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Oral health-related quality of life of periodontal patients

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Background and Objective: The purpose of this study was to assess the oral health-related quality of life of patients presenting to a periodontal specialist by means of six questions, and to assess the perceived oral health by means of one question. Self-assessments of oral health were associated with clinical characteristics.

Material and Methods: Logistic regression models were used to associate self-assessments with clinical characteristics in a cross-sectional study.

Results: On the six-item questionnaire, close to 20% (295/1480) of the patients reported that teeth, gums or dentures had an impact fairly often or very often on one or more items (eating, relaxing, avoiding going out, feeling self-conscious, pain or discomfort). On the single question requesting a self-assessment of oral health, 42% (628/1468) rated their oral health as fair or poor. Both common oral health-related quality of life problems and worse perceived oral health were associated with having more than eight teeth with >5 mm periodontal pockets (odds ratio = 1.45, 95% confidence interval = 1.01–2.08; and odds ratio = 2.83, 95% confidence interval = 2.08–3.84, respectively), compared with patients who had fewer than three teeth with >5 mm periodontal pockets.

Conclusion: Oral health-related problems in patients presenting to a periodontal specialist office negatively affect their quality of life. If some of the findings of this study can be confirmed in other studies, it could change the perception of chronic periodontitis as a silent disease.

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Chronic periodontitis has been reported to be asymptomatic during most of its course, with clinical signs, such as periodontal pockets, being generally painless (1). Because chronic periodontitis is believed to be asymptomatic in its initial stages, it has been suggested that individuals may be unaware of their clinical periodontal status (2–4) and underestimate what treatments are required, as judged by dental professionals (5). In its more advanced stages, chronic periodontitis can be associated with signs and symptoms that are readily perceivable by individuals, such as tooth mobility, pain, eating difficulties, unesthetic loss of anterior interproximal papillae, or discomfort (6,7).

Various tools and methods have been developed to assess the impact of dental diseases on the oral health-related quality of life as perceived by the affected individual. Two such distinct methods include a self-report of oral health, typically assessed by a single question (subsequently referred to as the perceived oral health), and a self-report on oral symptoms and functions as assessed by a battery of questions (subsequently referred to as oral health-related quality of life). Surveys in the community and clinical settings have used these measures to describe the oral health from an individual perspective (7–15). Improvements on both the way individuals rate their oral health and the oral health-related quality of life of patients under treatment are desirable outcomes of dental treatments (16). Such measures are increasingly being used in clinical trials as subjective true end points (17–22).

In terms of these patient-oriented outcomes, little is known about their frequency among periodontal patients or their relationship to clinical signs of periodontal diseases. The aim of this study was to describe the perceived oral health, the oral health-related quality of life and the association of

these two subjective assessments with clinical characteristics among patients presenting to a periodontal specialist.

Subjects and methods

The study population consisted of members of the Washington Dental Service presenting for a comprehensive initial clinical examination by a periodontal specialist. A total of 3617 individuals were invited to participate in the study; 1497 patients consented to participate and mailed back the questionnaire during the period from February 2003 to October 2004 (41% response rate). The protocol of the study was approved by the Institutional Review Board of the University of Washington.

Patients' characteristics were obtained from a mailed questionnaire, which included questions on age, smoking, diabetes status, perceived oral health (one question) and oral health-related quality of life (six questions). Gender was obtained from administrative data. Number of teeth with at least one periodontal pocket deeper than 5 mm and 8 mm, and number of missing teeth were abstracted from the dental charts.

Perceived oral health was measured by a single question 'How would you describe the health of your teeth and gums?' where the possible answers were: excellent, very good, good, fair and poor. Patients reporting fair or poor oral health were considered as having worse perceived oral health.

Oral health-related quality of life was measured by a short oral health-related quality of life questionnaire consisting of six questions about the impact of teeth, gums and dentures on eating, relaxing, avoiding going out, feeling self-conscious or worried, pain and denture discomfort (Table 1). Patients who answered either fairly often or very often; always; or either quite a bit or a great deal to one or more of the six questions were considered as having common oral health-related quality of life problems.

The oral health-related quality of life questionnaire was developed by Kressin and colleagues (unpublished), based on a conceptual model of oral health and quality of life which posited that the dimensions of physical function, social role function, distress, worry, denture discomfort and impairment/disease were the six most important areas that could be impacted by decrements in oral health. They tested this model empirically, using data previously collected from two samples of older male veterans (total $n = 816$), which included three oral health-related quality of life indices – the Oral Health Impact Profile (23), the Geriatric Oral Health Assessment Index (24) and the Oral Health-related Quality of Life measure (25). They assigned each item from the three scales to the dimension it best represented, and then, using factor analysis and multitrait analyses, pared down the number of items by eliminating items whose deletion least affected the internal consistency reliability of the scales. At the same time, they sought to retain the items which they considered, from a conceptual standpoint, to best represent the subscale. Ultimately, the brief oral health-related quality of life questionnaire consisted of a six-item measure representing six oral health-related quality of life dimensions in which four of these items were from the Oral Health Impact Profile questionnaire; one was from the Geriatric Oral Health Assessment Index; and one was from the Oral Health-related Quality of Life measure (Table 1). Reliability and validity of the new questionnaire were tested and the brief oral health-related quality of life questionnaire presented good internal consistency (Cronbach's alpha = 0.80) and convergent validity, as measured by its overall correlation with number of teeth, coronal and root dental caries, and periodontal status from the two samples of older male veterans.

Statistical analysis

The distribution of perceived oral health and each impact (i.e. each item) of the oral health-related quality of life instrument were examined using descriptive statistics. In the main analysis, logistic regression models were used to relate both worse perceived oral health and common oral health-related quality of life problems to number of teeth with pockets deeper than 5 mm (0–2, 3–4, 5–8, 9–30 teeth), number of teeth with pockets deeper than 8 mm (0, 1–2, 3–19 teeth) and number of missing teeth (0–3, 4–7, 8–11, 12–31 teeth). Subgroup analyses were performed for anterior and posterior teeth (see Table 2 for categories). In a secondary analysis, logistic regression was used to relate each impact (item) of the oral health-related quality of life questionnaire with the clinical characteristics of

Table 1. Development of a short-form oral health-related quality of life (OHQoL) questionnaire

Item	Scale	Original instrument	OHQoL dimension
During the past 3 mo, how often have you experienced the following difficulties because of problems with your teeth, mouth or dentures?			
Have you had to avoid eating some foods?	Never, Hardly ever, Occasionally, Fairly often, Very often	OHIP	Physical
Have you found it difficult to relax?	Never, Hardly ever, Occasionally, Fairly often, Very often	OHIP	Distress
Have you avoided going out?	Never, Hardly ever, Occasionally, Fairly often, Very often	OHIP	Social role
Have you felt nervous or self-conscious?	Never, Sometimes, Always	GOHAI	Worry
How much pain or distress have your teeth or gums caused you?	None at all, A little bit, Some, Quite a bit, A great deal	OHQoL	Impairment
Have you had uncomfortable dentures?	Never, Hardly ever, Occasionally, Fairly often, Very often	OHIP	Denture discomfort

GOHAI, Geriatric Oral Health Assessment Index; OHIP, Oral Health Impact Profile; OHQoL, oral health-related quality of life.

the patients. Given the exploratory nature of this latter analysis, we report only those results where the lower limit of the confidence interval is ≥2. In addition to the clinical characteristics, the multivariate models included age groups (35 to < 49, 49 to < 54, 54 to < 60, 60–89 years old), gender (male, female), smoking status (never, former, current), diabetes status (yes, no) and partial denture use (yes, no).

Results

Participants presenting for an initial periodontal examination and consenting to participate were 35–89 years old (mean = 54.8; standard deviation = 8.2); 51.2% were women; 9.5% reported having diabetes; and 21.8% and 42.9% were current and former smokers, respectively. Fourteen per cent of the patients reported using some type of removable dentures. In general, patients had 6.1 teeth with periodontal pockets deeper than 5 mm (standard deviation = 5.6) [1.2 (standard deviation = 2.3) in the anterior teeth and 4.9 (standard deviation = 3.9) in the posterior teeth]. The mean number of teeth with periodontal pockets deeper than 8 mm was 0.7 (standard deviation = 1.4) [0.1 (standard deviation = 0.5) in the anterior teeth and 0.6 (standard deviation = 1.2) in the posterior teeth]. On average, patients had 7.1 missing teeth (standard deviation = 4.8) [0.8 missing anterior teeth (standard deviation = 1.9) and 6.1 missing posterior teeth (standard deviation = 3.0)].

Perceived oral health

Only 1.9% of the patients rated their oral health as excellent; 14.1% rated their oral health as very good, 40.2% as good, 34.5% as fair and 7.4% as poor (28 participants did not answer this question). A total of 41.9% of the sample indicated that their oral health was in the 'worst' category (fair or poor).

Periodontal pockets > 5 mm and worse perceived oral health — The unadjusted odds of worse perceived oral health increased by 19% for patients with 3–4 teeth that had pockets > 5 mm (95% confidence interval = 0.86–1.66); by 40% for patients with 5–8 teeth that had pockets > 5 mm (95% confidence interval = 1.03–1.90); and by 183% for those with ≥9 teeth that had pockets > 5 mm (95% confidence interval = 2.08–3.84), compared with patients who had 0–2 teeth with pockets > 5 mm. After adjustment, only the odds of worse perceived oral health for patients who had ≥9 teeth with pockets > 5 mm remained significantly different from patients who had 0–2 teeth with pockets > 5 mm. When restricting the analyses to anterior or posterior teeth, worse per-

Table 2. Association of worse perceived oral health (reported as fair or poor self-assessed oral health) with clinical characteristics of periodontal patients presenting for an initial examination

	Worse perceived oral health[a]	
	Crude OR (95% CI)	Adjusted OR[b] (95% CI)
No. of teeth PD > 5 mm		
0–2 teeth (reference)		
3–4 teeth	1.19 (0.86 1.66)	1.09 (0.77 1.53)
5–8 teeth	1.40 (1.03 1.90)	1.21 (0.88 1.67)
9 or more teeth	2.83 (2.08 3.84)	2.78 (2.00 3.87)
No. of teeth PD > 8 mm		
0 tooth (reference)		
1–2 tooth	1.25 (0.96 1.62)	1.10 (0.83 1.45)
3 or more teeth	3.28 (2.10 5.14)	3.18 (2.00 5.05)
No. of missing teeth		
0–3 teeth (reference)		
4–7 teeth	1.53 (1.18 1.99)	1.73 (1.31 2.28)
8–11 teeth	2.08 (1.46 2.96)	2.45 (1.66 3.61)
12 or more teeth	1.92 (1.27 2.90)	2.61 (1.65 4.13)
Subgroup analyses		
No. of anterior teeth PD > 5 mm		
0 tooth (reference)		
1–4 teeth	1.48 (1.14 1.91)	1.34 (1.03 1.74)
5 or more teeth	4.47 (2.95 6.78)	3.73 (2.43 5.73)
No. of posterior teeth PD > 5 mm		
0–2 teeth (reference)		
3–8 teeth	1.53 (1.18 1.97)	1.39 (1.07 1.82)
9 or more teeth	2.61 (1.89 3.62)	2.62 (1.84 3.73)
No. of anterior teeth PD > 8 mm		
0 tooth (reference)		
1–2 tooth	1.70 (1.03 2.82)	1.60 (0.95 2.69)
3 or more teeth	4.23 (1.14 15.69)	3.30 (0.86 12.60)
No. of posterior teeth PD > 8 mm		
0 tooth (reference)		
1–2 tooth	1.25 (0.96 1.63)	1.09 (0.83 1.44)
3 or more teeth	3.33 (2.04 5.45)	3.21 (1.93 5.32)
No. of anterior missing teeth		
0 tooth		
1 teeth	1.08 (0.76 1.54)	1.12 (0.77 1.62)
2–4 teeth	1.12 (0.73 1.71)	1.02 (0.65 1.61)
4 or more teeth	1.31 (0.89 1.95)	1.34 (0.88 2.04)
No. of posterior missing teeth		
0–5 teeth (reference)		
6–8 teeth	1.39 (1.09 1.79)	1.52 (1.17 1.98)
9–10 teeth	2.30 (1.51 3.52)	2.51 (1.61 3.93)
11 or more teeth	1.58 (1.05 2.40)	2.03 (1.27 3.23)

CI, confidence interval; OR, odds ratio; PD, pocket depth.

[a]Patients who described a fair or poor health of their teeth and gums as opposed to excellent, very good and good.

[b]Logistic model included age (35 to < 49, 49 to < 54, 54 to < 60 and 60–89 years), gender, smoking (never, former, current smoker), diabetes, partial denture use, number of teeth with pockets deeper than 5 mm and number of missing teeth.

ceived oral health was associated with both anterior and posterior teeth with pockets > 5 mm (Table 2).

Periodontal pockets > 8 mm and worse perceived oral health — The unadjusted odds for worse perceived oral health increased by 228% for patients who had ≥3 teeth with pockets deeper than 8 mm compared to patients without pockets > 8 mm (odds ratio = 3.28; 95% confidence interval = 2.10–5.14). After adjustment, this association remained statistically significant. When restricting the analyses to anterior or posterior teeth, posterior teeth with pockets > 8 mm was associated with worse perceived oral health (Table 2).

Missing teeth and worse perceived oral health — When compared with patients who had 0–3 missing teeth, having 4–7, 8–11 or ≥12 missing teeth increased the unadjusted odds of worse perceived oral health by 53% (95% confidence interval = 1.18–1.99), 108% (95% confidence interval = 1.46–2.96) or 92% (95% confidence interval = 1.27–2.90), respectively. After adjustment for confounding, all levels of missing teeth (4–7, 8–11 and ≥12) remained significantly associated with worse perceived oral health. When restricting the analyses to anterior or posterior teeth, the number of posterior missing teeth was associated with worse perceived oral health (Table 2).

Common oral health-related quality of life problems: one or more out of six problems with a poor rating

Almost 20% of the patients had one or more items endorsed as having problems fairly often or very often with eating, relaxing, avoiding going out, feeling self-conscious, denture discomfort or pain caused by teeth, gums and dentures (i.e. common oral health-related quality of life problems) (Table 3). Of these patients, 11.1% reported one problem, 5.7% reported two problems, 1.8% reported three problems and 1.2% reported four to six problems.

Periodontal pockets > 5 mm and common oral health-related quality of life problems — Having ≥9 teeth with pockets deeper than 5 mm increased by 45% the unadjusted odds of common oral health-related quality of life problems compared with patients who had 0–2 teeth with pockets > 5 mm (odds ratio = 1.45; 95% confidence interval = 1.01–2.08). Compared with patients who had 0–2 teeth with pockets > 5 mm, the unadjusted odds of common oral health-related quality of life problems were not statistically different between patients who had 3–4 teeth with pockets > 5 mm (odds ratio = 1.00; 95% confidence interval = 0.67–1.50) or 5–8 teeth with pockets > 5 mm (odds ratio = 0.86; 95% confidence interval = 0.59–1.27). Adjustment for confounding increased the magnitude of the association between ≥9 teeth with pockets > 5 mm and frequent oral health-related quality of life (odds ratio = 1.59; 95% confidence interval = 1.07–2.35). The number of anterior and posterior teeth with pockets > 5 mm were also associated with common oral health-related quality of life problems (Table 4).

Periodontal pockets > 8 mm and common oral health-related quality of life problems — Compared with no pockets > 8 mm, the unadjusted odds of common oral health-related quality of life problems increased by 67% for patients who had ≥3 teeth with pockets > 8 mm (odds ratio = 1.67; 95% confidence interval = 1.04–2.68). After adjustment for confounding, ≥3 teeth with pockets > 8 mm remained associated with common oral health-related quality of life problems (Table 4). The number of posterior teeth with pockets > 8 mm was also associated with common oral health-related quality of life problems (Table 4).

Missing teeth and common oral health-related quality of life problems — Having 8–11 missing teeth increased by 106% the unadjusted odds of common oral health-related quality of life problems compared with patients who had 0–3 missing teeth (odds ratio = 2.06; 95% confidence interval = 1.38–

Table 3. Impact of oral health on the quality of life of periodontal patients

	OHQoL impacts[a]						
	Eating $n = 1476$	Relaxing $n = 1474$	Avoiding going out $n = 1476$	Self- conscious[b] $n = 1474$	Pain[c] $n = 1475$	Denture discomfort[d] $n = 209$	Common OHQoL problems[e] $n = 1480$
Intensity (%)							
Never	57.0	53.7	82.5	70.0	34.2	52.6	
Hardly ever	19.0	19.4	11.4		35.6	15.3	
Occasionally	18.0	18.7	4.4	25.3	19.6	16.8	
Fairly often	3.9	5.6	1.1		7.5	8.1	
Very often	2.2	2.5	0.7	4.8	3.1	7.2	
Fairly or very often (%)	6.0	8.1	1.8	4.8	10.6	15.3	19.9

[a]Patients were asked to report how often during the past 3 months they had experienced difficulties because of problems with their teeth, mouth or dentures.
[b]Frequencies of the impact 'feeling self-conscious (or nervous)' included never, sometimes and always.
[c]Frequencies of the impact 'feeling pain (or distress)' included none at all, a little bit, some, quite a bit and a great deal.
[d]Patients with at least one partial denture.
[e]Patients with at least one endorsement of a fairly often or very often impact of teeth, gums or dentures on eating, relaxing, avoiding going out, feeling self-conscious, pain or denture discomfort were considered as having common oral health-related quality of life (OHQoL) impact.

3.09). The odds of common oral health-related quality of life problems were not statistically different between patients with 4–7 (odds ratio = 1.01; 95% confidence interval = 0.72–1.41) or ≥12 (odds ratio = 1.48; 95% confidence interval = 0.91–2.43) missing teeth when compared with patients who had 0–3 missing teeth. After adjustment for confounding, the association between having 8–11 missing teeth and common oral health-related quality of life problems remained statistically significant. When restricting the analyses to anterior or posterior teeth, the number of posterior missing teeth was associated with common oral health-related quality of life problems (Table 4).

Table 4. Association of common oral health-related quality of life (OHQoL) problems (at least one item endorsed as having problems fairly or very often with eating, relaxing, avoiding going out, feeling self-conscious, denture discomfort or pain caused by teeth, gums and dentures) with clinical characteristics of periodontal patients

	Common OHQoL problems[a]	
	Crude OR (95% CI)	Adjusted OR[b] (95% CI)
No. of teeth PD > 5 mm		
0–2 teeth (reference)		
3–4 teeth	1.00 (0.67 1.50)	1.04 (0.68 1.58)
5–8 teeth	0.86 (0.59 1.27)	0.88 (0.58 1.32)
9 or more teeth	1.45 (1.01 2.08)	1.59 (1.07 2.35)
No. of teeth PD > 8 mm		
0 tooth (reference)		
1–2 tooth	1.00 (0.72 1.40)	1.00 (0.70 1.41)
3 or more teeth	1.67 (1.04 2.68)	1.80 (1.09 2.98)
No. of missing teeth		
0–3 teeth (reference)		
4–7 teeth	1.01 (0.72 1.41)	1.07 (0.76 1.51)
8–11 teeth	2.06 (1.38 3.09)	2.32 (1.49 3.61)
12 or more teeth	1.48 (0.91 2.43)	1.54 (0.89 2.65)
Subgroup analyses		
No. of anterior teeth PD > 5 mm		
0 tooth (reference)		
1–4 teeth	1.21 (0.88 1.66)	1.18 (0.85 1.64)
5 or more teeth	1.87 (1.22 2.87)	1.70 (1.08 2.67)
No. of posterior teeth PD > 5 mm		
0–2 teeth (reference)		
3–8 teeth	0.95 (0.69 1.31)	0.99 (0.71 1.38)
9 or more teeth	1.46 (1.00 2.13)	1.63 (1.08 2.48)
No. of anterior teeth PD > 8 mm		
0 tooth (reference)		
1–2 tooth	1.28 (0.70 2.31)	1.28 (0.70 2.37)
3 or more teeth	3.04 (0.96 9.65)	2.22 (0.67 7.40)
No. of posterior teeth PD > 8 mm		
0 tooth (reference)		
1–2 tooth	1.00 (0.72 1.40)	0.99 (0.70 1.40)
3 or more teeth	1.66 (0.99 2.79)	1.76 (1.02 3.04)
No. of anterior missing teeth		
0 tooth		
1 teeth	1.06 (0.68 1.66)	0.99 (0.63 1.58)
2–4 teeth	1.32 (0.79 2.18)	1.24 (0.73 2.11)
4 or more teeth	1.30 (0.82 2.08)	1.22 (0.74 2.03)
No. of posterior missing teeth		
0–5 teeth (reference)		
6–8 teeth	1.00 (0.73 1.38)	1.07 (0.76 1.49)
9–10 teeth	2.11 (1.33 3.35)	2.16 (1.32 3.53)
11 or more teeth	1.75 (1.09 2.82)	1.84 (1.07 3.16)

CI, confidence interval; OR, odds ratio; PD, pocket depth.
[a]At least one endorsement of a fairly often or very often impact of teeth, gums or dentures on eating, relaxing, avoiding going out, feeling self-conscious, pain or denture discomfort.
[b]Logistic model included age (35 to < 49, 49 to < 54, 54 to < 60 and 60–89 years), gender, smoking (never, former, current smoker), diabetes, partial denture use, number of teeth with pockets deeper than 5 mm and number of missing teeth.

Specific oral health-related quality of life impacts: exploratory analyses

Pain and difficulty in relaxing were the most frequent impacts, with prevalences of 10.6% and 8.1%, respectively. Six per cent of the periodontal patients reported having eating problems fairly or very often, 4.8% reported feeling always self-conscious and 1.8% reported fairly or very often avoiding going out because of oral problems. Among patients with dentures, 15.3% of the patients reported discomfort fairly or very often (Table 3).

Periodontal pockets > 5 mm and specific oral health-related quality of life impacts — None of the lower limits of the odds ratio's confidence intervals for the association between periodontal pockets > 5 mm and each oral health-related quality of life impact on eating, avoiding going out, relaxing, feeling self-conscious, pain and denture discomfort were ≥2.

Periodontal pockets > 8 mm and specific oral health-related quality of life impacts — Having ≥3 anterior teeth with pockets > 8 mm was associated with feeling pain frequently when compared to no anterior teeth with pockets > 8 mm (odds ratio = 6.43; 95% confidence interval = 2.01–20.57). This association remained significant after adjustment for confounding (Table 5).

Missing teeth and specific oral health-related quality of life impacts — Patients with 8–11 and ≥12 missing teeth had an increased unadjusted odds of reporting frequent self-consciousness as a result of teeth, gums and dentures when compared to patients who had 0–3 missing teeth (odds ratio = 4.70, 95% confidence interval = 2.05–10.75; and odds ratio = 4.25, 95% confidence interval = 1.68–10.72, respectively). After adjustment, 8–11 and ≥12 missing teeth remained associated with feeling self-conscious

Table 5. Exploratory analyses of the association of each oral health-related quality of life (OHQoL) impact (reported fairly or very-often occurrence of problems on eating, relaxing, avoiding going out, feeling self-conscious, denture discomfort or pain caused by teeth, gums and dentures) with clinical characteristics of periodontal patients: only results where the lower limit of the confidence interval is ≥2 are reported

	Crude OR (95% CI)	Adjusted OR[a] (95% CI)
Self-conscious		
No. of missing teeth		
0–3 teeth (reference)		
4–7 teeth	1.89 (0.86 4.12)	2.12 (0.96 4.70)
8–11 teeth	4.70 (2.05 10.75)	6.28 (2.58 15.31)
12 or more teeth	4.25 (1.68 10.72)	5.24 (1.91 14.37)
No. of posterior missing teeth		
0–5 teeth (reference)		
6–8 teeth	1.64 (0.86 3.11)	1.87 (0.97 3.63)
9–10 teeth	2.86 (1.22 6.67)	3.17 (1.30 7.73)
11 or more teeth	4.06 (1.88 8.74)	5.20 (2.14 12.63)
Pain		
No. of teeth PD > 8 mm – anterior		
0 tooth (reference)		
1–2 tooth	1.29 (0.60 2.76)	1.28 (0.59 2.80)
3 or more teeth	6.43 (2.01 20.57)	5.19 (1.53 17.66)
Denture discomfort		
No. of missing teeth		
0–3 teeth (reference)		
4–7 teeth	1.82 (0.35 9.45)	1.69 (0.27 10.75)
8–11 teeth	9.57 (2.01 45.51)	2.80 (0.47 16.69)
12 or more teeth	17.38 (3.70 81.61)	3.64 (0.62 21.53)
No. of anterior missing teeth		
0 tooth (reference)		
1 teeth	5.41 (1.43 20.39)	2.15 (0.49 9.42)
2–4 teeth	19.53 (6.40 59.57)	6.2 (1.74 22.05)
4 or more teeth	10.66 (3.20 35.54)	2.09 (0.56 7.84)
No. of posterior missing teeth		
0–5 teeth (reference)		
6–8 teeth	1.71 (0.55 5.33)	1.45 (0.37 5.61)
9–10 teeth	2.29 (0.46 11.50)	0.68 (0.12 4.03)
11 or more teeth	11.08 (3.86 31.84)	2.48 (0.61 10.16)

CI, confidence interval; OR, odds ratio; PD, pocket depth.
[a]Logistic model included age (35 to < 49, 49 to < 54, 54 to < 60 and 60–89 years), gender, smoking (never, former, current smoker), diabetes, partial denture use, number of teeth with pockets deeper than 5 mm and number of missing teeth.

frequently. When restricting to anterior or posterior missing teeth, posterior missing teeth was associated with frequent self-consciousness (Table 5).

Missing teeth was associated with denture discomfort. Patients with 8–11 and ≥12 missing teeth had higher odds of frequent denture discomfort than patients with 0–3 missing teeth (odds ratio = 9.57, 95% confidence interval = 2.01–45.51; and odds ratio = 17.38, 95% confidence interval = 3.70–81.61, respectively). These associations were not statistically significant after adjustment for confounding. When restricting to anterior and posterior missing teeth, both anterior and posterior missing teeth were associated with frequent denture discomfort (Table 5).

Discussion

The findings of this study indicate that 42% of the patients reported either fair or poor oral health when a simple question was asked with regard to the perception of the conditions of their teeth and gums. In addition, one in five periodontal patients reported frequent episodes of one or more oral health-related quality of life problems when six questions related to their teeth, gums and dentures were posed. The relationships of periodontal pockets and missing teeth with both perceived oral health and oral health-related quality of life self-assessments were not simple linear associations.

Many patients were not satisfied with the health of their teeth and gums; almost half rated their oral health as fair or poor. It is important to note that these periodontal patients are not necessarily rating their oral health worse than the general population. Our findings were similar to national United States estimates, where 36% and 44% of adults 40–64 years and > 65 years rated their oral health as fair or poor, respectively (15).

About one-fifth of this population of periodontal patients reported one or more frequent adverse impacts in their quality of life caused by teeth, gums or dentures. This figure is similar to estimates from national surveys in the UK and Australia, where 16% and 18% of adults reported at least one oral health-related quality of life adverse impact occurring very or fairly often (26). The three most commonly reported problems were pain, difficulty relaxing and denture discomfort. These findings suggest that not only the physical functioning, but also pleasurable life experiences, such as relaxation and social interaction, can be affected by the oral conditions of periodontal patients.

There was not a simple linear relationship between the number of deep pockets, the number of missing teeth and the self-assessed oral health measures. For periodontal pockets, oral health-related quality of life and perceived oral health was only affected when multiple teeth were involved (generalized periodontitis?). In contrast, the presence of a few periodontal pockets (localized periodontitis?) did not influence the oral health-related quality of life or the perceived oral health. In a study in England, oral health-related quality of life was found to be linearly associated with periodontal pockets 5 mm or deeper of patients either at an initial examination or during the maintenance phase of the periodontal treatment (7), a finding we failed to duplicate.

The findings that a few periodontal pockets were not related to common oral health-related quality of life

problems and moderately related to worse perceived oral health suggest that, even though patients being referred to a periodontal specialist may be aware of their periodontal disease status, the consequences of a few periodontal pockets on the oral health-related quality of life of these patients are likely to be small.

In contrast with localized chronic periodontitis, patients with generalized forms of chronic periodontitis may be more likely to have noticeable signs and symptoms, such as tooth mobility and unaesthetic loss of anterior interproximal papillae, which may be driving the observed poor oral health-related quality of life and worse perceived oral health. These findings suggest that chronic periodontitis may interfere with the social life of periodontitis patients and challenge the perception of chronic periodontitis as a silent disease. In addition, the lack of linear correspondence between the current objective measure of periodontal diseases (i.e. periodontal pockets) and oral health-related quality of life or perceived oral health may encourage clinicians and investigators to make use of outcomes more meaningful to their patients by adding together traditional clinical indicators and subjective indicators to assess periodontal needs and evaluate treatments in the periodontal practice.

Number of missing teeth was another clinical characteristic of the periodontal patients associated with both oral health-related quality of life and worse perceived oral health. This relationship was more complex. When people were missing less than one-quarter of their dentition, quality of life was unaffected. Similarly, when people were missing more than one-third of their dentition, quality of life was not substantially affected. It is only within a relatively narrow range of missing teeth (one-quarter to one-third missing) that oral health-related quality of life seems to be affected, as compared to the people with a complete dentition or missing up to 3 teeth. This pattern was also observed for self-consciousness and denture discomfort, two specific questions of the oral health-related quality of life questionnaire. The findings highlight the non-linearity between number of teeth and these subjective assessments of oral health. Missing teeth has been related to oral health-related quality of life in several studies (27–33) and contrasting results have been reported. Our findings suggest that tooth loss may be associated with both a positive or a negative impact on quality of life, depending on whether a patient relates the loss of their teeth to absence of dental pain and swelling or to functional limitations, such as eating and aesthetic appearance.

The strengths of this study include the diversity of patients, who originated from a large number of clinical practices across the north-west of the USA. The weaknesses of this study include the low response rate and the lack of additional information on other specific dental problems. As people who do not respond to mail surveys may be different from those who do, the low response rate may have introduced bias, the direction and magnitude of which cannot be determined. No information was collected on a range of specific dental problems such as cavities, food impaction, receding gums and other specific dental problems. Such data might have assisted in determining to what extent periodontal therapies could improve oral health-related quality of life outcomes.

In summary, patients presenting for an initial periodontal examination have frequent problems related to teeth, gums and denture, and many of these patients perceive their oral health as fair or poor. In addition, lack of a linear association between periodontal pockets and these subjective measures emphasizes the importance of using subjective oral health assessments in the clinical practice as a tangible patient outcome, as they add information (which is not available through the purely clinical indices) about the impact of the disease state on the patient. Finally, the association of specific aspects of oral health-related quality of life and chronic periodontitis should be confirmed or refuted in other studies as it may significantly change the perception of chronic periodontitis as a silent disease.

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