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Efficacy of a trauma-focused treatment approach for dental phobia: a randomized clinical trial

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It has been hypothesized that treatment specifically focused on resolving memories of negative dental events might be efficacious for the alleviation of anxiety in patients with dental phobia. Thirty-one medication-free patients who met the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR) criteria of dental phobia were randomly assigned to either Eye Movement Desensitization and Reprocessing (EMDR) or a waitlist control condition. Dental anxiety was assessed using the Dental Anxiety Questionnaire (DAS), the Dental Fear Survey (DFS), a behavior test, and dental attendance at 1-yr of follow up. Eye Movement Desensitization and Reprocessing was associated with significant reductions of dental anxiety and avoidance behavior as well as in symptoms of post-traumatic stress disorder (PTSD). The effect sizes for the primary outcome measures were $d = 2.52$ (DAS) and $d = 1.87$ (DFS). These effects were still significant 3 months ($d = 3.28$ and $d = 2.28$, respectively) and 12 months ($d = 3.75$ and $d = 1.79$, respectively) after treatment. After 1 yr, 83.3% of the patients were in regular dental treatment ($d = 3.20$). The findings suggest that therapy aimed at processing memories of past dental events can be helpful for patients with dental phobia.

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Dental phobia is a disproportional fear of (invasive) dental procedures and is currently classified as a specific phobia of the blood-injection-injury (B-I-I) subtype within the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR: 300.29) (1). Triggers of fear responses can be injections or injuries, but also pain experiences, the sight or sound of the drill, characteristic smells, or the dentist in person and his or her behavior (2). Dental phobia is a frequently occurring condition that can be found in 4% of the general population, and is one of the most prevalent specific phobias in the general population (3). Moreover, dental phobia is associated with significant impairment of oral health-related quality of life, as well as – in some patients – pronounced negative psychosocial consequences (4–9). Usually, genetic factors, in combination with learning experiences, are regarded as etiologically relevant in specific phobias (10–12).

To this end, traumatic experiences have been described as powerful learning experiences and therefore an important etiological factor for dental phobia. For example, De Jongh *et al.* (13) found that 87% of patients with high levels of dental anxiety reported a horrific event during a previous dental treatment that could be attributed to the onset of their anxiety and fears; of those patients, 46% had one or more symptoms of post-traumatic stress disorder (PTSD) (14). This, and evidence from other studies (15), strongly suggest that exposure to distressing dental events plays a crucial role in the development and maintenance of long-standing dental fear and dental phobia in that memories of these experiences are provoked when dental treatment is imminent.

Psychotherapeutic methods, particularly those based on cognitive behavioral therapy (CBT), are regarded as the treatments of choice for dental phobia (16, 17). A meta-analysis on 38 intervention studies found strong treatment effects on dental anxiety of mainly behavior therapy, particularly in-vivo exposure. In most of these studies, four to 10 sessions of treatment were delivered with a mean effect size of 1.78 for self-reported dental anxiety (16). In those studies reporting follow-up data, 76.9% of patients visited the dentist at least once after the intervention (16). It should be noted that these numbers do not imply a long-lasting remission of dental phobia with regular dental attendance. Treatment failures might be a consequence of relevant psychiatric comorbidity (18). It has been argued that mere exposure treatment might not be appropriate for at least some dental phobic patients because those who also have PTSD symptoms might not experience extinction of anxiety during exposure, but rather an increase of anxiety as traumatic memories are reactivated (13). As a consequence, it has been argued that individuals with

a specific phobia, such as dental phobia, might benefit from trauma-focused treatment for the alleviation of dental fear (19, 20).

Eye Movement Desensitization and Reprocessing (EMDR) represents an internationally well-established and empirically validated treatment of PTSD (21, 22). Some recent studies hinted on the beneficial effect of EMDR in patients with specific phobias (20, 23). Indeed, one study, using a multiple baseline design, showed a significant reduction of self- and observer-rated anxiety, dysfunctional beliefs concerning dental treatment, following two to three sessions of EMDR (20). Although all patients underwent the dental treatment they feared most within 3 wk after treatment, this study included only four patients who met the diagnostic criteria of dental phobia.

Therefore, the present study was undertaken to test this approach within a larger sample of dental phobic patients using a randomized clinical trial.

Material and methods

Patients

Patients were recruited at the division of Psychosomatics in Dentistry of the Department of Prosthodontics and Biomaterials, University of Münster, Germany. Inclusion criteria were: age between 18 and 45 yr; diagnosis of dental (specific) phobia according to DSM-IV-TR 300.29 (1); a history of a traumatic experience during a previous dental treatment; and the ability to understand and respond to the questions asked in this study.

Exclusion criteria were: severe mental disorder with impaired cognitive functioning (e.g. schizophrenia; bipolar I and II disorder with a major depressive, manic, or hypomanic episode during the previous 6 months; substance dependency (including alcohol) during the previous 6 months; organic pathology; or mental retardation); severe dissociative disorder; severe somatic disorder with a contra-indication for EMDR (e.g. severe cardiovascular disorder; epilepsy; or eye disorders); acutely suicidal; pregnancy or lactation; current treatment with psychopharmacological medication; current psychiatric inpatient treatment; and/or current psychotherapy.

Study design

This study was designed and conducted in compliance with the Code of Ethics of the World Medical Association (Declaration of Helsinki) and was approved by the Ethics Commission of the Medical Faculty of the University of Münster on May 3, 2007 (ID: 2007-137-f-S). It was registered at clinicaltrials.gov (identifier: NCT-01207960). After a detailed explanation of the study, all patients gave their written informed consent to participate. Initial assessments included diagnostic interviews, six questionnaires, and a behavior test. Those who fulfilled the inclusion criteria were randomly assigned, following simple randomization procedures (computerized random numbers), to either the EMDR intervention group or the waitlist control group.

The intervention group received three 90-min EMDR sessions (i.e. one session every week for 3 wk), whereas the waitlist control group did not receive any intervention. Four weeks after the initial assessment, the second assessment took place, using the same diagnostic instruments. Next, the waitlist control group received the EMDR intervention, and was assessed for a third time after 4 wk. Follow-up measurements were conducted at 3 months and 1 yr following the conclusion of treatment. The follow-up assessments consisted of the self-rating instruments and additional questions covering dental visits and treatment during the follow-up period. Patients who did not complete the questionnaires at the follow-up investigations were contacted by telephone and asked for their dental visits and treatment after the EMDR therapy.

Assessments

The intervention group received four assessments, and the waitlist control group received five assessments. All assessments contained the same instruments, except for the Structured Clinical Interviews for DSM-IV Axis I and II Disorders (SCID-I and -II) that were conducted at baseline only and the behavior test that was not performed at the follow-up assessments.

SCID-I and -II (24, 25) were conducted to assess psychiatric disorders, according to the DSM-IV (1), at baseline.

Primary outcome measures were:

(i) Dental anxiety assessed using the German version of the Dental Anxiety Scale (DAS) (26, 27), a four-item questionnaire that aims to assess the levels of stress and anxiety experienced when different aspects of dental treatment are imagined by the patient.
(ii) Dental anxiety assessed using the German version of the Dental Fear Survey (DFS) (27, 28), a 20-item self-rating instrument that covers general emotional aspects of dental anxiety as well as physiological reactions to specific stimuli related to dental treatment.

Secondary outcome measures were:

(i) Symptoms of psychopathology assessed using the German version of the Brief Symptom Inventory (BSI) (29, 30). The clinical global impression score (CGI) represents an overall measure for psychopathology.
(ii) Symptoms of anxiety and depression indexed by the German version of the Hospital Anxiety and Depression Scale (HADS) (31, 32).
(iii) Symptoms of PTSD measured using the German version of the Impact of Event Scale-Revised (IES-R) (33, 34), in which an overall diagnostic score of more than 0 indicates relevant symptoms of PTSD, whereas scores below 0 indicate mild or no symptoms of PTSD, with lower scores indicating fewer PTSD symptoms.
(iv) Dissociative symptoms assessed using the German version of the Dissociative Experiences Scale (DES) (35), the Fragebogen zu dissoziativen Symptomen (FDS-20) (36).
(v) A behavior test, carried out during an actual dental visit by means of standardized observation of behavior and an interview. This in-vivo test represents an observer-rated instrument that was developed for this study. It contains 10 situations that occur during a dental visit (e.g. entering the examination room, sitting in the dental chair, inspection of the oral cavity using two dental mirrors, probing dental pockets, and dental scaling). While the patient undergoes the dental visit and, if possible, routine supra- and subgingival scaling, it is observed whether he/she is able to tolerate the situation, and he/she is asked by

the observer to assess his/her level of anxiety on a scale of 0–10 in each situation. Both observation and answers to the standardized questions are recorded during the procedure.
(vi) Follow-up investigation of dental treatment. In a telephone interview patients were asked if they visited a dentist, how often they did this, which kind of treatment was carried out, and if he/she tolerated it.

Treatment

All treatments were delivered by the same therapist (V.B.). She is trained and extensively supervised in both CBT and EMDR (advanced course, or so-called Level II), and received specialized EMDR supervision for the treatment of dental phobia. All treatment sessions were videotaped, and treatment attrition was evaluated by five senior EMDR supervisors accredited by the EMDR International Association.

The EMDR intervention was manualized on the basis of an EMDR treatment protocol for specific phobias (19, 37, 38). According to the standard protocol of the treatment of specific phobias by SHAPIRO (19), the first, the worst, and the most recent memory were selected as target memories.

At the first treatment session the target memories were identified and techniques of distancing were practiced. After this, the memories were assessed on a seven-point scale with regard to the believability of cognitions (VoC), and related subjective distress (SUD) was rated on a 10-point scale. The main part of an EMDR session is the reprocessing of memories using the application of eye movements to tax working memory (39, 40). A series of 25–30 horizontal movements are repeated until the SUD related to the target memory reaches 0. The patient is instructed to keep a diary between the sessions recording new trauma-related memories and dreams. The second and the third sessions resemble the first one; if necessary, additional traumatic memories are processed. In the third session, the most recent memory of a distressing dental treatment is reprocessed. Next, the patient is prepared for future confrontations with dental treatment by installing a so-called future template, a positive mental image of oneself successfully undergoing dental treatment. Also, the patient is asked to 'run a mental video' (19); that is, to mentally run a videotape of the time between the present session and successful confrontation with dental treatment in the near future. Disturbing images and present triggers were processed using eye movements in combination with having these images in mind.

Treatment integrity

Videotapes of all EMDR sessions were recorded. Following treatment of each of the 21 patients with EMDR, one session was randomly selected for independent fidelity rating by five different raters (senior EMDR supervisors accredited by the EMDR International Association). The rating scale was a modified standard instrument for the rating of EMDR fidelity (41) that used a four-point Likert-type scale, as follows: 1 = no adherence, 2 = some adherence, 3 = adherence adequate, 4 = adherence very good. The mean $\pm$ SD fidelity score across sessions was 3.5 ± 0.5.

Statistical analyses

For an equivalence design, a sample size of 10 patients per arm was needed (power = 80% and two-sided significance level = 0.05) to detect medium-size treatment effects, taking into account a difference (d) of fewer than three points of the DAS (26, 27) between the post-treatment means for equivalence of the two arms.

t-Tests and chi-square tests were employed for group comparisons in demographic data and changes within groups. For between-group comparisons, analysis of covariance (ANCOVA) values were calculated with the baseline values as covariate. For the follow-up investigations, univariate ANOVAs for repeated measures were computed. For effect sizes of within-group changes, Cohen's d was calculated based on the average SD from two means and was corrected for dependence between means, using MORRIS & DESHON's (42) equation 8.

Two different intention-to-treat (ITT) analyses were conducted for the group comparisons of pre- to post-treatment changes. Patients were included in an ITT observed cases analyses when they had received treatment in the intervention group and had completed the first two assessments (both groups). To control for the stability of the effects, ITT last observation carried forward (LOCF) analyses were calculated in all randomized patients for the primary outcome variables. In patients who were not available for the second assessment, the values of the first evaluation were imputed to the second. As two primary outcome measures were employed, the level of significance was reduced to $P < 0.025$ (Bonferroni correction) in all ITT analyses.

In a second step, all patients who received treatment and completed the follow-up assessments after 3 and 12 months, respectively, were pooled. The assessments immediately before treatment ('pretreatment') were used as baseline (i.e. the first assessment of the intervention group and the second assessment of the waitlist control group).

Results

Sample characteristics at baseline

The patient flow can be seen in Fig. 1. Of the 31 patients who were randomized, 13 of the intervention group received treatment as well as nine of the waitlist control group. Two more patients of the waitlist control group were available for assessment after the waiting period, but did not show up for the treatment sessions. Thus, 24 patients were included in the ITT observed cases analyses. All 31 patients were included in the ITT LOCF analysis. Demographic data of the whole sample are presented in Table 1.

At baseline there were no significant differences between the groups in terms of dental problems, with the exception of a tendency towards more missing teeth and more periodontal diseases in the waitlist control group.

Patients who did not begin treatment did not differ significantly from those who received treatment with regard to all demographic variables and dental anxiety measures.

Twelve patients from both groups participated in the pooled follow-up assessment 3 months after treatment and six patients were followed up 12 months after treatment.

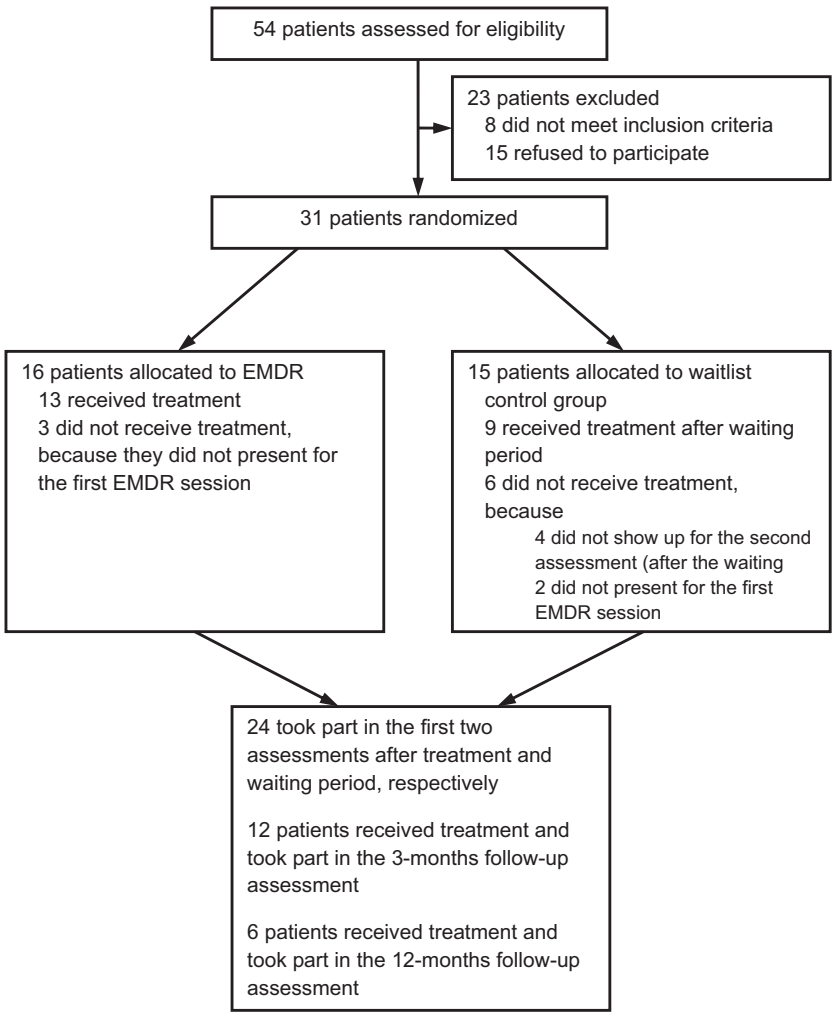

Fig. 1. Patient flow in the trial.

Based upon the scores of the IES-R, nine (29.0%) patients of the whole sample and eight (33.3%) patients of the observed cases sample showed global scores above 0, indicating relevant PTSD symptom levels.

Twenty-three patients initially screened were not included in the study. Eight did not meet the inclusion criteria; of these, two did not report, or could not remember, a traumatic event during a previous dental treatment, two had severe organic disorders and four had severe psychiatric disorders. Fifteen patients refused to participate, and the demographic data of these patients could not be collected systematically.

Treatment outcome – group comparison, ITT observed cases analyses

Thirteen patients of the intervention group who received treatment were compared with 11 patients of the waitlist control group who did not receive treatment. The results of the ITT observed cases analyses are presented in Table 2. The intervention group improved significantly on all outcome variables except for depression. Significant group differences of considerable effect sizes occurred in the measures of dental anxiety and self-ratings, as well as in the behavior test. In contrast, analyses based upon the general measures of psychopathology did not reveal any significant group difference.

Treatment outcome – group comparison, ITT LOCF analyses

To control for the stability of the effects, LOCF ITT analyses were calculated for the primary outcome variables. All 31 patients initially randomized were included. According to the LOCF method, missing values of the second assessment were replaced with the baseline values. The results of these analyses are displayed in Table 3. It can be seen that the significant effects remain stable, although the effect sizes are somewhat smaller than in the observed cases analyses.

Treatment outcome: follow-up investigation

For the assessment of lasting changes, patients of both groups who had received treatment were pooled. Until

Table 1

Sample characteristics at baseline

	EMDR group (n = 16)	Waitlist control group (n = 15)	Analysis			
			T	χ^2	d.f.	P
Age (yr)	41.69 ± 14.93	40.20 ± 10.39	0.320		29	0.75
Gender						
Female	15 (93.8)	11 (73.3)		2.386	1	0.12
Male	1 (6.2)	4 (26.7)				
Education						
Compulsory school	3 (18.8)	4 (26.7)		0.788	3	0.85
High school	7 (43.8)	5 (33.3)				
A-level	3 (18.8)	4 (26.7)				
Academic	3 (18.8)	2 (13.3)				
Employment						
In occupational training	2 (12.5)	1 (6.7)		3.905	6	0.69
Unemployed	1 (6.2)	1 (6.7)				
Part-time	4 (25.0)	6 (40.0)				
Full-time	4 (25.0)	4 (26.7)				
Homemaker	2 (12.5)	0				
Retired	1 (6.2)	0				
Missing values	2 (12.5)	3 (20.0)				
Family status						
Single	5 (31.2)	1 (6.7)		3.638	3	0.30
Unmarried with partner	3 (18.8)	6 (40.0)				
Married	7 (43.8)	7 (46.7)				
Divorced/separated	1 (6.2)	1 (6.7)				
Number of axis I diagnoses (including dental phobia)	2.44 ± 1.03	2.47 ± 1.30	−0.69		29	0.95
Number of axis II diagnoses	0.06 ± 0.25	0.07 ± 0.26	−0.46		29	0.96
Avoidance of dental visits (yr)	4.19 ± 3.29	4.47 ± 3.38	−0.23		29	0.82
Dental status						
Missing teeth	4.13 ± 3.46	6.40 ± 3.70	−1.769		29	0.09
Carious teeth	2.31 ± 3.67	1.53 ± 2.62	0.677		29	0.50
Destroyed teeth	0.69 ± 1.96	0.27 ± 0.46	0.836		29	0.42
Periodontal disease	12 (75.0)	15 (100)		4.306	1	**0.04**
Dental fillings	6.81 ± 5.72	8.53 ± 3.82	−0.979		29	0.34
Artificial dentitions (corona, bridge)	3.44 ± 5.30	2.80 ± 4.09	0.373		29	0.71
Artificial dentitions (removable prosthesis)	0.06 ± 0.25	0.07 ± 0.26	−0.046		29	0.96

d.f., degrees of freedom; EMDR, Eye Movement Desensitization and Reprocessing.
Values are given as mean ± SD or n (%).
Significant P-values are given in bold.

3 months after treatment there was a continuing decrease of dental anxiety; subsequently, this trend plateaued (see Tables 4 and 5).

The ANOVA revealed a significant reduction of PTSD symptoms between baseline and 3 months of follow up. None of the patients with a positive IES-R score for PTSD symptoms, indicating relevant symptoms of PTSD, showed a positive score after treatment. However, although this difference was still present after 12 months, it was no longer significant.

Figure 2 shows the changes of dental anxiety (DAS) in the 12 single patients available for the follow-up investigation. Reduction of dental anxiety was found in all patients at the post-treatment assessments, whereas in five patients a slight increase of anxiety occurred after the intervention. Only one patient almost reached the initial level of anxiety. At the end of their follow-up period, one patient could be considered as highly anxious (DAS > 15) and two patients had moderate anxiety (DAS = 13 or 14). All other patients had low or normal levels of anxiety (DAS < 13).

Treatment outcome: dental visits

The avoidance behavior of the 12 patients who took part in the 3-month follow-up assessments and of four other patients who were contacted by telephone, was assessed. Twelve (75%) reported dental visits and dental treatment; the effect size of the 2 × 2 frequency tables was d = 2.45. Seven (43.8%) had received one or more dental fillings, four (25.0%) a root canal treatment, four (25.0%) the extraction of a tooth, three (18.8%) had received periodontal treatment, and two (12.5%) had undergone renewal of fixed prostheses.

After 12 months, 18 patients who had received EMDR treatment could be evaluated. Fifteen (83.3%) were receiving regular dental treatment (d = 3.20). Eight (44.4%) had undergone root canal fillings, seven (38.9%) had undergone tooth extractions, eight (44.4%) had undergone dental fillings, seven (38.9%) had undergone periodontal treatment, and seven (38.9%) had undergone renewal of fixed prostheses.

Table 2

Outcome measures group comparisons: intention-to-treat observed case analyses

Measure	EMDR intervention group (n = 13)					Waitlist control group (n = 11)					Group comparison		
	Pretreatment Post-treatment Mean ± SD	Analysis			Effect size	Prewaiting period Postwaiting period Mean ± SD	Analysis			Effect size	Analysis		
		T	d.f.	*P*	*d*		T	d.f.	*P*	*d*	*F*	d.f.	*P*
Dental Anxiety Scale (total score)	18.2 ± 1.6 12.2 ± 2.9	8.236	12	**< 0.001**	2.52	18.1 ± 1.8 17.9 ± 1.2	0.329	10	0.75	0.11	41.236	1, 22	**< 0.001**
Dental Fear Survey (total score)	83.1 ± 8.7 59.9 ± 14.2	6.305	12	**< 0.001**	1.87	82.4 ± 10.7 79.6 ± 10.0	1.994	10	0.07	0.60	23.050	1, 22	**< 0.001**
Brief Symptom Inventory (global severity index)	56.8 ± 12.1 51.6 ± 13.0	2.246	12	**0.04**	0.63	62.6 ± 13.8 60.1 ± 12.4	0.925	10	0.38	0.28	1.317	1, 22	0.26
Hospital Anxiety and Depression Scale – Anxiety	7.4 ± 4.0 6.0 ± 3.8	2.330	12	**0.04**	0.66	8.6 ± 3.7 8.7 ± 3.6	−0.095	10	0.93	−0.03	3.086	1, 22	0.09
Hospital Anxiety and Depression Scale – Depression	3.9 ± 3.4 3.7 ± 3.4	0.478	12	0.64	0.11	5.0 ± 2.8 5.8 ± 2.5	−1.576	10	0.15	0.47	3.224	1, 22	0.09
Impact of Event Scale (diagnostic score)	−2.0 ± 2.1 −3.2 ± 1.3	2.615	12	**0.02**	0.76	−1.7 ± 1.9 −2.6 ± 1.5	1.728	10	0.12	0.51	1.032	1, 22	0.32
Dissociative Experience Scale	6.9 ± 6.0 4.8 ± 4.2	2.857	12	**0.01**	1.13	7.8 ± 4.9 5.5 ± 4.8	2.061	10	0.07	0.62	0.006	1, 22	0.94
Behavior test (no. of steps)	8.7 ± 1.4 9.4 ± 1.3	−2.635	12	**0.02**	0.74	8.7 ± 0.8 8.6 ± 1.1	0.559	10	0.59	0.10	4.724	1, 22	**0.04**
Behavior test (total score)	69.5 ± 14.8 41.5 ± 17.4	6.363	12	**< 0.001**	1.78	74.3 ± 20.0 68.4 ± 24.5	1.138	9	0.29	0.37	11.525	1, 21	**0.003**

d.f., degrees of freedom; EMDR, Eye Movement Desensitization and Reprocessing.
Significant *P*-values are given in bold.

Table 3

Outcome measures group comparisons: intention-to-treat last observation carried forward analyses

Measure	EMDR intervention group (n = 16)					Waitlist control group (n = 15)					Group comparison		
	Pretreatment Post-treatment Mean ± SD	Analysis			Effect size	Prewaiting period Postwaiting period Mean ± SD	Analysis			Effect size	Analysis		
		T	d.f.	P	d		T	d.f.	P	d	F	d.f.	P
Dental Anxiety Scale (total score)	18.3 ± 1.6 13.3 ± 3.7	5.783	15	**< 0.001**	1.78	17.9 ± 1.8 17.7 ± 1.4	0.333	14	0.74	0.10	23.540	1, 29	**< 0.001**
Dental Fear Survey (total score)	82.6 ± 11.0 63.8 ± 17.0	4.991	15	**< 0.001**	1.33	80.9 ± 9.6 78.9 ± 8.7	1.921	14	0.08	0.49	16.509	1, 29	**< 0.001**
Brief Symptom Inventory (global severity index)	58.6 ± 13.4 54.4 ± 14.7	2.179	15	**0.046**	0.55	58.8 ± 14.8 56.9 ± 13.4	0.927	14	0.37	0.25	0.748	1, 29	0.40
Hospital Anxiety and Depression Scale – Anxiety	8.1 ± 4.1 7.0 ± 4.2	2.255	15	**0.04**	0.55	7.6 ± 4.0 7.7 ± 4.0	−0.096	14	0.93	−0.04	1.784	1, 29	0.19
Hospital Anxiety and Depression Scale – Depression	4.3 ± 3.2 4.1 ± 3.3	0.481	15	0.64	0.13	4.5 ± 2.6 5.1 ± 2.6	−1.547	14	0.14	−0.40	2.276	1, 29	0.14
Impact of Event Scale (diagnostic score)	−1.9 ± 2.1 −3.0 ± 1.6	2.505	15	**0.02**	0.70	−2.1 ± 1.7 −2.8 ± 1.3	1.685	14	0.11	0.47	0.320	1, 29	0.58
Dissociative Experience Scale	7.8 ± 7.7 6.1 ± 6.9	2.712	15	**0.02**	0.72	7.4 ± 4.9 4.7 ± 4.3	1.979	14	0.07	0.82	0.095	1, 29	0.76
Behavior test (no. of steps)	8.6 ± 1.3 9.2 ± 1.3	−2.522	15	**0.02**	0.66	8.8 ± 0.8 8.7 ± 1.1	0.564	14	0.58	0.11	4.224	1, 29	**0.049**
Behavior test (total score)	70.5 ± 14.1 46.2 ± 20.5	5.314	14	**< 0.001**	1.44	70.8 ± 18.2 66.9 ± 21.0	1.132	14	0.28	0.30	12.528	1, 28	**0.001**

d.f., degrees of freedom; EMDR, Eye Movement Desensitization and Reprocessing.
Significant P-values are given in bold.

Table 4

Outcome measures at the 3-month follow-up (n = *12*)

Measure	Pretreatment Mean ± SD	Post-treatment Mean ± SD	3-month follow-up Mean ± SD	Effect size (pretreatment – 3 months) *d*	ANOVA *F*	d.f.	*P*
Dental Anxiety Scale (total score)	18.1 ± 1.2	11.3 ± 2.2	10.5 ± 3.5	3.28	33.151	2	**< 0.001**
Dental Fear Survey (total score)	78.3 ± 10.5	54.3 ± 14.0	48.1 ± 10.9	2.28	21.480	2	**< 0.001**
Brief Symptom Inventory (global severity index)	57.0 ± 11.2	46.8 ± 12.9	50.1 ± 13.8	1.01	2.047	2	0.15
Hospital Anxiety and depression Scale – Anxiety	7.5 ± 3.9	4.9 ± 3.6	5.9 ± 3.4	0.69	1.538	2	0.23
Hospital Anxiety and depression Scale – Depression	4.2 ± 2.2	3.3 ± 2.9	3.3 ± 2.8	0.37	0.434	2	0.65
Impact of Event Scale (diagnostic score)	−2.1 ± 1.8	−3.4 ± 1.2	−3.8 ± 0.6	1.40	6.007	2	**0.006**
Dissociative Experience Scale	6.3 ± 6.4	3.9 ± 4.2	3.2 ± 3.6	1.34	1.234	2	0.30

Significant *P*-values are given in bold.

Table 5

Outcome measures at the 12-month follow-up (n = *6*)

Measure	Pretreatment Mean ± SD	Post-treatment Mean ± SD	3-month follow-up Mean ± SD	12-month follow-up Mean ± SD	Effect size (pretreatment – 12 months) *d*	ANOVA *F*	d.f.	*P*
Dental Anxiety Scale (total score)	17.7 ± 1.1	11.2 ± 2.5	9.2 ± 3.1	10.5 ± 2.4	3.75	14.522	3	**< 0.001**
Dental Fear Survey (total score)	76.2 ± 11.5	54.3 ± 13.6	42.2 ± 10.8	44.7 ± 10.7	1.79	10.468	3	**< 0.001**
Brief Symptom Inventory (global severity index)	49.0 ± 6.7	39.7 ± 10.6	42.7 ± 12.1	46.7 ± 18.0	0.16	0.658	3	0.59
Hospital Anxiety and depression Scale – Anxiety	5.0 ± 2.8	3.3 ± 1.8	5.2 ± 3.2	5.0 ± 4.6	0.0	0.427	3	0.74
Hospital Anxiety and depression Scale – Depression	3.5 ± 2.2	2.7 ± 2.1	2.5 ± 1.9	2.8 ± 5.1	0.16	0.121	3	0.95
Impact of Event Scale (diagnostic score)	−1.7 ± 1.6	−3.0 ± 1.5	−4.0 ± 0.6	−3.2 ± 1.5	5.08	2.506	3	0.096
Dissociative Experience Scale	2.2 ± 2.4	1.0 ± 1.0	1.0 ± 1.3	1.1 ± 1.0	0.94	0.831	3	0.49

Significant *P*-values are given in bold.

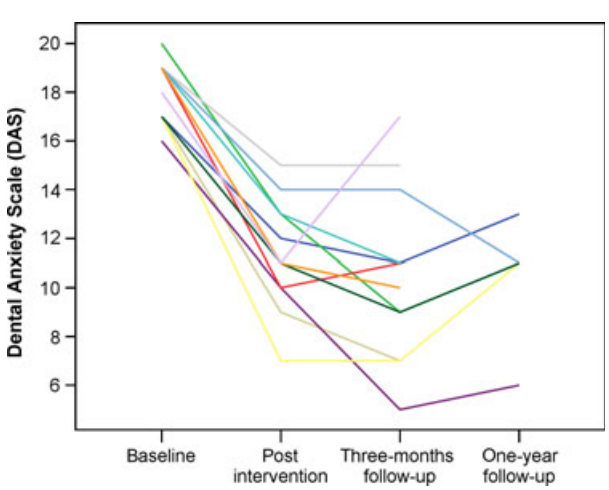

Fig. 2. Dental Anxiety Scale (DAS) sum scores of 12 patients available for follow up (each line represents one patient).

Discussion

This study investigated the efficacy of EMDR in patients with dental phobia. The results demonstrated large effects of EMDR on dental anxiety. More specifically, the effect size for the reduction on the two independent measures of self-reported anxiety was 2.52 and 1.87 (1.78 and 1.33 in the LOCF analyses), respectively. This improvement was even larger at the 3-month follow-up and was still detectable after 12 months. Reduced anxiety was also indexed by patients' responses to the behavior test; that is, after treatment, patients tolerated more stages of exposition during a real dental visit with lower rates of anxiety. However, the behavior test employed in this study showed a ceiling effect because at baseline the majority of the patients had already tolerated all steps of the test (although with different levels of anxiety). This might be attributed to the fact that patients with dental

phobia, as a result of their avoidance behavior, might not have been able to visit the dental clinic for participation in the study.

The most important result is the fact that a high number of patients overcame their avoidance behavior and visited the dentist regularly following treatment. The effect sizes (2.45 and 3.20 after 3 and 12 months, respectively) are considerably higher than those reported in the meta-analysis of KVALE *et al.* (16), who found mean effect sizes of 1.8 for self-reported dental anxiety and 1.4 for attendance at dental visits after up to 10 sessions of mostly behavioral therapy. This implies that EMDR not only alleviates anxiety in traumatically induced dental phobia, but also changes patients' behavior. It can be hypothesized that mere exposure or cognitive training does not sufficiently relieve anxiety symptoms driven from memories of previous distressing dental events, but, in contrast, direct targeting of the memories of such events would reduce anxiety and facilitate behavior change.

To test the hypothesis that patients with dental phobia have symptoms of PTSD and would benefit from EMDR as a trauma-specific psychotherapy (13, 14, 20), symptoms of PTSD were assessed using the German version of the IES-R. At baseline, eight patients of the observed cases showed global scores above 0, which indicates relevant PTSD symptom levels. The mean IES-R scores of the two groups were −2.0 and −1.7, respectively. These values indicate that those patients, who did not suffer from severe symptoms of PTSD, had, at least in part, some mild symptoms of PTSD. During treatment the mean scores improved significantly in the intervention group, and also during the 3 months of follow up in the pooled group of patients who had received EMDR. Although the group comparison was not significant regarding the IES-R changes, these results indicate a meaningful reduction of PTSD symptoms following EMDR treatment of patients with dental phobia. The co-occurrence of the reduction of PTSD symptoms and the reduction of dental anxiety and related behavior supports the assumption that memories of traumatic experiences during a previous dental treatment play a significant role in the etiology of dental phobia in a particular group of patients. To this end, the present results are in line with a recent randomized controlled study showing that EMDR produces equivalent effects in patients with PTSD and those with other psychiatric conditions, including specific phobias (43). However, it has to be taken into account that other important etiological factors exist (10–12) and that false memories (44) might occur in some patients. Thus, additional prospective studies, including early dental experiences, psychopathology, and effects of treatment, are necessary to elucidate this relationship in further detail.

The fact that the symptoms of general psychopathology did not significantly improve after the three-session EMDR treatment can be explained by the short duration and specificity of the intervention. The treatment delivered in this study may not be suited to improve pathology beyond dental anxiety with the exception of trauma-related symptoms that are caused and triggered by memories of dental experiences from the past. The efficacy of the treatment is not restricted to patients with PTSD because patients with negative IES-R baseline scores also benefited from it.

This study is characterized by some limitations. First, the sample was relatively small. However, the sizes of the effects regarding changes in dental anxiety were large and significant. It is conceivable that with the use of a larger sample, the group comparison with regard to PTSD symptom changes would have reached significance. Second, a post-treatment SCID interview assessment of dental phobia was not carried out. It would have been important to know how many patients no longer fulfilled the diagnostic criteria for dental phobia. Third, a methodological shortcoming can be seen in the waitlist control group design, namely that it does not allow comparison with a second, already established, treatment such as behavior therapy (e.g. in-vivo exposure) and makes follow-up group comparisons impossible because all participants eventually received the same treatment. Future studies are needed to replicate our results in a larger randomized clinical trial with CBT as an active comparator. Moreover, as all patients knew in advance that they would receive EMDR, either immediately or after a 4-wk waiting period, placebo effects depending on positive anticipation might have occurred in the waitlist control group. Third, only 21 out of 31 patients who initially had been randomized received treatment, whereas 10 (32.3%) dropped out of the study and were not available for follow-up assessments. It could be observed clinically that these patients might have had particular problems with attending the psychotherapist's office, which is situated within the dental clinic. The attrition rate may have been lower if the patients had been treated in a private practice outside the dental clinic. In view of the high dropout rate we calculated ITT LOCF analyses for the outcome variables, which confirmed the results with somewhat lower effect sizes. Fourth, as a result of the waitlist control group design, it was impossible to perform group comparisons of the follow-up data.

Moreover, only a relatively small proportion of the patients were available for follow-up assessments. As a consequence, the follow-up data have to be interpreted with caution. On the other hand, these data may provide a preliminary insight into the long-term course of dental anxiety after EMDR treatment. Conceivably, the decrease of dental anxiety continues over a time-period of several months, eventually plateauing at a level that still indicates a low to moderate level dental anxiety, but not phobia. Nevertheless, the majority of the patients in the present study were able to give up avoidance behavior and undergo regular dental treatment.

Taken together, this study provides preliminary evidence for the efficacy of EMDR for dental phobia in patients who experienced distressing and potentially traumatic dental visits in the past. Future randomized

controlled studies with larger samples and active comparators are needed to confirm these results.

Conflicts of interest – The authors declare no conflicts of interest.

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