One-year follow-up of patients treated for dental fear: effects of cognitive therapy, applied relaxation, and nitrous oxide sedation

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The effects of dental fear treatments were assessed in a 1-year follow-up study. Sixty-two patients had finished a controlled study in which they were randomly allocated to nitrous oxide sedation (NO), cognitive therapy (CT), or applied relaxation (AR). During the trial highly significant reductions in dental fear and general distress were observed. One year later a majority (95%) of the participants had attended dental treatment in general practice. On the whole, continued favorable effects with regard to dental fear and general distress were observed. Patients in the applied relaxation group evidenced the largest reductions on the dental fear measures. All patients judged the dental fear treatment to have been beneficial, and 80% judged the treatment given in the year after the dental fear treatment successful. All three treatment groups scored in the normative range for general distress both at the end of treatment and at follow-up. □ *Applied relaxation; cognitive therapy; dental fear/therapy; follow-up studies; nitrous oxide sedation*

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Patients with dental fear have a tendency to avoid dental treatment (1). Thus, a treatment program should not be considered successful until the patients are able to receive regular dental treatment.

Long-term follow-up data have been presented in studies from Sweden (2), Denmark (3), Canada (4), and The Netherlands (5, 6). Generally, this research has shown that behavioral treatment can produce substantial long-standing positive effects with regard to dental fear and dental attendance. Additional effects, such as reduction in general distress and somatic complaints, are also reported (7).

So far the most reliable treatment method seems to be systematic desensitization (8–13). Sedative medication such as benzodiazepines or nitrous oxide sedation has also proved effective in clinical trials (14–17). However, long-term effects of alternative psychological treatment methods based on different underlying principles have scarcely been explored in the context of dental fear treatment. Both applied relaxation (18) and variants of cognitive therapy have been found particularly useful in several conditions and are now considered established treatment methods for phobias and other anxiety disorders (19). Moreover, there are a few studies based on written treatment manuals, applicable in general practice.

To test different treatment principles for dental fear in this context, a trial was conducted in which a dentist performed psychological interventions and dental treatment in the same session (20, 21). After at least 1 month on a waiting list, patients with severe dental fear were randomly assigned to nitrous oxide sedation (NO), cognitive therapy (CT), or relaxation training (AR). Treatment manuals (22) for NO, CT, and AR were developed. In the treatment manuals both specific and non-specific treatment principles were described in detail. The same set of non-specific treatment principles were specified and adhered to in all treatment methods (for example, education about fear, control, and pain control). The specific treatment manual for the NO group was developed in accordance with standard use of NO sedation (14). CT was based on standard CT principles and on the cognitive theory of panic in particular (19, 23). CT aimed to help patients identify and change fear-related thoughts. The manual for AR was developed from clinical studies (13) and Öst's manual (18). AR has two primary aims: to learn to recognize early signs of anxiety, and, secondly, to cope with this anxiety by initiating relaxation. All patients received 10 treatment sessions over a period of 10 weeks. A separate pilot study was conducted to ensure integrity of treatment—that is, competence and adherence to the treatment manuals (20). During the trial the patients achieved highly significant reductions in scores on dental fear (21). At enrollment scores on general psychological distress (SCL-90-R) were significantly higher than the normative scores for the general adult population but decreased significantly during the trial to a level within the normative range in all treatment groups (for more details, see Refs. 21, 24). After the 10th session all patients were referred to a total of 12 general practice clinics.

The primary aim of the present study was to examine the long-time effects of the three contrasting treatment principles (CT, AR, and NO) on dental fear, dental attendance, and general distress. It was hypothesized that psychological treatment methods, in which the patients

Table 1. Data collected from dental records in the 1-year period after the main trial

	Nitrous oxide sedation, $n = 21$		Cognitive therapy, $n = 20$		Applied relaxation, $n = 20$		
	Mean	(*s*)	Mean	(*s*)	Mean	(*s*)	*F*, ANOVA
Treatment sessions	4.9	(4.4)	7.3	(6.2)	8.2	(6.2)	1.95
Non-attended sessions	1.4	(1.3)	0.5	(0.7)	1.0	(2.0)	1.90
Percentage non-attended sessions	26.0	(24.8)	11.9	(24.0)	15.6	(25.6)	1.7

s = standard deviation.

had learned a technique, had more favorable long-term effects.

Patient population and methods

One year after the patients ($n = 62$) had completed dental fear treatment, they received a questionnaire by mail (for more information on the patient population, see Refs. 20, 21, and 24). At the same time clinical data were obtained from the dentist who had been treating the patient.

Measures

The questionnaire comprised questions about the dental treatment received the 1st year after the trial as well as the same tests of dental fear and general distress used in the treatment program. The following instruments were included:

Corah's Dental Anxiety Scale (CDAS) is a coarse but valid and reliable scale with scores ranging from 4 (no dental fear) to 20 (extreme dental fear) (25, 26).

The Kleinknecht Dental Fear Scale (DFS) comprises 20 items with scores ranging from 1 (none) to 5 (extreme). The DFS is divided into three dimensions: cancellation/postponing dental sessions (behavioral), level of arousal during dental treatment (arousal), and fear level with regard to specific dental situations (situational). The comprehensiveness of the DFS gives it an advantage over the CDAS (27–29).

The Dental Belief Scale (DBS) assesses the patient's lack of trust in and security with the dentist on a 15-item test with scores varying from 1 (none) to 5 (extreme) (30).

The Symptom Checklist 90 Revised (SCL-90 R) assesses general psychological distress (31). This instrument is scored in accordance with nine primary symptom dimensions. The person's mean score on all 90 items is called the global severity index (GSI) and is a widely used global index of distress. To further explore side effects of the dental fear treatment, the patients were asked whether the treatment had affected other parts of their lives.

Initial oral status was described as the number of decayed (D), filled (F), and missing (M) teeth (T) at the start of the dental fear treatment. The DMFT index as an expression of dental disease, and treatment experience was calculated by summing the number of decayed, filled, and missing teeth.

Since avoidance of dentistry is a major part of dental fear, the general dentists registered the number of canceled treatment sessions.

Additional questions about the patients' assessment of the dental fear treatment conducted in the main trial and the dental treatment conducted the 1st year in the general practice clinic were included.

Statistical analyses

As expected, the scores on the dental fear and distress measures were shown to deviate from a normal distribution in the present sample. In addition, most of the variables were measured on an ordinal scale level. Thus, the data were analyzed by using both non-parametric tests (Wilcoxon signed-rank tests for changes within groups and Kruskal–Wallis one-way analysis of variance for between-group differences) and parametric tests (repeated-measures ANOVA).

On the whole, the parametric and non-parametric tests yielded highly similar results (see also Ref. 21). As parametric statistics are generally used in dental fear studies, we have chosen to present the results on the basis of ANOVA and *t* tests in the present report. Repeated-measures analysis of variance (ANOVA) was performed to study changes over time, differences between treatment groups, and time × group interaction effects. In cases of statistically significant group effects, simple contrast analysis was conducted. In cases of time × group interaction post hoc multiple comparisons of means at each assessment were conducted with Bonferroni adjustments. To detect between-group differences in tests with continuous data obtained on one occasion only, one-way ANOVA was conducted. If between-group differences were detected, post hoc tests with Bonferroni adjustments were done.

Effect sizes were calculated in accordance with the formula M1-M2/*s*, where M1 is the mean of the treatment group, M2 is the mean of the control group and *s* is the pooled standard deviation (32).

Table 2. Mean scores on the Corah Dental Anxiety Scale (CDAS), Dental Fear Scale (DFS), Dental Belief Scale (DBS), and SCL-90R at the end of the main trial and 1 year after treatment (* $P < 0.05$)

	End of treatment, $n = 57$		One year after treatment, $n = 57$			F, ANOVA,	
	Mean	(*s*)	Mean	(*s*)	Time (T)	group (G)	T × G
Dental fear scores							
CDAS	9.1	(2.7)	9.2	(3.5)	0.0	0.3	2.4
DFS	2.6	(0.8)	2.4	(0.9)	5.4*	3.1*	3.2*
Behavior dimension	3.6	(1.2)	2.9	(1.5)	16.0*	2.3	4.6*
Arousal dimension	2.6	(1.1)	2.4	(1.0)	3.8*	1.2	0.1
Situation dimension	2.4	(0.9)	2.3	(0.9)	1.4	2.8	4.2*
DBS	1.8	(0.8)	1.8	(0.8)	0.7	1.5	0.0
General distress, SCL-90-R							
Total score, GSI	0.4	(0.5)	0.5	(0.5)	0.7	0.8	0.5
Dimensions							
Somatization	0.6	(0.6)	0.5	(0.5)	1.2	0.2	0.4
Anger–hostility	0.5	(0.6)	0.4	(0.5)	0.3	1.6	0.4
Anxiety	0.5	(0.6)	0.5	(0.6)	1.2	1.2	2.6
Depression	0.6	(0.6)	0.5	(0.5)	2.5	1.5	0.8
Interpersonal sensitivity	0.5	(0.6)	0.5	(0.7)	0.8	1.7	1.1
Obsession–compulsion	0.6	(0.6)	0.5	(0.5)	0.7	1.6	0.6
Phobic anxiety	0.3	(0.5)	0.2	(0.4)	4.3*	0.3	0.7
Paranoid ideation	0.5	(0.6)	0.4	(0.6)	0.4	1.3	2.1
Psychoticism	0.2	(0.4)	0.2	(0.4)	1.0	2.3	0.7

Results

Fifty-eight of the 62 patients returned the questionnaires. According to the dentists who had treated the patients after the trial, three patients who did not reply had been treated successfully. For two patients who had changed dentist, only information from the patients was available.

Fifty-nine patients had seen a dentist in the year after the trial. Two participants in the NO group reported no dental visits. One participant in the CT group neither returned the questionnaire nor attended the referral dental clinic. These three patients (4.8%) were recorded as drop-outs.

The patients' present dentists reported a mean number of 7.3 appointments (range, 1–25) in the year after the main trial. Because of different treatment needs there were major individual differences, but there were no between-group differences in the number of treatment sessions or number of non-attended sessions. The percentage non-attended sessions was calculated for each patient. Again, there were large individual differences, and although not statistically significant, patients in the NO group had the lowest number of treatment sessions and the highest percentage of non-attended sessions (Table 1).

Changes in dental fear scores are presented in Table 2 and Fig. 1. The DFS total scores decreased significantly from post-treatment to 1 year after treatment ($F = 5.4$, $P < 0.05$). The time × group interaction effect was also significant ($F = 3.2$, $P < 0.05$). Post hoc tests using Bonferroni adjustments showed a significantly lower score at the 1-year follow-up in the AR group than in the NO group ($t = 2.70$, $P < 0.05$). On the DFS dimensions there were significant time and time × group effects with regard to both the behavioral and arousal dimensions. No significant changes in CDAS and DBS scores were found.

Table 3 summarizes the scores on dental fear assessments 1 year after treatment across treatment groups. The AR group scored significantly lower than the CT and NO groups on the DFS-total and on the DFS-behavioral and situational dimensions.

No effect sizes of relevance were found during the 1st year in the dental fear assessments (CDAS = 0.0, DFS dimensions = 0.1–0.5 and DBS = 0).

Linear regression analyses with DFS total score at follow-up entered as the dependent variable, and treatment group (coded as dummy variables; dummy 1 = NO versus CT/AR, and dummy 2 = AR versus NO/CT), age, DFS, DMFS, and GSI at enrollment as the independent variables were performed. The results showed the dummy variable representing the psychological treatment groups versus NO to be a significant predictor ($P < 0.05$). The DFS score at enrollment and the GSI were found to approach significance as predictors of DFS at follow-up ($P = 0.06$ and $P = 0.07$, respectively). Dental status at enrollment (DMFS) was not significant. However, these variables accounted for only 18% of the variance ($R^2 = 0.18$).

All the patients reported the dental fear treatment in the main trial as useful or very useful. With regard to the patient's experiences with the change of dentist, about half of the patients (53.6%) reported difficulties associated with change of dental clinic (14 persons (70%) in the NO group, 10 (50.0%) in the CT group, and 6 (33.3%) in the AR group). At a more detailed level, 18 patients (31%) reported difficulties associated with meeting a new person, and six (10.3%) experienced the 'new' dentist as less

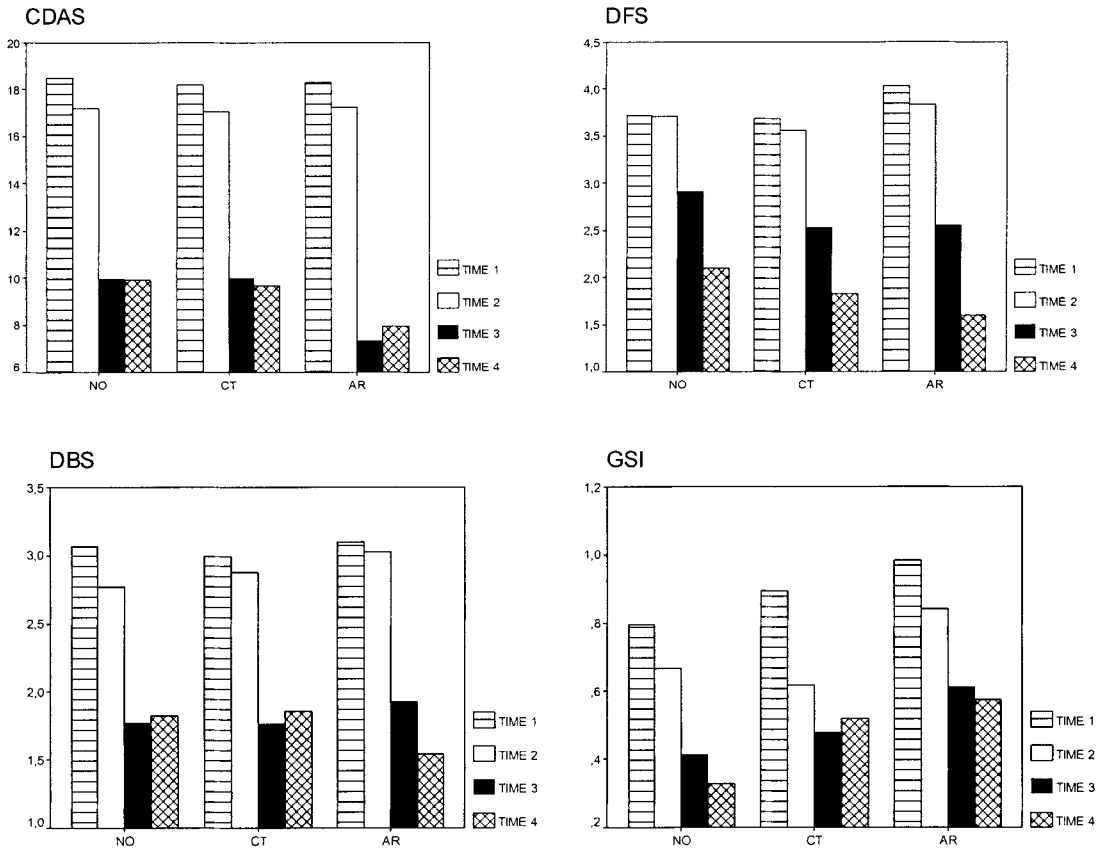

Fig. 1. Mean scores on dental fear and general distress measures. Time 1–Time 2: at least 1 month on a waiting list, control condition. Time 2–Time 3: 10 weeks of dental fear treatment. Time 3–Time 4: 1 year in general practice after dental fear treatment. NO (nitrous oxide sedation), $n = 19$; CT (cognitive therapy), $n = 18$; AR (applied relaxation), $n = 19$.

understanding. Five (10.3%) experienced more pain during treatment, 12 (20.7%) less control, and 6 (10.3%) more stress due to shortness of time in the clinic. Thirteen patients (22.4%) felt ashamed of their teeth.

Most patients (80%) reported that the treatment during the follow-up period was very successful or successful. Treatment was evaluated as partly successful and partly failure by 29% of the patients in the NO group, 15% of the patients in the CT group, and 11% of the patients in the AR group. The treatment was assessed as a failure by one patient in the CT group.

None of the patients had used sedatives other than nitrous oxide sedation for dental treatment. About half of the NO group had used nitrous oxide sedation after the main trial, in contrast to only one participant in the AR group and two in the CT group.

Table 3. The mean scores for each treatment group and the results from one-way ANOVA analysis (* $P < 0.05$)

	Nitrous oxide sedation, $n = 19$		Cognitive therapy, $n = 18$		Applied relaxation, $n = 19$		
	Mean	(*s*)	Mean	(*s*)	Mean	(*s*)	*F*, ANOVA
CDAS	9.9	(3.7)	9.7	(3.5)	7.8	(3.2)	2.01
DFS							
Total score	2.7	(1.0)	2.5	(0.8)	2.0	(0.7)	3.30* AR < NO = CT
Behavior	3.3	(1.2)	3.2	(1.6)	2.2	(1.4)	3.46* AR < NO = CT
Arousal	2.6	(1.0)	2.5	(1.0)	2.2	(0.9)	1.00
Situational	2.6	(1.0)	2.5	(0.8)	1.8	(0.8)	3.56* AR < NO = CT
DBS	1.9	(1.0)	1.8	(0.9)	1.6	(0.6)	0.56

With regard to general distress no time effect was observed, with the exception of the phobic anxiety dimension (Table 2). The scores were in the normative range both at the end of the main trial and 1 year after the treatment.

A large proportion of the participants (57.9%, $n = 33$) assessed the treatment as having affected other parts of their lives. No between-group differences were found. Increased self-efficacy, a better mood, more understanding of bodily sensations, and the ability to master difficult situations were reported.

Discussion

The principal aim of the study was to investigate maintenance of treatment effects in a 1-year follow-up study of dental-fear patients who had received applied relaxation, nitrous oxide sedation, or cognitive therapy.

The results showed that all three treatment methods still had effect 1 year after treatment. Mean CDAS scores were unchanged, and mean DFS scores were improved. However, half of the NO patients still used sedation. Moreover, they reported more difficulties with treatment in the new clinic and less favorable scores on DFS and CDAS, particularly when compared with the AR group.

The hypothesis that the psychological treatment methods with which the patients had learned a technique had more favorable long-time effects was not proved true with regard to the CT group. It should be emphasized, however, that although both the CT and the NO group scored less favorably on dental fear tests than the AR group, their dental fear levels were markedly reduced as compared with pre-treatment levels.

Interestingly, similar differential treatment effects are reported in a recent study by Berggren et al. (33). As in the present study, they found that relaxation-oriented treatment resulted in more significant reduction in dental fear than cognitive interventions. In the study by Berggren et al. a clinical psychologist conducted the psychological interventions. Exposure to dental situations consisted of video recordings of dental treatment sessions. Moore et al. (13) showed that video training and clinical rehearsals conducted by a dentist were equally effective in combination with relaxation training. Taken together, these studies clearly indicate that variants of relaxation training represent a robust and effective treatment principle. The interventions in the present study are based on an even more direct approach than those used by Moore et al., consisting of dental treatment in accordance with the patient's individual needs for exposure and no use of special technical equipment (for example, biofeedback). In addition, treatment manuals specifying both general and specific treatment principles were used. These advantages make the present treatment methods more applicable for use in general practice.

The patients in the present study were randomly assigned to the treatment methods. It could be assumed that if the dentist and the patient chose treatment method jointly, the results would improve. Furthermore, combination therapies should be seriously considered. For example, it may be that relaxation/nitrous oxide sedation and relaxation/cognitive therapy could be favorable for many dental fear patients. However, relaxation therapy requires substantial motivation for home practice. It should be emphasized that for patients who do not have this motivation, CT or NO treatment may be the most appropriate treatment methods.

No between-group differences with regard to general effects of treatment were found. As in a comparable study (7), positive side effects were reported in about half of the patients. The decrease in general distress scores during the trial was maintained during the following year. Further research should explore what factors are important for decrease in general psychological distress—for example, improved dental status, the intervention itself, or changes with regard to the general consequences of dental phobia.

The sample characteristics must be carefully considered. It may be assumed that patients who register for treatment trials in specialist university clinics are particularly motivated for treatment. Another possible weakness pertains to the limited time perspective, as 1 year usually implies only the first treatment sequence in the new dental clinic. Thus, treatment effects should be analyzed in a follow-up after 3–5 years.

In conclusion, all three treatment methods obviously had their merits, and continual effects were shown after 1 year. The AR training seems the most favorable with regard to dental fear scores. The reduction in general distress achieved during the dental fear treatment was maintained.

References

1. Berggren U, Linde A. Dental fear and avoidance: a comparison of two modes of treatment. J Dent Res 1984;63:1223–7.
2. Hakeberg M, Berggren U, Carlsson SG, Gröndahl HG. Long-term effects on dental care behavior and dental health after treatments for dental fear. Anesth Prog 1993;40:72–7.
3. Moore R, Brodsgaard I. Group therapy compared with individual desensitization for dental anxiety. Community Dent Oral Epidemiol 1994;22:258–62.
4. Liddell A, Di Fazio L, Blackwood J, Ackerman C. Long-term follow-up of treated dental phobics. Behav Res Ther 1994;32: 605–10.
5. Veerkamp JS, Gruythuysen RJ, Hoogstraten J, van Amerongen WE. Dental treatment of fearful children using nitrous oxide. IV. Anxiety after two years. ASDC J Dent Child 1993;60:372–6.
6. Aartman IH, de Jongh A, Makkes PC, Hoogstraten J. Dental anxiety reduction and dental attendance after treatment in a dental fear clinic: a follow-up study. Community Dent Oral Epidemiol 2000;28:435–42.
7. Hakeberg M, Berggren U, Carlsson SG. A 10-year follow-up of patients treated for dental fear. Scand Dent Res 1990;98:53–9.
8. Berggren U, Linde A. Dental fear and avoidance: a comparison of two modes of treatment. J Dent Res 1984;63:1223–7.
9. Carlsson SG, Linde A, Öhman A. Reduction of tension in fearful dental patients. J Am Dent Assoc 1980;101:638–41.
10. Carpenter DJ, Gatchel RJ, Hasegawa T. Effectiveness of a

videotaped behavioral intervention for dental anxiety: the role of gender and the need for information. Behav Med 1994;20:123–32.
11. Horowitz LG. Audiotaped relaxation, implosion, and rehearsal for the treatment of patients with dental phobia. Gen Dent 1992;40:242–7.
12. Klepac RK. Successful treatment of avoidance of dentistry by desensitization or by increasing pain tolerance. J Behav Ther Exp Psychiatry 1975;6:307–10.
13. Moore R. Dental fear treatment: comparision of a video training procedure and clinical rehearsals. Sand J Dent Res 1991;99:229–35.
14. Hallonsten AL. Sedation by the use of inhalation agents in dental care. Acta Anaesthesiol Scand 1988;88 Suppl:31–5.
15. Veerkamp JS, van Amerongen WE, Hoogstraten J, Groen, HJ. Dental treatment of fearful children, using nitrous oxide. I. Treatment times. ASDC J Dent Child 1991;58:453–7.
16. Veerkamp JS, Gruythuysen RJ, van Amerongen WE, Hoogstraten J. Dental treatment of fearful children using nitrous oxide. III. Anxiety during sequential visits. ASDC J Dent Child 1993; 60:175–82.
17. Van der Bijl, P. The benzodiazepines in dentistry: a review. Compendium 1992;13:46–50.
18. Öst G. Applied relaxation: Description of a coping technique and review of controlled studies. Behav Res Ther 1986;25:397–409.
19. Clark DM, Salkovskis PM, Hackmann A, Middleton H, Anastasiades P, Gelder MA. Comparison of cognitive therapy, applied relaxation and imipramine in the treatment of panic disorder. Br J Psychiatry 1994;164:759–69.
20. Willumsen T. Treatment of dental phobia: short-time and long-time effects of nitrous oxide sedation, cognitive therapy and applied relaxation [thesis]. Oslo: Faculty of Dentistry, University of Oslo; 1999.
21. Willumsen T, Vassend O, Hoffart A. A comparison of cognitive therapy, applied relaxation, and nitrous oxide sedation in the treatment of dental fear. Acta Odontol Scand 2001;59:290–6.
22. Hoffart A. Use of treatment manuals in comparative outcome research: a schema-based model. J Cogn Psychotherapy 1994;8: 41–54.
23. Hoffart A, Hauge T, Hedley L, Larsen S, Olsen B, Simarud J, et al. Kognitiv terapi ved panikk med agorafobi. Tidsskr Nor Psykologforen 1993;30:742–8.
24. Vassend O, Willumsen T, Hoffart A. Effect of dental fear treatment on general distress: the role of personality variables and treatment method. Behav Mod 2000;24:580–99.
25. Corah NL. Development of a dental anxiety scale. J Dent Res 1969;48:596.
26. Corah NL, Gale EN, Illig SJ. Assessment of a dental anxiety scale. J Am Dent Assoc 1978;97:816–9.
27. Kleinknecht RA, Bernstein DA. The assessment of dental fear. Behav Ther 1978;9:6626–34.
28. Kleinknecht RA, Thorndike RM, Mcglynn FD, Harkavy J. Factor analysis of the dental fear survey with cross-validation. J Am Dent Assoc 1984;108:59–61.
29. Moore R, Berggren U, Carlsson, SG. Reliability and clinical usefulness of psychometric measures in a self-referred population of odontophobics Community Dent Oral Epidemiol 1991;19: 347–51.
30. Smith T, Milgrom P, Weinstein P. Evaluation of treatment at a dental fears research clinic. Spec Care Dentist 1987;7:130–4.
31. Derogatis LR. SCL-90-R: administration, scoring and procedures manual. Baltimore (MD): Clinical Psychometric Research; 1983.
32. Kazdin AE. Research design in clinical psychology. 3rd ed. Boston: Allyn and Bacon; 1998.
33. Berggren U, Hakeberg M, Carlsson SG. Relaxation vs. cognitively oriented therapies for dental fear. J Dent Res 2000;79:1645–51.

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