20):S149–61.
4. Trombelli L, Farina R, Silva CO, Tatakis DN. Plaque-induced gingivitis: case definition and diagnostic considerations. J Clin Periodontol 2018;45(Suppl 20):S44–67.
5. Page RC, Eke PI. Case definitions for use in population-based surveillance of periodontitis. J Periodontol 2007;78(Suppl 7S):1387–99.
6. Eke PI, Dye BA, Wei L, et al. Self-reported measures for surveillance of periodontitis. J Dent Res 2013;92:1041–7.
7. Pihlstrom BL, Michalowicz BS, Johnson NW. Periodontal diseases. Lancet 2005;366:1809–20.
8. Ainamo J, Barmes D, Beagrie G, Cutress T, Martin J, Sardo-Infiri J. Development of the World Health Organization (WHO) community periodontal index of treatment needs (CPITN). Int Dent J 1982;32:281–91.
9. World Health Organization (WHO). Oral health survey: basic methods.. Geneva, Switzerland: World Health Organization; 1997.
10. Primal KS, Esther SR, Boehm TK. Periodontal screening and recording (PSR) index scores predict periodontal diagnosis. J Dent App 2014;1:8–12.
11. Landry RG, Jean M. Periodontal screening and recording (PSR) index: precursors, utility and limitations in a clinical setting. Int Dent J 2002;52:35–40.
12. Montero E, La Rosa M, Montanya E, et al. Validation of self-reported measures of periodontitis in a Spanish population. J Periodontal Res 2019;55:400–9.
13. Eke PI, Genco RJ. CDC periodontal disease surveillance project: background, objectives, and progress report. J Periodontol 2007;78(Suppl 7S):1366–71.
14. Soriguer F, Goday A, Bosch-Comas A, et al. Prevalence of diabetes mellitus and impaired glucose regulation in Spain: the Di@bet.es Study. Diabetologia 2012;55:88–93.
15. Albandar JM, Brunelle JA, Kingman A. Destructive periodontal disease in adults 30 years of age and older in the United States, 1988-1994. J Periodontol 1999;70:13–29.
16. Dye BA, Thornton-Evans G. A brief history of national surveillance efforts for periodontal disease in the United States. J Periodontol 2007;78:1373–9.
17. Warnakulasuriya S, Dietrich T, Bornstein MM, et al. Oral health risks of tobacco use and effects of cessation. Int Dent J 2010;60:7–30.
18. Lindhe J, Meyle J. Peri-implant diseases: consensus report of the Sixth European Workshop on Periodontology. J Clin Periodontol 2008;35:282–5.
19. Haber J, Wattles J, Crowley M, Mandell R, Joshipura K, Kent RL. Evidence for cigarette smoking as a major risk factor for periodontitis. J Periodontol 1993;64:16–23.
20. Haber J. Smoking is a major risk factor for periodontitis. Curr Opin Periodontol 1994:12–8.
21. Sonnenschein SK, Meyle J. Local inflammatory reactions in patients with diabetes and periodontitis. Periodontol 2000 2015;69 221-25=4.
22. Preshaw PM, Alba AL, Herrera D, et al. Periodontitis and diabetes: a two-way relationship. Diabetologia 2012;55:21–31.
23. Meyle J, Gonzales JR. Influences of systemic diseases on periodontitis in children and adolescents. Periodontol 2000 2001;26:92–112.
24. Kocher T, Holtfreter B, Petersmann A, et al. Effect of periodontal treatment on HbA1c among patients with prediabetes. J Dent Res 2019;98:171–9.
25. Lang NP, Tonetti MS. Periodontal risk assessment (PRA) for patients in supportive periodontal therapy (SPT). Oral Health Prev Dent 2003;1:7–16.
26. Listgarten MA. Bacterial invasion of periodontal tissues. J Periodontol 1988;59:412.
27. Lang NP, Adler R, Joss A, Nyman S. Absence of bleeding on probing. An indicator of periodontal stability. J Clin Periodontol 1990;17:714–21.
28. Claffey N, Nylund K, Kiger R, Garrett S, Egelberg J. Diagnostic predictability of scores of plaque, bleeding, suppuration and probing depth for probing attachment loss. 3 1/2 years of observation following initial periodontal therapy. J Clin Periodontol 1990;17:108–14.
29. Badersten A, Nilveus R, Egelberg J. Scores of plaque, bleeding, suppuration and probing depth to predict probing attachment loss. 5 years of observation following nonsurgical periodontal therapy. J Clin Periodontol 1990;17:102–7.
30. Matuliene G, Pjetursson BE, Salvi GE, et al. Influence of residual pockets on progression of periodontitis and tooth loss: results after 11 years of maintenance. J Clin Periodontol 2008;35:685–95.
31. Papapanou PN, Sanz M, Buduneli N, et al. Periodontitis: consensus report of workgroup 2 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. J Clin Periodontol 2018;45(Suppl 20): S162–70.