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Original Article

Impact of non-surgical periodontal treatment on dental anxiety: A comparative study on patients with periodontitis

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Abstract *Background/purpose:* Dental anxiety is prevalent and may result in the avoidance of periodontal therapy and maintenance. This study aimed to explore the impact of non-surgical periodontal treatment (NSPT) on dental anxiety among patients with periodontitis.

Materials and methods: In this study, 122 patients with periodontitis participated. The Chinese version of the Modified Dental Anxiety Scale (MDAS) gauged baseline dental anxiety during the initial appointment. Patients receiving non-surgical periodontal treatment (NSPT) in subsequent appointments formed the NSPT group, while those with a delayed NSPT of at least two months constituted the delayed group. In the NSPT group, the second termination questionnaire was administered one month post the last NSPT visit, just before the periodontal re-evaluation. In the delayed group, the second questionnaire was completed before the delayed NSPT initiation.

Results: Baseline MDAS scores were comparable between the delay and NSPT groups. However, the NSPT group exhibited lower total scores and scores for each of the five MDAS items at termination compared with the delay group. At baseline, MDAS total scores were inversely associated with age and were lower in males. A reduction in MDAS total scores between

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observation points was correlated with NSPT, sex, and age after adjustment. Regarding MDAS item 4 (teeth scaled/polished), score reduction consistently correlated with NSPT and age.

Conclusion: Participation in NSPT may alleviate dental anxiety, and consequently enhance the patients' conceptiveness to undergo periodontal maintenance or surgery.

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Introduction

Dental anxiety, the fifth most common cause of anxiety,¹ manifests as emotional fear with distinct psychosomatic components triggered by dental stimuli. Although its prevalence varies across countries, ethnicities, ages, and socioeconomic statuses,^{2–4} the adverse effects of dental anxiety on dental health persist.^{5–7} Dental anxiety may result in decreased dental care-seeking behavior.^{8,9} More than 70% of referred patients requiring periodontal treatment without a previous history of periodontal therapy experienced anxiety regarding their pending treatment.¹⁰ For those with a history of dental therapy, anxiety may increase due to previous uncomfortable experiences,^{11,12} discouraging them from receiving essential treatments and compromising their oral health.¹³

Non-surgical periodontal treatment (NSPT) primarily addresses inflammatory periodontal infection through plaque control, mechanical therapy, and adjunctive pharmaceutical agents.¹⁴ Studies indicate varied effects of NSPT on dental anxiety, with one revealing reduced anxiety after 6 months given quadrant-wise scaling and root planing with weekly intervals between sessions,¹⁵ and another showing limited anxiety reduction before each of four visits during conventional-staged root surface debridement.¹⁶ A recent study discovered that individuals reported higher dental anxiety before undergoing NSPT compared to after the treatment.¹⁷ However, it is important to note that the study may not have accounted for the Hawthorne effect, wherein behavior can be influenced by the awareness of being observed.¹⁸ In this cohort study, dental anxiety levels were assessed and compared among patients with chronic periodontitis undergoing NSPT. The patients were divided into two groups: the NSPT group, where NSPT was performed subsequently after the initial dental visit, and the delayed group, with a schedule postponed by at least two months.

Materials and methods

Study cohort

In this study, 122 patients exhibiting localized or generalized periodontitis, with an average of 16 natural teeth per person, were recruited from the periodontal department of Taipei Tzu Chi Hospital and Tri-Service General Hospital. Exclusion criteria were as follows: (1) undergoing periodontal therapy for 12 months before study commencement; (2) currently taking anxiolytic, sedative, or analgesic

drugs; (3) a history of mental disorders; and (4) being a current smoker. NSPT included quadrant-wise plaque control, scaling, and root planing once per week for 4–6 weeks.¹⁵ Patients received a brief pre-NSPT lecture on the basic concept of periodontal therapy and importance of oral hygiene and maintenance.¹⁹ The Chinese version of the MDAS²⁰ was used to assess baseline dental anxiety at the first dental visit, with a second MDAS questionnaire administered based on treatment schedules: either immediate treatment (NSPT group) or delayed treatment (with a delay of at least two months; delay group). In the NSPT group, the second questionnaire (at termination) was administered one month after the last NSPT visit and immediately before periodontal re-evaluation; in the delay group, the second questionnaire was completed before the initiation of delayed NSPT. The rationale behind employing the two-group design was to mitigate bias stemming from the awareness of being observed, such as Hawthorne effect or the social-desirability bias, while the primary factor distinguishing between the groups was NSPT. Participants were enrolled in the study after they read and signed the written informed consent. The study received Institutional Review Board approval from Taipei Tzu Chi Hospital, New Taipei city, Taiwan (No. 08-X-086) and from Tri-service General Hospital, Taipei, Taiwan (no. 1-106-05-037). The study procedures were conducted in compliance with the Helsinki Declaration of 1975, as amended in 2013.

Comprehensive periodontal examinations were used to record patients' periodontal status before NSPT. The recorded parameters included plaque control (O'Leary index),²¹ bleeding on probing (BOP),²² probing depth,²³ gingival recession (REC), and clinical attachment level (CAL).²⁴ The O'Leary plaque index was recorded at four sites per tooth, whereas all other measurements were recorded at six locations around each tooth.

Questionnaire

The MDAS, originally developed in 1995 by Professor Gerry Humphris,²⁵ is a modification of Corah's dental anxiety scale and one of the two most commonly used questionnaires for assessing dental anxiety. The Chinese version of MDAS¹⁹ was used in the present study. The five-item Likert scale questionnaire offers set responses for each item, ranging from "not anxious" (score of 1) to "extremely anxious" (score of 5), with minimum and maximum scores of 5 and 25 points, respectively.²⁵ The MDAS contains the following five items:

Item 1: If you went to your dentist for treatment tomorrow, how would you feel?

Item 2: If you were sitting in the waiting room, how would you feel?

Item 3: If you were about to have a tooth drilled, how would you feel?

Item 4: If you were about to have your teeth scaled and polished, how would you feel?

Item 5: If you were about to have a local anesthetic injection in your gum, how would you feel?

Statistical analysis

All data were analyzed using SPSS statistical software (released in 2009). General characteristics and periodontal parameters of patients in the NSPT and delay groups were compared using t-tests or χ^2 tests, while the paired t-tests were used to compare the parameter means at the time points before and after NSPT. Spearman's correlation analysis was used to determine statistical correlations between age, O'Leary index, periodontal parameters, and MDAS scores. MDAS scores were compared between patient groups using the Kruskal–Wallis test. Multiple regression analysis was performed to assess the correlation of MDAS score changes between the first and second questionnaires. $P < 0.05$ was considered statistically significant.

Results

Table 1 summarizes the general characteristics and periodontal parameters of patients in both the delay and NSPT groups (55 and 66 patients, respectively). The information pertaining to periodontitis stage and grade, O'Leary index, and pocket depth revealed no intergroup differences. However, patients in the delay group were older and had a higher female-to-male ratio, along with lower values in BOP, REC, and CAL compared to those in the NSPT group. In NSPT group, significantly reduced O'Leary Index, BOP, and PPD, but increased REC, were observed at periodontal re-evaluation compared with before NSPT.

Baseline mean MDAS total scores in the delay and NSPT groups were statistically indistinguishable (Fig. 1). However, scores at termination differed significantly between groups, with NSPT group termination scores being significantly lower than baseline scores, whereas delay group scores remained statistically similar between baseline and termination. Consistent findings were observed for each of the five questionnaire items (Fig. 1B).

Table 2 shows the impact of patient characteristics and periodontal parameters on mean MDAS scores. Female patients exhibited higher mean scores compared with male patients, and age was negatively correlated with obtained MDAS scores ($r = -0.201$, $P = 0.03$; Table 2). However, MDAS scores were statistically similar across periodontitis stages and grades, exhibiting no correlation with periodontal parameters.

Examining MDAS score reduction from baseline to termination revealed a significantly greater reduction in the NSPT group compared with the delay group (1.98 and 0.54, respectively; Table 3). Notably, questionnaire item 4 displayed a significant reduction.

In models 1 and 2, regression analysis indicated positive correlations between MDAS score reduction and NSPT as well as female sex (with males as the reference group), in addition to a negative correlation with age (Table 4). In questionnaire item 4, similar findings were observed after adjustment, indicating that the score reduction was correlated with NSPT and age, but not with sex.

Discussion

In this study, dental anxiety levels were assessed in 122 patients with periodontitis, comprising 56 and 66 patients in the delay and NSPT groups, respectively. At baseline, mean MDAS scores were statistically similar in these groups. However, at termination, a significant reduction in mean scores was observed in the NSPT group, whereas the delay group showed no similar improvement (Fig. 1). Additionally, the NSPT group exhibited a significantly greater reduction

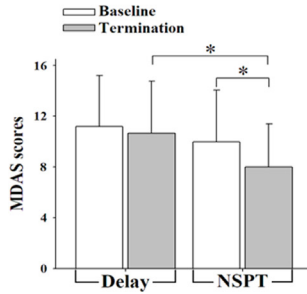
Table 1 General characteristics and periodontal parameters of patients in the delay and NSPT groups.

	Delay group (n = 56)	NSPT group (n = 66)	
	Baseline	Baseline	Re-evaluation
Age (years)	57.3 $\pm$ 11.0 ^a	53.1 $\pm$ 10.1*	
Sex, n (%) F/M	44 (78.6)/12 (21.4)	36 (54.5)/30 (45.5)*	
Periodontitis, n (%)			
Stage II/III/IV	7 (12.5)/33 (58.9)/16 (28.6)	5 (7.6)/31 (47)/30 (45.4)	
Grade A/B/C	3 (5.4)/23 (41.1)/30 (53.5)	1 (1.5)/17 (25.8)/48 (72.7)	
O'Leary index (%)	56.4 $\pm$ 18.5	54.9 $\pm$ 18.4	31.8 $\pm$ 19.9 [#]
BOP (%)	22.0 $\pm$ 13.7	39.1 $\pm$ 20.5*	20.7 $\pm$ 12.0 [#]
PD (mm)	3.4 $\pm$ 0.4	3.7 $\pm$ 0.8	3.1 $\pm$ 0.6 [#]
REC (mm)	0.7 $\pm$ 0.5	1.2 $\pm$ 0.9*	1.8 $\pm$ 1.2 [#]
CAL (mm)	4.1 $\pm$ 0.7	4.9 $\pm$ 1.4*	4.8 $\pm$ 1.5

^a Mean $\pm$ standard deviation; F/M: female/male;

* significant difference between the delay and NSPT group at $P < 0.05$, t-test or χ^2 test; #: significant difference between before and after NSPT, pair t-test at $P < 0.05$; NSPT: non-surgical periodontal treatment; BOP: bleeding on probing; PD: probing depth; CAL: clinical attachment level; REC: gingival recession.

A. MDAS total scores



B. Individual MDAS scores for each of the five questionnaire items

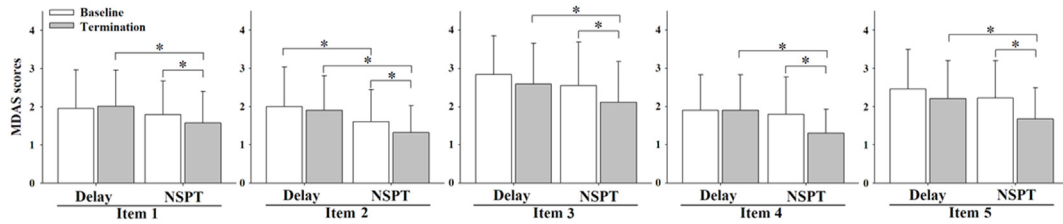


Figure 1 Comparison of MDAS scores of patients in the delay and NSPT groups at baseline and termination. All data are presented as means $\pm$ standard deviations. *: significant difference between the delay and NSPT groups based on the Kruskal–Wallis test ($P < 0.05$). MDAS: Modified Dental Anxiety Scale; NSPT: non-surgical periodontal treatment.

Table 2 Impact of patient characteristics and periodontal parameters on the Modified Dental Anxiety Scale (MDAS) scores obtained at baseline.

Factors	MDAS scores	P-value
Sex, Male	9.5 $\pm$ 3.5 ^a	0.047*
Female	11.1 $\pm$ 4.3	
Age (years)	-0.201 ^b	0.03*
Periodontitis, Stage II	11.0 $\pm$ 3.0	>0.05
Stage III	10.3 $\pm$ 4.0	
Stage IV	10.7 $\pm$ 4.5	
Periodontitis, Grade A	11.3 $\pm$ 3.9	>0.05
Grade B	10.5 $\pm$ 3.5	
Grade C	10.5 $\pm$ 4.4	
O’Leary index (%)	0.134 ^b	0.14
BOP (%)	-0.053	0.56
PD (mm)	-0.041	0.65
REC (mm)	-0.076	0.41
CAL (mm)	-0.036	0.69

^a Mean $\pm$ standard deviation, testing using the t-test or ANOVA;

^b r value based on Spearman’s correlation analysis;

* denotes statistical significance ($P < 0.05$); BOP: bleeding on probing; PD: probing depth; CAL: clinical attachment level; REC: gingival recession.

Table 3 Reduction of the Modified Dental Anxiety Scale (MDAS) scores from baseline to termination in the delay and NSPT groups.

	Delay group	NSPT group	P-value
Total score	0.54 $\pm$ 3.29	1.98 $\pm$ 3.04	0.038 ^a
Item-1, Visit tomorrow	-0.05 $\pm$ 1.00	0.23 $\pm$ 0.74	0.127
Item-2, Waiting room	0.09 $\pm$ 0.88	0.29 $\pm$ 0.72	0.070
Item-3, Use of drill	0.25 $\pm$ 0.92	0.42 $\pm$ 1.10	0.362
Item-4, Scale & polish	0.00 $\pm$ 0.85	0.50 $\pm$ 0.86	0.011 ^a
Item-5, Injection	0.25 $\pm$ 1.13	0.55 $\pm$ 0.88	0.151

^a Significant difference between the delay and NSPT groups based on the Kruskal–Wallis test; NSPT: non-surgical periodontal treatment.

in MDAS total scores from baseline to termination compared with the delay group (1.98 $\pm$ 3.04 vs. 0.54 $\pm$ 3.29; Table 3). Correlations between score reduction and various factors, including NSPT, sex, and age, were also assessed using two analysis models (models 1 and 2; Table 4). Regarding to MDAS item 4 (teeth scaled and polished), a significant reduction from baseline to termination was correlated with NSPT and age, but not sex.

Patients had a mean ($\pm$ standard deviation) age of 55.1 $\pm$ 10.7 years, and their mean MDAS score at baseline was 10.53 $\pm$ 4.07 points. This value was lower than that in studies involving younger populations in Beijing, China,²⁰ Malaysia,²⁶ India,²⁷ Poland,²⁸ Sweden,²⁹ Turkey,³⁰ and Kuwait³¹ but similar to that in a UK study involving a similar age group,³² as well as studies performed in Lebanon and Costa Rica.^{17,33} Consistent with previous research, older patients tend to exhibit lower MDAS scores than younger patients.^{32,34} This aligns with the negative correlation between the MDAS total score and patient age at baseline ($r = -0.201$, $P = 0.03$) in the present study (Table 2). However, a negative correlation was also observed between MDAS score reduction, including total and item-4 scores, and patient age (Table 4). Furthermore, a significant sex-related influence on MDAS total score was observed (Table 2), consistent with previous findings reporting higher MDAS scores in females compared with males.^{35,36} However, when considering the reduction in item-4 scores (teeth

Table 4 Confounding factors related to the Modified Dental Anxiety Scale (MDAS) score reduction.

	Crude β , (95%CI), <i>P</i>	Model 1 β , (95%CI), <i>P</i>	Model 2 β , (95%CI), <i>P</i>
MDAS score reduction, Total			
NSPT (delay, ref.)	1.449, (0.315, 2.583), 0.013*	1.455, (0.315, 2.596), 0.013*	1.333, (0.050, 2.615), 0.042*
Age	—	−0.077, (−0.129, −0.024), 0.004*	−0.074, (−0.130, −0.019), 0.009*
Female (Male, ref.)	—	1.374, (2.558, 0.189), 0.023*	1.409, (0.185, 2.633), 0.024*
BOP	—	—	0.004, (−0.034, 0.041), 0.851
REC	—	—	0.322, (−1.002, 1.645), 0.631
CAL	—	—	−0.158, (−1.079, 0.762), 0.734
MDAS score reduction, Item 4			
NSPT (delay, ref.)	0.500, (0.191, 0.809), 0.002*	0.475, (0.156, 0.793), 0.004*	0.479, (0.122, 0.836), 0.009*
Age	—	−0.017, (−0.032, −0.002), 0.023*	−0.017, (−0.032, −0.001), 0.035*
Female (Male, ref.)	—	0.193, (−0.137, 0.524), 0.249	0.195, (−0.146, 0.536), 0.259
BOP	—	—	−0.003, (−0.013, 0.008), 0.625
REC	—	—	0.129, (−0.239, 0.498), 0.489
CAL	—	—	−0.046, (−0.303, 0.210), 0.723

* and bold: significant difference at $P < 0.05$; CI: confidence interval; NSPT: non-surgical periodontal treatment; BOP: bleeding on probing; REC: gingival recession; ref: references; CAL: clinical attachment level.

Model 1: Adjusted for NSPT, age, and gender.

Model 2: Adjusted for NSPT, age, gender, BOP, REC, and CAL.

scaled/polished), the influence of sex was not statistically significant after adjusting (Table 4).

Studies suggest that patients with recent dental attendance exhibit lower MDAS scores compared with those who infrequently visit the dentist.³⁴ In the present study, all participants were patients treated at the urban medical center's periodontal department, predominantly those referred from recent dental appointments. This could partly explain the comparatively lower MDAS scores observed in our patients compared with some other studies. Furthermore, the renowned and affordable Taiwan National Health Insurance system has markedly improved the use and accessibility of medical care resources in Taiwan.³⁷

This study is the first to document that patients underwent NSPT show significantly lower dental anxiety compared to those without NSPT due to delayed scheduling (Fig. 1). Comparable results, indicating a significant reduction in anxiety six months after quadrant-NSPT (compared to baseline) have been reported previously using a different questionnaire (Corah's dental anxiety scale).¹⁵ Another prior study explored preprocedural dental anxiety and postprocedural pain in patients with chronic periodontitis undergoing conventional-staged root surface debridement (performed across four visits) or single-stage debridement (performed in one visit).¹⁶ In the conventional-staged debridement group, a significant reduction in preprocedural dental anxiety was noted between visits 3 and 4, although anxiety levels between visits 1 and 4 showed no significant difference.

In the present study, notable reductions in anxiety levels and MDAS total scores were detected 1 month after NSPT, i.e., at the periodontal re-evaluation (Table 3). The analysis extended to individual questionnaire items, revealing statistically distinct distributions in Likert scale responses at the two assessment time points, particularly for item 4 (If you were about to have your teeth scaled and polished, how would you feel?) unlike the other items. Existing literature suggests that items 1 and 2 form the endogenous

component subscale of dental anxiety, whereas items 3–5 constitute the exogenous component (treatment) subscale.^{38–40} Notably, NSPT involved repeated scaling and root planing, performed in a quadrant-wise manner, excluding tooth drilling (the focus of item 3). This disparity may, at least partially, account for the significant difference in score reduction observed for each item.

In the current study, the two patient groups exhibited variations in age, female-to-male ratio, and periodontal parameters, including BOP, REC, and CAL values (Table 1). The influence of these differences on the reduction of dental anxiety warrants further assessment (Table 4). Our findings revealed that correlations of MDAS total score reduction with NSPT, sex, and age were evident when using analysis models, including confounding factors. In addition, a consistent correlation between MDAS score reduction and NSPT was also found for questionnaire item 4 (pertaining to teeth scaling and polishing). Although the precise reasons for reduced anxiety following NSPT remain inadequately explored, factors such as the patients' personal experiences with NSPT and knowledge or awareness gained from patient education may contribute to alleviating dental anxiety. Importantly, when patients experience a reduction in dental anxiety after NSPT, the likelihood of compliance with subsequent periodontal maintenance or surgical procedures may be improved. Further in-depth investigation is essential to clarifying these findings. The present study encountered several limitations. Firstly, there is a possibility of selection bias within this cohort, which may restrict the generalizability of our findings. Secondly, our study had limited demographic variables, with educational and income levels not being included.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

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References

- Agras S, Sylvester D, Oliveau D. The epidemiology of common fears and phobia. *Compr Psychiatr* 1969;10:151–6.
- Weinstein P, Shimonoto T, Domoto P, et al. Dental fear in Japan: okayama Prefecture school study of adolescents and adults. *Anesth Prog* 1992;39:215–20.
- Armfield JM, Spencer AJ, Stewart JF. Dental fear in Australia: who's afraid of the dentist? *Aust Dent J* 2006;51:78–85.
- Appukuttan D, Datchnamurthy M, Deborah SP, Hirudayaraj GJ, Tadepalli A, Victor DJ. Reliability and validity of the Tamil version of modified dental anxiety scale. *J Oral Sci* 2012;54:313–20.
- Carter AE, Carter G, Boschen M, AlShwaimi E, George R. Pathways of fear and anxiety in dentistry: a review. *World J Clin Cases* 2014;2:642–53.
- Cianetti S, Lombardo G, Lupatelli E, et al. Dental fear/anxiety among children and adolescents. A systematic review. *Eur J Paediatr Dent* 2017;18:121–30.
- Fagerstad A, Lundgren J, Arnrup K. Dental fear among children and adolescents in a multicultural population-a cross-sectional study. *Swed Dent J* 2015;39:109–20.
- Locker D. Psychosocial consequences of dental fear and anxiety. *Community Dent Oral Epidemiol* 2003;31:144–51.
- Pohjola V, Lahti S, Vehkalahti MM, Tolvanen M, Hausen H. Association between dental fear and dental attendance among adults in Finland. *Acta Odontol Scand* 2007;65:224–30.
- Fardal O, Johannessen AC, Linden GJ. Pre-treatment conceptions of periodontal disease and treatment in periodontal referrals. *J Clin Periodontol* 2001;28:790–5.
- Humphris G, King K. The prevalence of dental anxiety across previous distressing experiences. *J Anxiety Disord* 2011;25:232–6.
- van Wijk A, Lindeboom JA, de Jongh A, Tuk JG, Hoogstraten J. Pain related to mandibular block injections and its relationship with anxiety and previous experiences with dental anesthetics. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2012;114:S114–9.
- Armfield JM, Stewart JF, Spencer AJ. The vicious cycle of dental fear: exploring the interplay between oral health, service utilization and dental fear. *BMC Oral Health* 2007;7:1.
- Drisko CH. Nonsurgical periodontal therapy. *Periodontol* 2000 2001;25:77–88.
- Santuchi CC, Cortelli SC, Cortelli JR, Cota LO, Alencar CO, Costa FO. Pre- and post-treatment experiences of fear, anxiety, and pain among chronic periodontitis patients treated by scaling and root planing per quadrant versus one-stage full-mouth disinfection: a 6-month randomized controlled clinical trial. *J Clin Periodontol* 2015;42:1024–31.
- Naik VK, Balasundaram A, Appukuttan D, et al. Preprocedural anxiety and pain perception following root surface debridement in chronic periodontitis patients. *J Nat Sci Biol Med* 2018;9:82–9.
- Piedra-Hernandez L, Batista-Cardenas D, Gomez-Fernandez A, Ramirez K. Dental anxiety and oral health-related quality of life before and after non-surgical periodontal treatment. *Clin Oral Invest* 2023;27:5459–74.
- De Amici D, Klersy C, Ramajoli F, Brustia L, Politi P. Impact of the Hawthorne effect in a longitudinal clinical study: the case of anesthesia. *Contr Clin Trials* 2000;21:103–14.
- Wilson Jr TG. Compliance and its role in periodontal therapy. *Periodontol* 2000 1996;12:16–23.
- Yuan S, Freeman R, Lahti S, Lloyd-Williams F, Humphris G. Some psychometric properties of the Chinese version of the Modified Dental Anxiety Scale with cross validation. *Health Qual Life Outcome* 2008;6:22.
- O'Leary TJ, Drake RB, Naylor JE. The plaque control record. *J Periodontol* 1972;43:38.
- Lang NP, Nyman S, Senn C, Joss A. Bleeding on probing as it relates to probing pressure and gingival health. *J Clin Periodontol* 1991;18:257–61.
- Listgarten MA. Periodontal probing: what does it mean? *J Clin Periodontol* 1980;7:165–76.
- Lopez R, Retamales C, Contreras C, et al. Reliability of clinical attachment level recordings: effects on prevalence, extent, and severity estimates. *J Periodontol* 2003;74:512–20.
- Humphris GM, Morrison T, Lindsay SJ. The modified dental anxiety scale: validation and United Kingdom norms. *Community Dent Health* 1995;12:143–50.
- Sitheequ M, Massoud M, Yahya S, Humphris G. Validation of the Malay version of the Modified Dental Anxiety Scale and the prevalence of dental anxiety in a Malaysian population. *J Invest Clin Dent* 2015;6:313–20.
- Marya CM, Grover S, Jnaneshwar A, Pruthi N. Dental anxiety among patients visiting a dental institute in Faridabad, India. *W Indian Med J* 2012;61:187–90.
- Kanaffa-Kilijanska U, Kaczmarek U, Kilijanska B, Frydecka D. Oral health condition and hygiene habits among adult patients with respect to their level of dental anxiety. *Oral Health Prev Dent* 2014;12:233–9.
- Bergdahl M, Bergdahl J. Temperament and character personality dimensions in patients with dental anxiety. *Eur J Oral Sci* 2003;111:93–8.
- Tunc EP, Firat D, Onur OD, Sar V. Reliability and validity of the modified dental anxiety scale (MDAS) in a Turkish population. *Community Dent Oral Epidemiol* 2005;33:357–62.
- Honkala S, Al-Yahya H, Honkala E, Freeman R, Humphris G. Validating a measure of the prevalence of dental anxiety as applied to Kuwaiti adolescents. *Community Dent Health* 2014;31:251–6.
- Humphris G, Crawford JR, Hill K, Gilbert A, Freeman R. UK population norms for the Modified Dental Anxiety Scale with percentile calculator: adult dental health survey 2009 results. *BMC Oral Health* 2013;13:29.
- Kassem El Hajj H, Fares Y, Abou-Abbas L. Assessment of dental anxiety and dental phobia among adults in Lebanon. *BMC Oral Health* 2021;21:48.
- Humphris GM, Freeman R, Campbell J, Tuutti H, D'Souza V. Further evidence for the reliability and validity of the modified dental anxiety scale. *Int Dent J* 2000;50:367–70.
- Ogawa M, Sago T, Furukawa H. The reliability and validity of the Japanese version of the Modified Dental Anxiety Scale among dental outpatients. *Sci World J* 2020;2020:8734946.
- Saba Z, Katirci G. Relationship between dental anxiety levels and oral health among dental patients in Turkey: a cross-sectional study. *BMC Oral Health* 2023;23:328.
- Lu JF, Hsiao WC. Does universal health insurance make health care unaffordable? Lessons from Taiwan. *Health Aff* 2003;22:77–88.
- Weiner AA, Sheehan DV. Etiology of dental anxiety: psychological trauma or CNS chemical imbalance? *Gen Dent* 1990;38:39–43.
- Beaton L, Freeman R, Humphris G. Why are people afraid of the dentist? Observations and explanations. *Med Princ Pract* 2014;23:295–301.
- Lahti SM, Tolvanen MM, Humphris G, et al. Association of depression and anxiety with different aspects of dental anxiety in pregnant mothers and their partners. *Community Dent Oral Epidemiol* 2020;48:137–42.