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Original Article

Evaluation of the relationship among dental fear, scaling and root planing and periodontal status using periodontitis stages: A retrospective study

Yeungyeung Liu ^a, Caimei Zhang ^b, Jingyi Wu ^c, Huimin Yu ^a, Chengjie Xie ^{a*}

^a Department of Periodontology, Stomatological Hospital, Southern Medical University, Guangzhou, China

^b Department of Endodontics, Stomatological Hospital, Southern Medical University, Guangzhou, China

^c Department of Implantology, Stomatological Hospital, Southern Medical University, Guangzhou, China

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Abstract *Background/purpose:* Patients with periodontal disease have higher dental fear levels, which may have negative effects on their clinical outcome during scaling and root planing (SRP). The present study used the new classification of periodontitis and validated questionnaires to assess the relationship among dental fear, SRP pain and periodontal status. *Materials and methods:* A total of 120 periodontitis patients were enrolled and staging according to the new classification of periodontitis. SRP was performed, and the visual analog scale (VAS) to assess pain was used with every patient after treatment. Questionnaires, including Corah's Dental Anxiety Scale (DAS), Dental Fear Survey (DFS), and short-form Dental Anxiety Inventory (S-DAI) were implemented from the first attendance and subsequent visits after 6 months. The patients were grouped by DAS scores. The statistical analysis was performed using T-test, chi-square, Pearson and Spearman correlative analysis.

Results: Compared to pre-SRP treatment, the dental fear level on DFS was decreased in the posttreatment period for all periodontitis stages. There were no statistically significant differences in S-DAI and DAS between pretreatment and posttreatment periods in stage I and II; meanwhile, there were statistically differences in stage III and IV. The correlation among periodontitis stages, VAS and dental fear level was significant. The proportion of high periodontitis stages was increased in high dental fear group.

* Corresponding author. Department of Periodontology, Stomatological Hospital, Southern Medical University, S366 Jiangnan Boulevard, Guangzhou, 510280, China. Fax: +86 20 8444 5386.

E-mail address: ChengJieXie2021@163.com (C. Xie).

Conclusion: SRP can reduce dental fear levels in all periodontitis stages, especially in stage III and IV. Correlations exist among periodontal status, dental fear and SRP pain. High dental fear is associated with poor periodontal status.

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Introduction

Periodontal disease is one of the two most prominent oral diseases. Severe periodontal disease is the eleventh most prevalent disease worldwide and may lead to tooth loss.¹ Nonsurgical periodontal therapy, including scaling and root planing (SRP), is the gold standard for successful periodontal therapy.² SRP was found to be effective in reducing the probing depth and improving the clinical attachment level.³ However, the resulting pain and sensitivity during treatment would discourage patient attendance and increase dental fear levels.⁴

Dental fear affects 5–20% of adults globally and ranges from a mild sensation of apprehension to prominent fear and dental phobia.^{5–7} Less frequent dental visits, worse oral health and greater functional impairment are related to dental fear.⁸ The dental fear level also negatively affects the treatment outcomes and even leads to avoidance of dental treatment.^{4–8} It was found that individuals who had high dental fear would delay treatment, leading to more extensive development of disease, which ultimately required more invasive and potentially painful treatment, and these experiences could then contribute to an increase in dental fear: this is a 'vicious cycle'.^{9,10}

Patients with periodontal disease have higher dental fear levels.¹¹ Continuously high levels of dental fear caused by discomfort or pain experienced during the periodontal treatment process might have negative effects on the clinical outcome.¹² Pain per se or the memory of pain was proven to be the stimuli inducing dental fear during periodontal treatment.¹³ Psychological stability was deemed beneficial in terms of reducing posttreatment pain and the degree of life activity impairment.¹⁴ Sites of bleeding on probing (BOP) and sites ≥ 4 mm probing depth also caused higher VAS scores.¹⁵ Correlations among dental fear, SRP pain and periodontal status have been established.

The relationship among dental fear, pain and periodontal status assessed using a previous periodontal disease classification (1999) was reported.^{16,17} According to Santuchi et al., patients with moderate chronic periodontitis based on the previous classification (1999) exhibited worse clinical periodontal status with higher dental fear levels.¹² Schirme et al. reported that severe periodontal inflammation (≥ 4 sites with ≥ 6 mm PD) was related to pain and dental fear during SRP.¹⁷ Levin et al. noted that patients with aggressive periodontitis (AgP) in the previous classification (1999) demonstrated higher dental fear levels.⁶

In 2018, researchers revisited the previous classification (1999) and incorporated new knowledge relevant to its epidemiology, etiology and pathogenesis that has accumulated since the current classification's inception, and then

proposed a novel classification framework along with case definitions. The new classification assessed periodontitis by stages and grades. Staging based on the severity of disease presented the complexity of disease management, while grading provided supplemental information about biological features of the disease.¹⁸ Graetz et al. and Karaaslan et al. stated that periodontal status assessed by the new periodontitis classification (2018) was associated with oral health-related quality of life (OHRQoL).^{19,20} Moreover, Petit et al. reported that increase stress, anxiety and depression could worsen SRP outcomes in periodontitis stage III and IV.²¹ The new periodontitis classification (2018) has been widely used in clinical assessment, but research on dental fear and SRP pain is insufficient.

The present study used the new classification of periodontitis and validated questionnaires to assess the relationship among dental fear, SRP pain and periodontal status.

Materials and methods

Study design and population

Patients who presented at the Outpatient Clinic of Stomatological Hospital, Southern Medical University from July 2018 to January 2020 were chosen to complete the questionnaires. Written informed consent for participation was obtained from all participants prior to the investigation. This study was approved by the Ethical Committee, Stomatological Hospital of Southern Medical University (Ethical approval number 2019–35).

The following inclusion criteria were adopted: 1. diagnosis of periodontitis (American Academy of Periodontology, AAP, 2018¹⁸); 2. aged 35–65 years old; 3. at least 4 natural teeth per quadrant (one incisor, one canine, one premolar and one molar) with healthy pulp status; 4. no dentin hypersensitivity. The exclusion criteria were as follows: 1. periodontal treatment including SRP procedures within 12 months. 2. utilization of antibiotics or anti-inflammatory drugs within 1 month; 3. use of desensitizing toothpaste within 1 month; 4. pregnancy and lactation; 5. history indicative of a medical or psychological disorder that may affect normal pain perception, or taking any stress or pain medication; 6. smoking or alcohol abuse; 7. systemic disease.

Study procedure

The new classification of periodontal disease (2018) provided an assessment of periodontitis in stages and grades.¹⁸

Stage parameters included interdental clinical attachment loss, probing depth, radiographic bone loss and tooth loss. Stage I: Interdental CAL 1–2 mm, maximum PD \leq 4 mm, radiographic bone loss less than 15% coronal third of the tooth, no tooth loss; Stage II: Interdental CAL 3–4 mm, maximum PD \leq 5 mm, radiographic bone loss of up to 15%–33% coronal third of the tooth, no tooth loss; Stage III: Interdental CAL \geq 5 mm, PD \geq 6 mm, radiographic bone loss extending to mid-third of root and beyond, less than 4 teeth lost; Stage IV: Interdental CAL \geq 5 mm, PD \geq 6 mm, radiographic bone loss extending to mid-third of root and beyond, more than 5 teeth lost, with or without loss of masticatory function. Grades were used as indicators of the progression rate of periodontitis. Smoking and diabetes were parameters used in evaluating the grade level. However, these factors were excluded in the current study. In this case, we did not integrate grading into population assessment. All patients who presented from July 2018 to January 2020 were divided into periodontitis stages. In each stage, the data of thirty consecutive patients were recorded. A total of one hundred and twenty patients' demographic data were collected in this study. Periodontal examination, including probing depth (PD), clinical attachment level (CAL) and radiographic inspection, was conducted at the first visit. Measurements of PD and CAL were obtained at six sites per tooth in all present teeth. After periodontal examination, SRP was performed with Gracey curettes until the root surfaces were hard and smooth. The VAS scale was applied immediately after SRP treatment. DAS, DFS and S-DAI questionnaires were implemented from the first attendance and consequent visits after 6 months. The procedure required two appointments (upper and lower teeth) for SRP and subsequent visits after 6 months. Every procedure was nonanesthetic and carried out by one doctor.

Questionnaires DAS, DFS and S-DAI

Prior to the procedure, the patient was interviewed using the questionnaires to gather information enabling the assessment of their dental fear level. The questionnaire comprised 3 separate tests: Corah's Dental Anxiety Scales (DAS), Dental Fear Survey (DFS), and the short-form Dental Anxiety Inventory (S-DAI). The questionnaire included 33 multiple-choice questions in total. The DAS consisted of four questions related to concerns about visiting the dentist,²² with the first two questions related to general anxiety and the last two questions related to anticipated fear of any specific stimuli. A score of 13 or above on the DAS was defined as "high dental fear", as widely accepted in previous assessments.²³ The DAS is the most extensively used dental fear scale for adults and has demonstrated adequate reliability and validity. Nonetheless, it fails to provide additional information regarding what the patient specifically fears. Dental Fear Survey (DFS) consisted of 20 items with five alternative answers to each item, rated from high to low intensity, covering the patients' specific fears.^{24,25} S-DAI was established by Stouthard et al., and it contains 9 items.²⁶ S-DAI allows for the assessment of physical reactions, thoughts and behavioral aspects of dental fear experienced by the individual.²⁷ The Chinese

versions of the DFS and S-DAI both have good reliability and validity.^{28,29}

General information besides the questionnaire included sociodemographic features, including gender, age, education level and marital status. Education level was divided into three types: "Under junior high school" (recorded as Level 1), "High school" (recorded as Level 2) and "College or over" (recorded as Level 3). Marital status was recorded either as unmarried (recorded as status 1) or married (recorded as status 2).

Visual analogue scale

Pain level was evaluated by Visual analogue scales (VAS). This scale is the most frequently used method to assess pain intensity. It consists of a horizontal line labeled at each end from 0 to 10 cm, and individuals mark their level of pain.³⁰ VAS was applied in a standard manner with an initial explanation to the patients, clarifying that 0 means no pain and discomfort, while 10 represents extremely intense pain and discomfort.¹² The VAS score was determined immediately after SRP treatment.

Data analysis

T-test was used to analyze the differences in dental fear pre- and post-SRP treatment. Pearson and Spearman correlative analyses were used to analyze correlations among dental fear values, VAS scores and periodontitis stages. Chi-square test was performed to evaluate the severity of periodontitis in patients with different dental fear levels. The differences in education level were evaluated by Wilcoxon test (Mann–Whitney). For all statistical analyses, *P* values were two-tailed, and the level of significance was set at $P < 0.05$.

Results

The current study retrospectively analyzed 120 periodontitis patients with an average age of 43.3 ± 5.98 years, including 64 males (53.33%) and 56 females (46.67%). According to their periodontal status, all patients were divided into 4 stage groups. No significant differences were observed among the patient groups with respect to age, gender, educational level and marital status ($P > 0.05$). Periodontal indicators and background characteristics are illustrated in Table 1.

From the dental fear questionnaires, compared to pre-SRP treatment, dental fear level of DFS was significantly decreased in the posttreatment period for all periodontitis stages. There were no statistically significant differences between the pretreatment and posttreatment periods on S-DAI and DAS in stage I and II; meanwhile, there were statistically significant differences between the pretreatment and posttreatment periods on S-DAI and DAS in stage III and IV (Table 2).

The results of correlative analysis revealed the relationship among dental fear, VAS and periodontitis stages as shown in Table 3. Correlations were statistically significant for dental fear levels assessed with DAS, DFS and S-DAI, VAS and periodontitis stages. Correlations among periodontitis

Table 1 Periodontal indicators and demographics of four periodontitis stages.

Periodontitis Stage	Stage I n = 30	Stage II n = 30	Stage III n = 30	Stage IV n = 30	P
Age	41.70 ± 5.96	43.17 ± 4.78	43.33 ± 6.09	45.13 ± 6.72	0.173
Gender (M:F)	14:16	15:15	17:13	16:14	0.885
Marriage	83.33%	86.67%	83.33%	80.00%	0.983
Education					
Level 1	0	0	0	2	0.426
Level 2	8	10	13	10	
Level 3	22	20	17	18	
PD ^a	2.28 ± 0.18	2.46 ± 0.24	3.72 ± 0.23	3.86 ± 0.32	<0.001**
CAL ^b	1.67 ± 0.19	2.72 ± 0.25	3.82 ± 0.27	4.13 ± 0.36	<0.001**

**Significant differences ($P < 0.01$)

T- test was performed on age, PD, and CAL. Chi-square test was performed on gender. Wilcoxon test (Mann–Whitney) was performed on education.

"Under junior high school" was recorded as Level 1; "High school" was recorded as Level 2; "College or over" was recorded as Level 3.

^a PD: Probing depth.

^b CAL: Clinical attachment level.

Table 2 Comparative analysis of dental fear between pre- and post-scaling and root planing (SRP) in four periodontitis stages.

Periodontitis stages	DAS ^a		DFS ^b		S-DAI ^c	
	pre-SRP	post-SRP	pre-SRP	post-SRP	pre-SRP	post-SRP
I	9.17 ± 1.98	8.20 ± 2.06	38.03 ± 5.89	34.70 ± 6.20*	21.40 ± 6.79	18.63 ± 5.90
II	10.77 ± 3.00	9.07 ± 3.67	45.03 ± 14.88	37.63 ± 11.89*	26.53 ± 9.17	23.43 ± 9.02
III	11.10 ± 4.16	8.97 ± 3.97*	48.93 ± 16.47	40.13 ± 13.87*	27.97 ± 9.69	22.83 ± 9.14*
IV	12.03 ± 4.06	9.57 ± 3.89*	54.87 ± 18.44	42.30 ± 15.94*	30.63 ± 7.92	24.47 ± 8.23*

*Compared to Pre-SRP, Significantly different, $P < 0.05$.

^a DAS: Corach's dental anxiety scales.

^b DFS: Dental fear survey.

^c S-DAI: Short-form dental anxiety inventory.

Table 3 Correlation among periodontitis stage, dental fear and visual analogue scale (VAS).

	VAS	Periodontitis stage
DAS ^a	0.531**	0.281*
DFS ^b	0.476**	0.380**
S-DAI ^c	0.200*	0.375**

* $P < 0.05$, ** $P < 0.01$.

^a DAS: Corach's dental anxiety scales.

^b DFS: Dental fear survey.

^c S-DAI: Short-form dental anxiety inventory.

stages, VAS and dental fear levels assessed via DAS, DFS and S-DAI were statistically significant.

High dental fear was defined by a score of 13 or above on the DAS scale, as widely accepted previously.²⁴ We separated the patients into two categories: the low dental fear group (DAS < 13) and the high dental fear group (DAS ≥ 13). Low dental fear group consisted of 28 (31.46%), 25 (28.09%), 19 (21.35%) and 17 (19.10%) patients in stage I, stage II, stage III and stage IV, respectively. High dental fear group comprised 2 (6.45%), 5 (16.13%), 11 (35.48%) and 13 (41.94%) patients in stage I, stage II, stage III and stage IV, respectively. In the categories divided according to DAS

scale, the proportion of high periodontitis stages was significantly increased in high dental fear group (DAS ≥ 13) (Fig. 1).

Discussion

In this study, the new 2018 periodontitis classification and validated questionnaires were used to determine the relationship among dental fear, SRP pain and periodontal status. The previous 1999 periodontitis classification was used extensively, but its major drawbacks were substantial overlap and a lack of clear pathobiology-based distinctions. Whereas, the new classification provides an assessment of periodontitis on the basis of stages and grades.¹⁸ Participants in this study had no systemic disease or smoking history, and the follow-up visits were set as 6 months following therapy. In this case, we did not include grading in the population assessment.

Dental fear should be studied with regard to the situation to which it pertains, the reactions it evokes, and its duration.¹¹ This study used DAS, DFS and S-DAI to evaluate dental fear from various aspects. DFS reflects dental fear informatively, which assists clinicians in obtaining a better understanding of the patient's fear, while DAS measures dental fear in a more general manner.³¹ Meanwhile, S-DAI

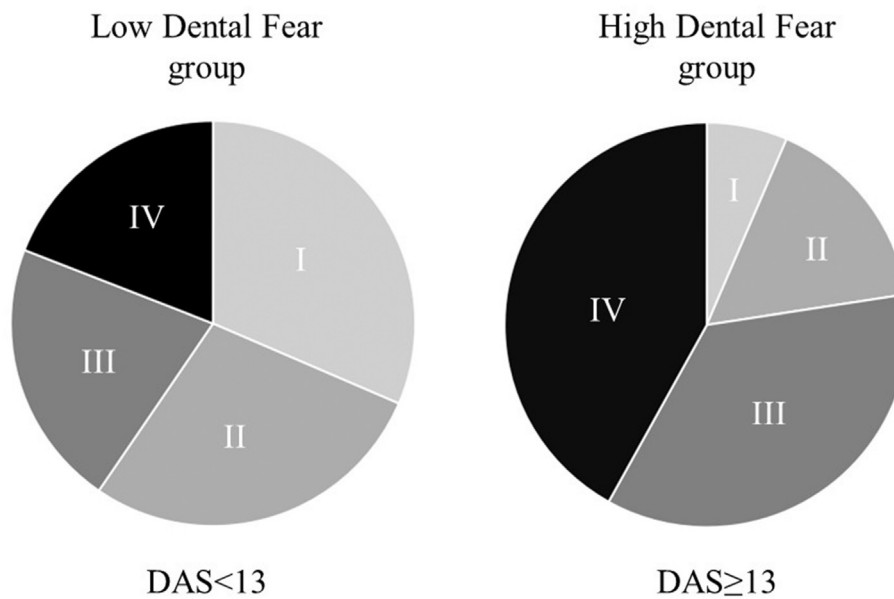


Figure 1 Distribution of the periodontitis stages between low and high dental fear groups.

focuses on psychometric grounds,²⁶ with nearly half of its items representing the emotional reactions of patients with respect to dental treatment.^{11,31} Santuchi et al. reported significantly lower dental fear levels at the first attendance, as suggested by DAS, but with no statistical significance on DFS.¹² Thus, researchers draw different conclusions toward the same issue based on their analyses of different scales. In the current study, the scores obtained from DAS and S-DAI were significantly decreased at the 6-month follow-up at most stages, but changes in DAS and S-DAI scores were not significant in stage I and II. Even though there was a discrepancy in the statistical significance of each scale, the mean value of all of the scales also declined. This study used a combination of three scales for analysis, which could enhance the accuracy of the results.

Notably, the present study demonstrated correlations between periodontitis stage and dental fear. Periodontal status was an important factor affecting dental fear, since a worse periodontal status was found to contribute to higher dental fear levels.¹² Guentsch et al. suggested that patients with higher dental fear levels experienced more bleeding on probing (BOP), which had negative effects on periodontal health.³² Levin et al. proved that periodontal clinical parameters, including plaque index, radiographic bone loss and probing depth, were correlated with DAS.⁶ Bell et al. reported that dental fear was associated with bleeding gums as a sign of gingivitis.³³ Notwithstanding, controversial opinions still exist. Delgado-Angulo et al. concluded that dental fear was not related to the number of teeth with $PD \geq 4$ mm,¹⁷ while Eitner et al. stipulated that anxiety was not associated with periodontal status.³⁴ These differences in dental fear levels may be attributed to the high variability of periodontal parameters, so the new classification is perfectly designed to avoid uncertainty on this issue.

Pain is an 'unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described by the patient in terms of such damage'.³⁵ As a

major component of dental fear, fear of pain associated with dental treatment has been identified.³⁶ SRP is often associated with pain and discomfort, although the occurrence of pain is variable and dramatically different among patients.¹⁶ The VAS scores representing the pain perceived during periodontal procedures range from approximately 20–80 mm.^{37,38} In this study, the mean VAS score during SRP was 24.79 ± 14.61 , which was significantly associated with dental fear. Tickle et al. discovered that subjects with dental fear were 2.3 times more likely to experience pain during dental treatment.³⁹ Fardal et al. drew a similar conclusion on various aspects of focus.⁴⁰ Based on these findings, Schirme et al. suggested that periodontal treatment should encourage healthcare professionals to design health and comfort treatment strategies that will cope with the dental fear of patients and reduce discomfort during dental treatment.¹⁶ On the other hand, Kyle et al. reported that patients reported less pain during treatment than they expected.⁴¹ Therefore, an evaluation of dental fear and pain levels is crucial for successful periodontal treatment.

In the present study, a statistically significant correlation was identified among dental fear, pain and periodontal status. The dental fear levels were all reduced across every stage of periodontitis, especially in stage III and IV, which highlighted the necessity of treatment intervention. Santuchi et al. reported that periodontal status was improved and experiences of fear were reduced during SRP, which was similar to our study's findings.¹² Fardal et al. reported that anxiety levels decreased with the progression of periodontal therapy.⁴² Consequently, clinicians should notice the level of dental fear and break the 'vicious cycle' in periodontitis patients.^{9,10}

The proportion of patients with periodontitis stage III (35.48%) and IV (41.94%) in the high dental fear group was significantly increased compared to that in the low dental fear group (stage III 21.34%, stage IV 19.10%). Despite the fact that the dental fear level of patients was reduced at the 6-month return visit, the dental fear values were still

high, especially in stage III and IV. Stage I and II were considered to indicate initial and moderate periodontitis, while stage III and IV were considered to indicate severe and advanced periodontitis.⁴³ This was in accordance with the findings in other studies demonstrating that patients with severe periodontitis had worse oral health, worse functional limitations, more physical pain, and higher psychological incapacity domain scores than those with mild and moderate periodontitis.⁴⁴ Based on the results of our study, clinicians should pay more attention to dental fear in stage III and IV periodontitis patients.

This is the first study in the literature to measure periodontal status based on periodontitis stages, aiming to evaluate the relationship between dental fear and pain. It is worth mentioning that our study has several limitations. For starters, the population size of the current study was relatively small, although statistically sufficient. Second, there was only one observer in the current study, so a lack of interrater reliability restricted the precision of our conclusion. Finally, grading assessment in future studies should incorporate a clinical evaluation of the new periodontitis classification.

In conclusion, SRP can reduce dental fear levels in all periodontitis stages, especially in stage III and IV. Correlations exist among periodontal status, dental fear and SRP pain. High dental fear is associated with poor periodontal status.

Declaration of competing interest

The authors declare that they have no competing interests.

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