



## GENERAL DENTISTRY

# Recognizing and differentiating dental anxiety from dental phobia in adults: a systematic review based on the German guideline “Dental anxiety in adults”

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**Objectives:** The prevalence of “dental anxiety” (DA) is often underestimated and numerous diagnostic methods are available for dental practitioners. It is difficult to differentiate between a dental phobia requiring an interdisciplinary approach and DA, which can be managed by dental practitioners alone. The appropriate use of diagnostic tools is key for the successful management of highly anxious and/or phobic patients. The aim was to provide a guideline to recognize dental fear and to differentiate DA from patients who are highly anxious or even have a phobia. **Data sources:** In total, 8,929 articles that were selected for the development of the German guidelines for “Dental anxiety in adults” in PubMed, Web of Science, Embase, and MedPilot were filtered for diagnosis of DA disorder. The focus for this review was on the use of scales to measure DA levels. The

methods and tools used in the 51 reviewed articles to assess DA levels were evaluated in terms of their practicability and suitability in daily practice to differentiate between phobia (ie, DA disorder) and nonpathologic anxiety. In addition, the internal consistency (Cronbach alpha) of the questionnaires/tools was determined. **Conclusion:** All identified DA questionnaires validated in the German language had an acceptable to excellent internal consistency (0.7 to 0.986). The only validated questionnaire-free method was galvanic skin reaction measurement. For the assessment of DA and diagnosis of a DA disorder in adults, the survey by means of any suitable questionnaire or even several questionnaires in combination with a behavioral observation of the patient is currently the method of choice. (*Quintessence Int* 2021;52:360–373; doi: 10.3290/j.qi.a45603)

**Key words:** dental anxiety, dental phobia, diagnosis, probability, scale

Dental anxiety (DA) and its impact on oral health is a widely underrated subject in dentistry. The reported prevalence of DA is highly variable and ranges from 5.7% to over 40%, and affects approximately one third of dental hygiene recall patients.<sup>1-5</sup> Moreover, patients suffering from DA are more likely to cancel dental appointments in the first place.<sup>6</sup> Hence, DA is a common problem experienced in dental practice.

As oral health is linked to a multitude of inflammatory and systemic diseases, it can be considered fundamental to overall physical and mental wellbeing.<sup>7</sup> DA, however, leads to an increased caries prevalence and incidence in adults and consequently results in a poor dental health status among anxious patients due to avoidance.<sup>8-10</sup> Additionally, highly anxious

patients have poorer oral hygiene compared to nonanxious patients in general.<sup>11</sup> Eventually, dental anxiety may have a negative impact on social interactions and lead to a decline in quality of life, caused by embarrassment and feelings of shame or guilt when eating, smiling, and talking.<sup>12</sup>

Historically, DA has been attributed to the expectation of pain, and the etiology of DA features classic characteristics of conditioning, originating in early periods of life (childhood to early adolescence).<sup>13-16</sup> Nevertheless, an individual’s dental fear/phobia is likely to have its origin in a multitude of factors like genetic vulnerability, negative affectivity/anxiety vulnerability, preparedness, cognitive conditioning (Pavlovian), operant conditioning, vicarious experience and verbal threat, cognitive content, or cognitive biases.<sup>17</sup>

Exploring DA in the population should be of special interest as DA is considered by many patients, and also by dental practitioners, to be an unavoidable evil. The real level of DA is usually unknown when starting the treatment. Furthermore, in dental practice, a diagnostic differentiation between DA and dental phobia is usually difficult to achieve. This is aggravated by the fact that there is a lack of uniformity in the use and definition of the different terms: "fear," "anxiety," "high anxiety," and "phobia."

Additionally, in contrast to other anxiety disorders, the attending dental practitioner is usually the first contact and initiates the diagnostic process for patients with DA, DA disorder (DAD), or phobia. Understandably, dental practitioners often in turn exhibit and display greater stress reactions when treating patients with high levels of fear or anxiety disorders.<sup>18,19</sup> The dental treatment of anxious patients is characterized by time-consuming procedures, difficult interactions in combination with a higher risk of accidents, the feeling of inadequacy on the dental practitioners' part, and higher costs due to frequently missed appointments.<sup>18,19</sup> For this reason, a previous knowledge of the extent of the anxiety as evaluated in the anamnesis in addition to the somatic disorders may guarantee an adequate and significantly less stressful treatment of the anxious patient and may provide more favorable outcome of dental treatment.<sup>20</sup>

Because anxiety is a cognitive, emotional, and physical reaction to an existing or expected dangerous and threatening situation, the patient's anxiety response spans three dimensions: the physiologic, the subjective, and the motoric or behavioral levels.<sup>21</sup> For this reason, anxiety can be diagnosed at all three of these levels in terms of the complex response pattern. The most reliable method for determining the level of anxiety before dental treatment in everyday dentistry is to interview the patients affected.<sup>22</sup> An observation of heart rate and/or electrodermal activity (EDA) (ie, galvanic skin response [GSR]) may provide subjective add-on information of a patient's state but needs additional technical equipment.<sup>23</sup> For optimal outcomes, it is necessary to determine in advance whether the patient will be able to bear the dental treatment or if an interdisciplinary approach is required, such as a referral to experts in the field of psychology, eg a psychologist or psychiatrist. In this way, a proper psychologic diagnosis is assured and a decision on the options for further treatment can be offered, in consideration of the fact that comorbidities are frequently present in anxious patients.<sup>24,25</sup> In some cases, the psychologist and the dental practitioner need to work together. It is therefore incumbent on dental practitioners to confirm suspicions of the presence of an anxiety disorder by asking specific questions and observing the patient's behavior including both the physical

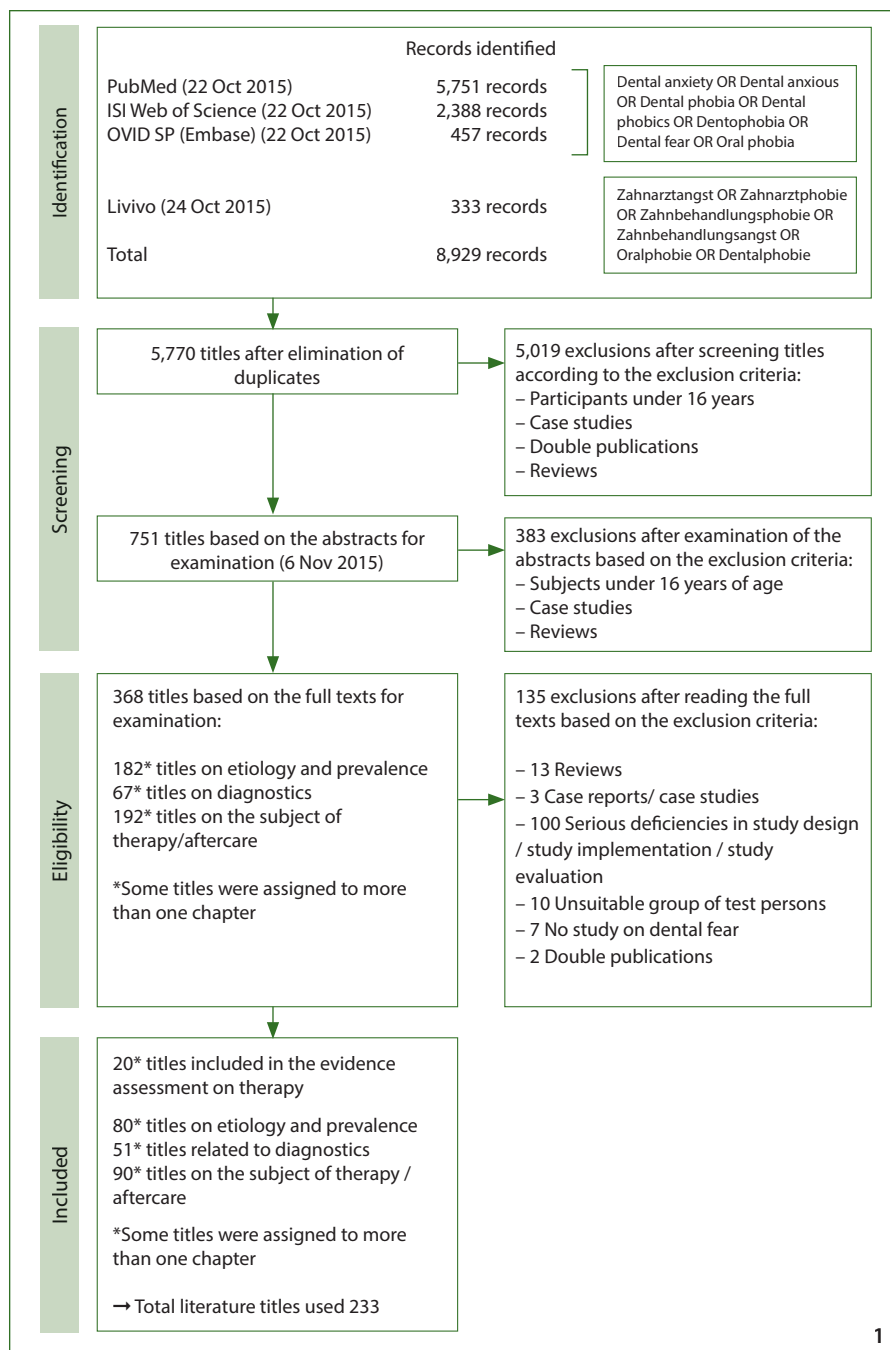
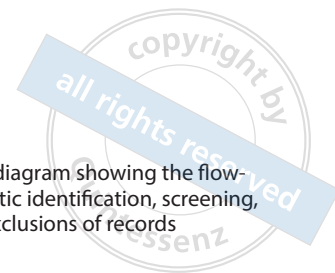
signs of anxiety (vegetative and general symptoms) and typical anxiety behavior (eg, avoiding eye contact, hesitant answers, fright reactions).<sup>26</sup>

Differentiation between highly anxious patients and patients exhibiting a DAD is of great importance and must be carefully assessed. This subjective level includes the anxiety experienced by the affected individual: apprehension, feelings of helplessness, the feeling of being at the dental practitioner's mercy, thought patterns generated by anxiety, and therefore the associated subjective anxiety experience ("something bad is going to happen").<sup>23</sup> Even the imagination of past or future anxiety-inducing situations or the perception of a stimulus as potentially dangerous can lead to physical reactions or specific behavioral patterns.<sup>16,17</sup>

The pathologic dental treatment anxiety represents a phobic disorder (ICD-10 F40.0) which is defined as an immediate, inappropriate fear reaction to a clearly defined situation.<sup>27</sup> Among the phobic disorders, dental treatment phobia belongs to the isolated specific phobias (ICD-10 F40.2; DSM 300.29).<sup>27,28</sup> Fear or anxiety usually results in the expression of a range of adaptive or defensive behaviors, aiming to escape from the source of danger or the triggering conflict. The defensive system with its hyper-responsiveness is claimed to be the key psychopathologic process on a neurophysiologic level related to specific phobias. The triggering event leads to a characteristic pattern of response, varying according to the perceived threat level and the strength of the accompanying arousal of the defensive system. Two kinds of mechanism occur: i) defensive immobility and ii) defensive action. The reaction is initially accompanied by a decrease of the heart rate and an inhibition of defensive reflexes such as the startle response.<sup>29,30</sup> When excitement increases, the defensive reflexes are eased. Due to the sympathetic activation, the heart rate switches from deceleration to acceleration representing a shift from defensive immobility to action (fight and flight reaction).

However, the extent to which dental phobic reactions also include vasovagal responses that are frequently observed in phobias associated with fear of blood, injections, and injuries (BII), is controversially discussed. Occurrence of comorbidities in dental anxious patients varies between 13% and 55%.<sup>31-33</sup> The BII-phobia is typically associated with a diphasic cardiovascular response of an initial tachycardia, followed by bradycardia, hypotension, shock, vertigo, syncope, diaphoresis, nausea, and seldom asystole and death.<sup>34</sup>

In most of the cases, the BII-phobia response is characterized by syncope or presyncope – meaning, BII-phobia patients are more prone to fainting when being confronted by the stim-



**Fig 1** PRISMA diagram showing the flow-chart of systematic identification, screening, inclusion, and exclusions of records identified.

ulus.<sup>35</sup> This behavior usually is not observed in dental phobic patients.<sup>36</sup> Hence, practitioners should be aware of the underlying reasons for the anxiety and decide if it is possible to lead the patient through the treatment.

In general, systematic and comparative research into DA started with the development of standardized questionnaires.<sup>37</sup> It should be taken into account that a normal assessment of DA prior to treatment – meaning completion of a DA questionnaire

– represents an adjunct to the treatment of adult patients attending general practice and does not negatively influence the state and trait anxiety.<sup>38</sup>

Nevertheless, the comparison of validated questionnaires with regard to quality is almost impossible, since different objectives are pursued. The aim of the review of the literature, compiled for the evidence based German Guideline “Dental anxiety in adults”,<sup>39</sup> was:

- To evaluate the existing questionnaires with regard to their practicability in everyday dental practice.
- To check whether they are suited to differentiate between anxiety and a dental anxiety disorder/ phobia.
- To compare the psychometric instruments using Cronbach alpha.

This systematic review was intended to help clinicians to select a suitable questionnaire or screening tool that provides the desired information and in particular differentiates between fear of being treated and phobia. Hence, the null hypothesis was that all questionnaires or screening tools are equally suited in recognizing dental fear and differentiate between subclinical and pathologic forms of dental fear.

## Methods and materials

### Data sources

For the systematic literature review to draft the German Guideline “Dental anxiety in adults” that was published in October 2019,<sup>39</sup> the following keywords were defined: “dental anxiety,” “dental anxious,” “dental phobia,” “dental phobics,” “dentophobia,” “dental fear,” “oral phobia.”

The terms for the guideline and the present study were linked with “AND” or “OR” and the search was conducted for articles published until 22 October 2015 without further date restrictions. The only requirement for inclusion was the availability of an abstract written in English or German language.

The literature search for the guideline was carried out in the databases PubMed, Web of Science (Core collection), and Embase. Two reviewers (CB, EF) carried out the electronic literature search using the literature administration program Endnote (Web of Science Group). The electronic search was complemented by manually browsing the bibliographies of the selected full texts, other systematic reviews, and current meta-analyses.

In addition, publications in German language were searched with the help of MedPilot using the terms *Zahnarztangst* (dental fear), *Zahnbehandlungsangst* (dental treatment fear), *Zahnbehandlungsphobie* (dental treatment phobia), *Zahnarztphobie* (dentist phobia), and *Oralphobie* (oral phobia = generic term for all phobias related to the oral cavity).

### Inclusion criteria

- Studies were included with patients who had “dental anxiety disorder or high dental fear.” These included:

- DSM-IV 28 300.29 (F40.23x) BII (eg, needles, invasive medical procedures)
- ICD-1027 F40.2 Specific (isolated) phobia
- Definition of a cut-off score for high anxiety (questionnaire for DA; eg, Dental Anxiety Score (DAS) > 15)<sup>3</sup>
- Studies involving patients with “unspecified dental fear/ anxiety” but who did not meet the criteria for dental phobia (ie, moderately anxious patients) or who did not have a homogenous highly anxious sample based on an anxiety scale were also included.

- Randomized controlled trials (RCTs)
  - Studies comparing interventions with control group (placebo, psychological placebo, waiting list)
- Studies comparing interventions with reference therapy. The reference therapy was defined as a therapy that has been shown to be effective in preliminary studies compared to a control group.
- Naturalistic open studies with comparison before and after intervention
- Sample size: at least 10 evaluable patients per group (for a noninferiority comparison, a minimum of 50 evaluable patients per study arm was required)
- Adults
- Use of scales that measure DA (eg, DAS) or state anxiety in situations directly related to the dental treatment or the visit to the dental practitioner (eg, State-Trait Anxiety Inventory-State or Visual Analog Scale [VAS] to assess the intensity of anxiety during dental treatment):<sup>40,4</sup>
  - Studies whose results contribute to answering at least one of the abovementioned guideline questions
  - Match of quality criteria: For this purpose, a systematic approach was used, which is also found in the World Federation of Societies of Biological Psychiatry (WFSBP) guidelines.<sup>42</sup>

### Exclusion criteria:

- Reviews and case reports
- Insufficient study quality:
  - lack of information on the result
  - lack of information on statistical parameter
  - insufficient statistical evaluation
  - studies in which one or more study groups contained less than 10 evaluable subjects:



- Studies with unsuitable groups of subjects
  - studies with children and/or adolescent
  - studies with subgroups only (seniors/etc).
  
- Studies not related to dental fear/anxiety.

All titles found were inspected and thematically relevant titles were subsequently subjected to an abstract screening. Any disagreements among the reviewers regarding article selection were clarified by discussion until agreement was reached.

A total of 8,929 titles were identified. After removing the duplicates, these were reduced to 5,770, and after evaluation of the headings, 751 abstracts were rated eligible regarding the following items: review/RCT/prevalence/therapy/diagnostics/epidemiology/comorbidity/prevention/meta-analysis/general or full anesthesia.

The guideline members had the opportunity to reinclude literature that had been initially rejected until 23 April 2016. This was done with regard to 17 items. Finally, after reading all preselected full-texts, 20 titles were included in the evidence evaluation for therapy, 80 titles on etiology and prevalence, 51 titles related to diagnostics, and 90 titles on the subject of therapy and aftercare – resulting in a total of 233 titles (titles could be assigned to multiple categories) (Fig 1).

Due to extensive controversy discussions during the consensus process by all affiliated scientific societies of the German guideline of “Dental anxiety disorder in adults” (end of 2015 to 2019), in the context of the current review, a second literature research was conducted with identical keywords for the diagnosis of dental anxiety/phobia including the current literature until 1 April 2020. Ten relevant references were additionally included.<sup>5,6, 14,23,36,43-47</sup> This review focused on the DA questionnaires validated in the German language. They vary to a large extent in their ability to recognize anxiety and to differentiate between high anxiety and suspected DAD (Table 1). The correlation to the DAS, the oldest and most commonly used questionnaire in studies on DA, and internal consistencies were extracted from the included articles. Overall, all questionnaires showed an acceptable (Cronbach alpha > 0.7) to excellent reliability (> 0.9) and the correlation to the DAS (as far as determined) was above  $r = 0.7$  for all questionnaires.

In order to make the acceptance and distribution of the questionnaires and screening tools used transparent for the reader, the literature search was extended to evaluate the total number of uses of the screening tools and questionnaires. The following databases and keywords were used: PubMed, Web of Science, Embase, and MedPilot: “Questionnaire/screening tool”

completely spelled out OR as an “abbreviation” AND “dental anxiety” AND/OR “dental phobia” (Table 2).

## Review

### Dental Anxiety Scale (DAS)

The most frequently used anxiety scale in dentistry is the DAS according to Corah.<sup>37</sup> It consists of four questions with five possible answers each. The patient is asked to choose between different situations and tick the answer option that corresponds to his/her current state and the perception, in relation to the respective situation. The scoring of each question ranges from 4 to 20. According to Corah,<sup>37</sup> values less than 9 are nonanxious and values between 9 and 12 indicate moderate anxiety that can likely be managed. High anxiety is indicated by values of 13 and 14. The next level is 15 to 20, meaning severe anxiety and representing a possibly phobic stage of fear.<sup>81</sup> The stability of the DAS is very high.<sup>48-50</sup> The DAS was translated into German by Tönnies et al<sup>51</sup> and examined in the German version.

### Modified Dental Anxiety Scale (MDAS)

Since the DAS does not include questions about local anesthesia, which is claimed to be a significant factor in many patients’ dental anxiety, the Modified Dental Anxiety Scale (MDAS) was developed.<sup>52,59</sup> The MDAS includes a question concerning local anesthesia and therefore has a point distribution of 5 to 25. In addition, the other questions have been modified and now relate to pure anxiety perceptions and not to possible feelings. Due to the modification, the cut-off point for the presence of a phobia is  $\geq 19$ .<sup>61,62</sup>

### State-Trait Anxiety-Depression Inventory (STADI)

The State-Trait Anxiety-Depression Inventory (STADI)<sup>82</sup> questionnaire is based on Spielberger’s theory of fear and does not specifically refer to dental fear, but rather on anxiety in a variety of daily situations. It consists of two modules: The trait anxiety captures anxiety as a superordinate property independent of the time and situation of the survey. The state anxiety measures the anxiety at a defined moment and in a specific situation. This can be an advantage in practical investigations as many patients do not feel any fear during the dental hygiene appointments, but do feel fear of any restorative and more invasive procedures. The questionnaire distinguishes anxiety from depression symptoms that are often associated with DA. They must be distinguished for an accurate diagnosis.



In dental research, STADI has replaced the STAI according to Spielberger.<sup>40</sup> This index has been frequently used in the past. It has to be borne in mind that there is no direct association between the state anxiety and the trait anxiety.<sup>66</sup> The correlation of the trait scale of the STAI to the DAS is  $r = 0.76$ .<sup>40</sup>

### **Dental Fear Survey (DFS)**

The Dental Fear Survey (DFS)<sup>67</sup> questionnaire consists of 20 questions concerning the level of anxiety in different dental situations. Each question can be answered in terms of a Likert scale of 1 to 5. Two items relate to avoidance behavior, five to physiologic reactions, and 12 in hierarchical order to specific stimuli that trigger anxiety during dental treatment. One question aims for general assessment of the fear of dental treatment. The score is between 20 (no fear) and 100 (great fear). One DFS question is also used to obtain more precise information about anxiety-inducing stimuli during dental treatment. The average score is 37, and a score of 60 or more may lead to suspected diagnosis of a "severe form of dental fear requiring treatment."<sup>51,67</sup> The DFS is therefore a suitable diagnostic measuring instrument for the presence of a dental phobia.<sup>67</sup> This results in a correlation coefficient of  $r = 0.92$  to the DAS.<sup>16,50,68</sup>

### **Dental Belief Survey (DBS)**

The Dental Belief Survey (DBS)<sup>63</sup> is not primarily a test-psychologic method for recording fear of dental treatment, but rather an instrument that measures the effect of the dental practitioner on the patient. A revised version (Revised Dental Belief Survey [DBS-R]) refers not only to the aspects of ethical background, communication, and control, but also considers trust as a further point.<sup>69,70</sup> DBS results correlate strongly with dental fear. Research shows that treated dental fear does not necessarily change the attitude towards the dental practitioner ("belief"). The attitude itself therefore seems to play a fundamental role in the development of dental fear. It has been shown that an improved attitude towards the dental practitioner from the beginning, eg through dental consultations and measured by DBS, increased the success in treating dental fear.<sup>69,70</sup>

### **Dental Anxiety Inventory (DAI)**

The Dental Anxiety Inventory (DAI) was developed by Stouthard et al<sup>71,72</sup> in 1993 and its high correlation to the DAS ( $r = 0.73$ ) was demonstrated. It includes 36 questions, which are intended

to capture anxiety disposition by three different components of the anxiety/fear of dental treatment:

- time (at home, the way to the dental practitioner, the waiting time, and the time in the dental chair)
- situation (introductory aspects, dental practitioner-patient interaction, current pending dental treatment)
- reaction (subjective sensations, physical reactions, and the cognitive level).

Much attention was given to the definition of anxiety in terms of state versus trait anxiety and anxiety as a process.

### **Short version of the Dental Anxiety Inventory (S-DAI)**

The short version of the DAI (S-DAI) developed by Aartman<sup>73</sup> contains only nine questions from the DAI: three time-related questions (the way to the dental practitioner, waiting room, and sitting on the treatment chair), three concrete dental situations (noise of the drill, tooth extraction, and anesthesia), and three questions about the reactions of the affected person (flight reflex, sweating, closing eyes).

A factor analysis revealed a moderate to good agreement/consistency of the individual questions to the whole questionnaire (0.6 minimum and 0.84 maximum). The correlation to DAS is  $r = 0.73$ .<sup>73</sup>

### **Dental Cognitions Questionnaire (DCQ)**

The self-rating Dental Cognitions Questionnaire (DCQ) according to de Jongh et al<sup>54</sup> consists of 38 negative cognitions (beliefs and self-statements) related to dental treatment. The patient is asked to confirm if they occur during dental treatment.<sup>54</sup> Fourteen items focus on negative beliefs pertaining to dentistry/dental practitioners in general and to the patients themselves. The remaining 24 items relate to negative self-statements (eg, "Everything is going wrong"). Patients are asked to indicate whether they notice these negative perceptions during dental treatment. The questions are answered with "yes" or "no." The frequency of "yes" answers (score range 0 to 38) is summed (DCQ frequency score).<sup>54</sup> In addition, patients individually evaluate the likelihood of their conviction by making a self-assessment of their perceptions. People with dental phobia have a significantly higher number of negative cognitions than non-phobic controls.<sup>54</sup> The correlation between the frequency and the believability scores revealed an acceptable level of validity ( $r = 0.58$ ) and the internal consistency for the DCQ-reliability



**Table 1** Questionnaires validated in German language

Questionnaire	No. of questions	Scores per question	Max. score	Highly anxious	Special features/contents
DAS 1969	4	1–5	20	≥ 13	Does not include questions about local anesthesia
MDAS 1985	5	1–5	25	≥ 19	DAS supplemented by one item: “local anesthesia”
STADI 2013 (previously: STAI)	2 × 20 = 40; 20 (State); 20 (Trait); separately or jointly	1–4	80 each	≥ 45	Two-part questionnaire: 1) general emotional state; 2) situation-related emotional state. Differentiation between anxiety and depression
DFS 1973	20	1–5, level 5 = highest fear, level 1 = lowest fear	100	> 60	Includes questions on: 1) Avoidance behavior; 2) Psychovegetative fear reactions to specific stimuli; 3) Fear/feelings in specific treatment situations; 4) Final assessment (global anxiety disorder)
DBS 1985	15	1–5, 1 = highly positive belief, 5 = highly negative belief	75	> 48	Weighing of the questions: Psychometry, Communication, Confidence, Disparagement, Loss of control
DAI 1993	36	1–5 unimodal answer alternatives	180		Self-assessment: a) Situational aspects (general fear of dental treatment (current treatment, interaction with the dental practitioner); b) Time related aspects (at home, way to dental practitioner, waiting room, chair); c) Reaction aspects (emotional, physical, cognitive)
S-DAI 1998	9	1–5	45		9 DAI items: anxiety-triggering situations; time-related situations; reacting
DCQ 1995	38	Dichotomous index: yes or no	38	≥ 19	38 negative findings (convictions and self-statements) in the context of dental treatment. 14 items: Dentistry in general. 24 treatment-related statements. Rating of the own conviction of perceptions by a self-assessment
HAQ 1999	11	1–5	55	> 38	Also includes avoidance of appointments/visits to the dental practitioner
SDFQ 1995	1	4 response options	Answer 4	Answer 4	One question: quick evaluation
IDAF-4C+ 2010	23	1–5	5.0	≥ 3.0	4 components of the dental anxiety: cognitive, physiologic, behavioral, emotional
DAQ 1990	1	4 response options: no; a little; yes, quite; yes, very	Yes, very	Yes, very	One question: quick evaluation
VAS	1	Free choice by the patients	100	≥ 70	10-cm long scale, free choice by the patients

and -believability were 0.89 and 0.95, respectively.<sup>54</sup> The correlation coefficient with DAS is  $r = 0.74$ .<sup>55</sup>

### Hierarchical Anxiety Questionnaire (HAQ)

The Hierarchical Anxiety Questionnaire (HAQ),<sup>74</sup> based on the DAS according to Corah,<sup>37</sup> includes 11 questions related to different dental treatment situations that are presented in a hierarchically structured sequence.<sup>83</sup> The questions focus on the

most fear-inducing situations in treatment and offer five different types of fear to reply (from “relaxed” [= 1 point] to “sick of anxiety” [= 5 points]). The sum of the scores allows division of patients into three groups: low anxious or slightly anxious ( $\leq 30$  points), moderately anxious (31 to 38 points), and extremely anxious (possibly phobic) ( $> 38$  points). The HAQ allows a suspected diagnosis of a dental phobia when the score exceeds 38 combined with a simultaneous anamnestic avoidance of dental treatment over more than 2 years.<sup>44,75,76</sup> The question-

Evaluation	Differentiation between fear and phobia	Cronbach alpha*	References
< 9 not anxious; 9–12 moderately anxious; 13–14 highly anxious; 15–20 extremely anxious/ phobia	No: only low, medium, and high anxiety	Up to 0.84	Jaakkola et al, <sup>4</sup> Kruger et al, <sup>8</sup> Eitner et al, <sup>9</sup> Nermo et al, <sup>14</sup> Sartory et al, <sup>26</sup> Corah, <sup>37</sup> Naumova et al, <sup>45</sup> Talo Yildirim et al, <sup>46</sup> Locker and Liddell, <sup>48</sup> Moore et al, <sup>49</sup> Johansson and Berggren, <sup>50</sup> Tönnies et al, <sup>51</sup> Humphris et al, <sup>52</sup> Moore et al, <sup>53</sup> de Jongh et al, <sup>54</sup> Sartory et al, <sup>55</sup> Neverlien, <sup>56</sup> Luuk et al, <sup>57</sup> Schuur et al <sup>58</sup>
< 11 not anxious; ≥ 11 slightly anxious; 11–14 moderate anxious; 15–18 very anxious; ≥ 19 extremely anxious	No: anxious, moderately anxious, highly anxious, and extremely anxious	Up to 0.83	White et al, <sup>6</sup> Appukuttan et al, <sup>41</sup> Höglund et al, <sup>43</sup> Humphris et al, <sup>52,59</sup> Humphris and Hull, <sup>60</sup> Pekkan et al, <sup>61</sup> Viinikangas et al, <sup>62</sup> Milgrom et al, <sup>63</sup> Kanegane et al, <sup>64</sup> Armfield et al <sup>65</sup>
≤ 22 low; 23–31; 32–40; 41–49; ≥ 50	No	Up to 0.9	Hofer et al, <sup>5</sup> Wang et al, <sup>20</sup> Naumova et al, <sup>45</sup> Talo Yildirim et al, <sup>46</sup> Moore et al, <sup>53</sup> de Jongh et al, <sup>54</sup> Sartory et al, <sup>55</sup> Luuk et al, <sup>57</sup> Humphris and Hull <sup>60</sup>
Very anxious > 60; phobia > 75	Yes, phobia = DFS score over 65 AND avoidance	0.95	Johansson and Berggren, <sup>50</sup> Wardle, <sup>66</sup> Kleinknecht et al, <sup>67</sup> Moore et al, <sup>53</sup> Berggren et al <sup>68</sup>
Not anxious, little anxious, moderately anxious, highly anxious, extremely anxious	No	Up to 0.91	Berggren et al, <sup>68</sup> Milgrom et al, <sup>63</sup> Abrahamsson et al <sup>69,70</sup>
36 = no anxiety; 180 = high anxiety	No	Up to 0.75	Stouthard et al <sup>71,72</sup>
No standard data/cut-off values available	No	Up to 0.88	Aartman <sup>73</sup>
Items are summarized to get a total value for negative perceptions. Rating of the own conviction of perceptions by a self-assessment.	Phobic patients = score ≥ 19	Frequency 0.89, believability 0.95	de Jongh et al, <sup>54</sup> Sartory et al <sup>55</sup>
< 30 low level of anxiety; 31–38 medium level of anxiety; > 38 high level of anxiety; phobia = HAF > 38 and avoidance > 2 y	Yes: phobia = HAF > 38 and avoidance > 2 y	Up to 0.936	Enkling et al, <sup>2</sup> Hofer et al, <sup>5</sup> Lenk et al, <sup>25</sup> Sartory et al, <sup>26</sup> Wannemueller et al, <sup>36,44</sup> Sartory et al, <sup>55</sup> Jöhren, <sup>74</sup> Jöhren et al, <sup>75</sup> Jöhren and Sartory, <sup>76</sup> Barthelmes <sup>77</sup>
1 = relaxed; 2 = slightly anxious; 3 = moderately anxious; 4 = extremely anxious	No	Up to 0.89	Jaakkola et al <sup>4</sup>
3 modules: Base module IDAF-4C (8 items); Phobia module IDAF-P (5 items); Stimulus module IDAF-S (10 items)	Yes, special phobia module based on DSM-IV diagnostic criteria; IDAF-4C ≥ 3.0 and interferences with life or distress	Up to 0.94	Wang et al, <sup>20</sup> Armfield, <sup>78</sup> Tönnies et al <sup>79</sup>
No, little, anxious, very anxious	No	Up to 0.88	Neverlien <sup>56</sup>
0 = not at all; ≥ 48 and < 70 anxious; ≥ 70 (phobia)	(Yes)	Up to 0.968	Hofer et al, <sup>5</sup> Appukuttan et al, <sup>41</sup> Höglund et al, <sup>43</sup> Luuk et al, <sup>57</sup> Kanegane et al, <sup>64</sup> Barthelmes, <sup>77</sup> Facco et al <sup>80</sup>

naire was validated and checked for its reliability (0.936) and its internal consistency (0.94).<sup>74</sup> The correlation to DAS is  $r = 0.88$ .<sup>74</sup>

### Index of Dental Anxiety and Fear (IDAF-4C+)

The Index of Dental Anxiety and Fear (IDAF-4C+)<sup>78</sup> consists of three modules designed to measure both fear and phobia. The index distinguishes specifically between dental fear and phobia.

Consisting of three modules, each with eight items, the IDAF-4C+ analyses emotional, behavioral, physiologic, and cognitive responses related to dental fear. Each module uses a Likert scale ranging from 1 to 5 (1 = strongly disagree, 5 = strongly agree).<sup>78</sup>

In the first, general module "IDAF-4C," emotional and cognitive aspects, behavioral observations, and physiologic reactions were recorded. In the IDAF-P module, the presence of a phobia is checked based on DSM IV. In the IDAF-S module, the fear-inducing potency of various stimuli associated to dental





**Table 2** Total number studies that used the evaluated questionnaires and screening tools in decreasing order (PubMed, Web of Science, Embase, and MedPilot: “Questionnaire completely spelled” out OR as an “abbreviation” AND “dental anxiety” AND/OR “dental phobia”); Enumeration of studies included in the present review with the number of participants

Questionnaire/ screening tool	Total number of uses	Study and number of participants included in the present review
DAS	1,712	Jaakkola et al <sup>4</sup> (26), Kruger et al <sup>8</sup> (649), Eitner et al <sup>9</sup> (347), Neremo et al <sup>14</sup> (986), Sartory et al <sup>26</sup> (1,139), Corah <sup>37</sup> (1,232), Naumova et al <sup>45</sup> (40), Talo Yildirim et al <sup>46</sup> (231), Locker and Liddell <sup>48</sup> (2,272), Moore et al <sup>49</sup> (155), Johansson and Berggren <sup>50</sup> (41), Tönnies et al <sup>51</sup> (137), Humphris et al <sup>52</sup> (1,392), Moore et al <sup>53</sup> (155), De Jongh et al <sup>54</sup> (180), Sartory et al <sup>55</sup> (48), Neverlien <sup>56</sup> (1,351), Luyk et al <sup>57</sup> (45), Schuurds et al <sup>58</sup> (620), Facco et al <sup>80</sup> (1,114)
DFS	1,680	Jaakkola et al <sup>4</sup> (26), Berggren and Meynert <sup>16</sup> (160), Talo Yildirim et al <sup>46</sup> (231), Johansson and Berggren <sup>50</sup> (44), Tönnies et al <sup>51</sup> (137), Moore et al <sup>53</sup> (80), Berggren et al <sup>68</sup> (100)
DAI	1,155	Stouthard et al <sup>71</sup> (1,575), Stouthard et al <sup>72</sup> (664)
MDAS	289	White et al <sup>6</sup> (308), Appukuttan et al <sup>41</sup> (200), Höglund et al <sup>43</sup> (1,128), Wannemüller et al <sup>44</sup> (823), Humphris et al <sup>52</sup> (1,392), Humphris et al <sup>59</sup> (800), Humphris and Hull <sup>60</sup> (583), Pekkan et al <sup>61</sup> (250), Viinikangas et al <sup>62</sup> (823), Milgrom et al <sup>63</sup> (480), Kanegane et al <sup>64</sup> (73), Armfield et al <sup>65</sup> (104)
VAS	223	Hofer et al <sup>5</sup> (46), Appukuttan et al <sup>41</sup> (200), Höglund et al <sup>43</sup> (1,128), Barthelmes <sup>77</sup> (1,820), Facco et al <sup>80</sup> (1,114), Luyk et al <sup>57</sup> (45), Kanegane et al <sup>64</sup> (73)
IDAF-4C+	143	Wang et al <sup>20</sup> (119), Armfield <sup>78</sup> (1,511), Tönnies et al <sup>79</sup> (287)
DCQ	133	De Jongh et al <sup>54</sup> (189), Sartory et al <sup>55</sup> (48)
DBS	94	Moore et al <sup>49</sup> (80), Moore et al <sup>53</sup> (80), Berggren et al <sup>68</sup> (100), Milgrom et al <sup>63</sup> (480), Abrahamsson et al <sup>69</sup> (117), Abrahamsson et al <sup>70</sup> (278)
STAI/STADI	31	Hofer et al <sup>5</sup> (46), Wang et al <sup>20</sup> (119), Naumova et al <sup>45</sup> (40), Talo Yildirim et al <sup>46</sup> (231), Moore et al <sup>49</sup> (155), Moore et al <sup>53</sup> (155), De Jongh et al <sup>54</sup> (180), Sartory et al <sup>55</sup> (48), Luyk et al <sup>57</sup> (45), Humphris and Hull <sup>60</sup> (583)
HAQ	24	Enkling et al <sup>2</sup> (300), Hofer et al <sup>5</sup> (46), Lenk et al <sup>25</sup> (212), Sartory et al <sup>26</sup> (120), Wannemueller et al <sup>36</sup> (126), Wannemueller et al <sup>44</sup> (43), Sartory et al <sup>55</sup> (48), Jöhren <sup>74</sup> (199), Jöhren et al <sup>75</sup> (160), Barthelmes <sup>77</sup> (1,820), Facco et al <sup>80</sup> (210)
S-DAI	14	Aartman <sup>73</sup> (321)
DAQ	10	Neverlien <sup>56</sup> (1,351)
SDFQ	10	Jaakkola et al <sup>4</sup> (26)

interventions were evaluated.<sup>79</sup> This index is suited for: i) the assessment of DA and dental fear at a population or individual level, ii) making a provisional diagnosis of dental phobia, and iii) determining important fear relevant stimuli for fearful (or nonfearful) individuals. IDAF-4C always showed good to excellent evaluation values: internal consistency (Cronbach alpha) 0.94, test-retest reliability  $r = 0.82$ , and correlation to DAS  $r = 0.84$  and DFS  $r = 0.89$ .<sup>10,78</sup>

### Single-item Dental Anxiety Question (DAQ)

In the Single-item Dental Anxiety Question (DAQ),<sup>56</sup> the question “Are you afraid to go to the dentist?” reduces the number of questions in the questionnaires to a minimum and provides helpful information about the presence of an anxiety disorder. The patient assesses the anxiety by self-explaining and based on predefined answers (no; a little; yes, quite; yes, very) representing a Likert scale. The correlation to DAS is  $r = 0.71$ .<sup>56</sup>

### Short Dental Fear Question (SDFQ)

The Short Dental Fear Question (SDFQ)<sup>4</sup> is a short clinical instrument containing one basic question supplied with four response options. The options are based on gradation and represent a four-point Likert scale indicating that the more fear the higher the numerical value. The last option (4) includes three items describing situations associated with difficulties during dental treatment situations give an assumption of whether treatment may be possible or will definitely fail from the clinically point of view. In options 3, 2, and 1, the degree of difficulty decreases gradually until it is finally nonexistent.<sup>4</sup> Treatment is manageable in patients who are moderately or slightly frightened or even relaxed.<sup>4</sup>

### Visual Analog Scale (VAS)

For self-assessment using VAS,<sup>41</sup> the VAS consists of a scale with two defined endpoints (0 to 100 mm). The patient is assessed

before treatment by marking his/her fear on this scale with a line. The value 0 corresponds to complete freedom from fear and the value 100 to the maximum fear imaginable. A vertical stroke on the line represents the anxiety level. The VAS offers a cut-off value of  $\geq 4.8$  to discriminate between patients who were and were not anxious, and a cut-off value of  $\geq 7$  to identify patients with dental phobia.<sup>41</sup> There is a recommendation to use a detailed questionnaire as a supplement starting from a value of  $> 0.5$ .<sup>77,84</sup> The reliability of the VAS is very high and it is characterized by a good correlation to significantly more extensive questionnaires in identifying dental anxiety (eg, DAS, MDAS).<sup>41,57,77,80,84</sup>

### Other (objective) methods

Further methods such as blood pressure and pulse rate measurements as well as pulse oximetry and the recording of finger temperature and galvanic skin response (GSR) were described, but only the measurement of GSR has been validated as a method for recording and diagnosing DA so far.<sup>85</sup> GSR measures the electrical changes (sweat on the skin reduces the resistance), which are caused by the slightest secretion from epidermal sweat glands, and allows a conclusion on the perceived fear.<sup>86</sup> The saliva concentration of the stress hormone cortisol was also investigated in several studies.<sup>45,64</sup> This procedure seems to be suitable for clinical diagnostics but offers insufficient sensitivity.<sup>45</sup> Only the saliva secretion rate is claimed to be a marker for DA.<sup>45</sup>

### Discussion

The null hypothesis has to be partially rejected. On the one hand, the screening tools and questionnaires are suitable for recognizing DA and offer good to excellent reliabilities, but on the other hand only a few were able to differentiate between phobia and subclinical anxiety (Table 1).

Only a small percentage of dental professionals use any form of assessment technique to rate DA.<sup>87</sup> If no assessment tool is used, dental professionals may rely on their experience and intuition, usually called the "clinical eye," to rate a patient's level of DA. Nevertheless, clinicians do not successfully identify anxious patients without the concurrent use of patient self-assessment tools or any other screening instruments like questionnaires.<sup>43</sup> Numerous screening tools and questionnaires are currently available. They are more or less comprehensive (1 to 40 items/questions) and time consuming. Ultimately, objectives and information content are decisive for choosing the right questionnaire. In general, anxiety questionnaires provide additional and more precise information regarding DA and can

be easily implemented in dental practice. Their validities and reliabilities have been well investigated and in the end they are all suitable for recording DA and do not influence or intensify patients anxiety.<sup>60,65,88-90</sup> However, most of them do not differentiate between DA and DAD/phobia. This is of clinical relevance as every second patient with a DAD (dental phobia) has at least one additional anxiety disorder. The majority (75%) of the patients exhibiting at least two disorders have never been under psychotherapeutic care.<sup>24,25</sup> It has been shown that DA and dental fear were related to psychologic status and different anxiety levels, symptoms, and triggers, and reflect the broad spectrum of fear of dental situations.<sup>46,47</sup> It is therefore up to the dental practitioner, when a phobia is suspected, to provide psychotherapeutic treatment for these patients.

Single item tools or questionnaires, which are compact and easy to answer and interpret, and thus convenient for use in a busy routine clinical setting by dental practitioners, represent the fastest and easiest way to find out whether a dental anxiety/phobia is present. The single-item VAS has been suggested as suitable for application in the dental clinic.<sup>41</sup> The VAS is widely used in psychology and medicine to assess subjective phenomena, such as pain and quality of life.<sup>91</sup> Several studies evaluated the ability of the VAS to rate DA and found it reliable and easy to use.<sup>41,84</sup> Like the VAS, the DAQ and SDFQ are suitable single-item tools for screening anxious patients. The SDFQ indicates the patient's potential avoiding behavior, whereas the VAS may differentiate between fear and phobia. However, it is questionable if the single-item screening tools are comparable or superior to multi-item tools capturing multidimensional elements of dental anxiety.<sup>58</sup>

The more comprehensive questionnaires are obviously more time consuming and use multiple questions with Likert-scale scoring, but they offer more detailed information concerning the fear and other aspects like anxiety-triggering stimulating factors. The questionnaires give a general overview of a patient's dental fear, eg more questions and/or alternative answers. Some represent specific dental fear inventories and psychometric instruments concerning several components of DA, such as cognitive, physiologic, behavioral, and emotional aspects. Nevertheless, administration of multi-item questionnaires is accompanied by some disadvantages. Time constraints in clinical practices; self-assessment depending on individual interpretation, perception, and actual mood; confusion due to too few or too many responses; limitation in predefined categorical terms of complex subjective behaviors and information on scale; and finally the summation to a general value may lead to incorrect conclusions.<sup>92-94</sup>



**Table 3** Web-based access to the recommended questionnaires according to the German guideline “Dental anxiety in adults”

Questionnaire/ screening tool	Available at:
DAS	<a href="https://www.researchgate.net/figure/Questionnaire-based-on-Corahs-Dental-Anxiety-Scale-DAS-Points-were-assigned-for-the_fig1_7826989">https://www.researchgate.net/figure/Questionnaire-based-on-Corahs-Dental-Anxiety-Scale-DAS-Points-were-assigned-for-the_fig1_7826989</a>
MDAS	<a href="https://www.researchgate.net/figure/Modified-dental-anxiety-scale_fig1_325971424">https://www.researchgate.net/figure/Modified-dental-anxiety-scale_fig1_325971424</a>
HAQ	<a href="https://www.researchgate.net/figure/Hierarchical-Anxiety-Questionnaire-HAQ-according-to-Joehren-15_fig3_5654841/amp">https://www.researchgate.net/figure/Hierarchical-Anxiety-Questionnaire-HAQ-according-to-Joehren-15_fig3_5654841/amp</a>
DFS	<a href="https://www.researchgate.net/figure/Dental-fear-survey-questions_fig2_325971424">https://www.researchgate.net/figure/Dental-fear-survey-questions_fig2_325971424</a>
IDAF-4C	<a href="https://www.researchgate.net/figure/Dental-fear-survey-questions_fig2_325971424">https://www.researchgate.net/figure/Dental-fear-survey-questions_fig2_325971424</a>

Irrespective of these limitations, some authors demand to consult a more detailed questionnaire if the VAS value is greater than 50 on the scale and even advocate the use of more than one questionnaire to verify the suspected diagnosis of a DAD.<sup>77,84,95</sup>

From the clinical point of view, it is important for the practitioner to know whether a dental treatment is possible under more or less regular conditions in the dental office or if the patient needs external help from specialists (psychologist or psychiatrist) to make the situation manageable. Ignoring the latter may be dangerous for both the patient and operator. Only very few questionnaires differentiate between DA and a phobia. The only tools suitable for a suspected diagnosis (the final diagnosis is reserved for the psychologist) of a DAD or phobia are the DFS, DCQ, HAQ, IDAF-4C, and with constraint the VAS. Avoidance, claimed to be characteristic for a DAD,<sup>68,96</sup> is one of the central aspects when addressing phobia using the DFS and HAQ whereas the IDAF-4C solely includes a specific phobia module. The DAS ( $\geq 15$ ) and VAS ( $> 0.7$ ) may indicate phobia by exceeding special cut-off values.<sup>41,81</sup>

Finally, the screening tool or questionnaire to record and evaluate DA should fit to the orientation and focus of the practice and be oriented accordingly. Each questionnaire is suited to fulfil this aspect and works even better than dental practitioners' experience and intuition in rating a patient's level of DA. The use of questionnaires and screening tools is strongly recommended, and the dissemination of these useful and valuable tools should be encouraged and supported. Nevertheless, the tools mentioned have different objectives (eg, cognition, beliefs, control) and offer some strengths and weaknesses in screening differences in cognitions and physiologic symptoms of anxious patients with avoidance compared with nonanxious patients with regard to dental treatment. The experts, nominated for the development of the German guideline “Dental anxiety in adults” by the participating scientific societies, agreed that the “diagnostic tools” were not suitable for evidence-based analysis.

A questionnaire can be validated, but a comparison with other questionnaires is difficult. If all questionnaires delivered identical results, then they would be redundant and superfluous. The distribution and popularity of the questionnaires vary greatly (Table 2) due to the availability in the respective languages and due to the different publication dates. Most of the common questionnaires (ie, those recommended in the German guideline) are web-based and are made available by the authors via ResearchGate (Table 3). Each questionnaire also depends on the honesty of the patients, and questionnaires performed in a semi-structured interview represent a tool that depends on several factors (questioner, environment, personal attitude/mood). There is a lack of evidence regarding which tool is superior, but there is a consensus that it is better to use a screening tool or questionnaire than not to use one at all.<sup>60,65,87</sup>

However, a questionnaire is never an isolated and sole instrument of investigation; it must be carefully analyzed and interpreted in conjunction with a thorough behavioral observation of the patient to obtain further information concerning DA.<sup>97</sup>

Other methods (blood pressure, pulse rate measurements, pulse oximetry, GSR, or saliva concentration of the stress hormone cortisol) may be suitable to assess objective values of anxiety levels in clinical diagnostics and may allow a classification of these individuals in mildly, moderately, or highly anxious, or even phobic patients.<sup>45,57,63,86</sup> However, most of these techniques offer limited practicability in daily dental practice due to additional laboratory equipment, costs, and the corresponding experience to use the devices and interpret the data obtained. Nevertheless, these methods may provide add-on information and allow a kind of monitoring of the patients enabling visualization of the heart rate or even neurologic phenomena like prepulse inhibition (PPI), in which the startle response (SR) is reduced by a weaker prestimulus that minimizes the reaction of the organism to a stimulus.<sup>98,99</sup> Wannemüller et al<sup>99</sup> also showed that the intramodal affective modulation inter-

feres with the SR and may even cause its potentiation.<sup>44</sup> Hence, the influence of various (lead) stimuli on affective SR-modulation (complexity and duration) is still controversially discussed. It remains unclear whether a generally higher fearfulness of anxious patients or their specific dental phobia is responsible for their increased SR.<sup>99</sup>

When monitoring a patient, dental practitioners may also determine the extent of blood injury fear in their patients and thus estimate the probability of the occurrence of vasovagal or fainting symptoms. Syncope in BII may be avoided by applying tension and relaxation to the muscles to raise the blood pressure.<sup>100</sup> Hence, these technical devices could provide valuable information.

## Recommendations for dental practitioners

The recommendations according to the German dental anxiety disorder guideline (Association of the Scientific Medical Societies in Germany [AWMF], 083-020)<sup>39</sup> are as follows:

- The first medical history should include a dichotomous question (“yes” or “no”) about the presence of DA. If the patient answers “yes”, the patient’s self-assessment of anxiety with a VAS is desirable. If the anxiety is greater than 50%
- Careful observation of the patient in an open interview provides additional hints of physical signs of anxiety (vegetative and general symptoms) as well as typical signs of anxiety behavior (eg, avoiding eye contact, hesitant answers, fright reactions). Thus, the dental practitioner – being the first contact in numerous cases – plays a major role in screening, observing, and referring patients with anxiety and/or psychological disorders to psychological specialists.
- The final diagnosis of whether a patient is phobic or not lies beyond the scope of dentistry, and hence interdisciplinary management with a psychiatrist or psychologist is crucial in such situations. ■■

## References

1. Armfield JM, Spencer AJ, Stewart JF. Dental fear in Australia: who’s afraid of the dentist? *Aust Dent J* 2006;51:78–85.
2. Enkling N, Marwinski G, Jöhren P. Dental anxiety in a representative sample of residents of a large German city. *Clin Oral Investig* 2006; 10:84–91.
3. Klingberg G, Broberg AG. Dental fear/anxiety and dental behaviour management problems in children and adolescents: a review of prevalence and concomitant psychological factors. *Int J Paediatr Dent* 2007;17:391–406.
4. Jaakkola S, Rautava P, Saarinen M. Dental fear: one single clinical question for measurement. *Open Dent J* 2009;3:161–166.
5. Hofer D, Thoma MV, Schmidlin PR, Attin T, Ehlert U, Nater UM. Pre-treatment anxiety in a dental hygiene recall population: a cross-sectional pilot study. *BMC Oral Health* 2016;16:43.
6. White AM, Giblin L, Boyd LD. The prevalence of dental anxiety in dental practice settings. *J Dent Hyg* 2017;91:30–34.
7. Glick M, Williams DM, Kleinman DV, et al. A new definition for oral health developed by the FDI World Dental Federation opens the door to a universal definition of oral health. *J Public Health Dent* 2017;77:3–5.
8. Kruger E, Thomson WM, Poulton R, et al. Dental caries and changes in dental anxiety in late adolescence. *Community Dent Oral Epidemiol* 1998;26:355–359.
9. Eitner S, Wichmann M, Paulsen A, et al. Dental anxiety – an epidemiological study on its clinical correlation and effects on oral health. *J Oral Rehabil* 2006;33:588–593.
10. 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.
11. DeDonno MA. Dental anxiety, dental visits and oral hygiene practices. *Oral Health Prev Dent* 2012;10:129–133.
12. Kent G. Cognitive processes in dental anxiety. *Br J Clin Psychol* 1985;24:259–264.
13. Bregstein SJ. Psychology in dentistry. *Dent Digest* 1923;29:387–389.
14. Neramo H, Willumsen T, Johnsen JK. Prevalence of dental anxiety and associations with oral health, psychological distress, avoidance and anticipated pain in adolescence: a cross-sectional study based on the Tromsø study, Fit Futures. *Acta Odontol Scand* 2019;77:126–134.
15. Locker D, Liddell A, Dempster L, et al. Age of onset of dental anxiety. *J Dent Res* 1999;78:790–796.
16. Berggren U, Meynert G. Dental fear and avoidance: causes, symptoms, and consequences. *J Am Dent Assoc* 1984;109:247–251.
17. Carter AE, Carter G, Boschen M, Al Shwaimi E, George R. Pathways of fear and anxiety in dentistry: a review. *World J Clin Cases* 2014;2:642–653.
18. Moore R, Brødsgaard I. Dentists’ perceived stress and its relation to perceptions about anxious patients. *Community Dent Oral Epidemiol* 2001;29:73–80.
19. Brahm CO, Lundgren J, Carlsson SG, Nilsson P, Corbeil J, Hägglin C. Dentists’ views on fearful patients. Problems and promises. *Swed Dent J* 2012;36:79–89.
20. Wang TF, Wu YT, Tseng CF, Chou C. Associations between dental anxiety and postoperative pain following extraction of horizontally impacted wisdom teeth: a prospective observational study. *Medicine (Baltimore)* 2017;96:e8665.
21. Lang PJ. Fear reduction and fear behaviour. Problems in treating a construct. Research in psychotherapy. Washington, DC: American Psychological Association, 1968.
22. Ingersoll B. Psychologische Aspekte in der Zahnheilkunde. Berlin: Quintessence Publishing, 1987.





- 23.** Appukuttan DP. Strategies to manage patients with dental anxiety and dental phobia: literature review. *Clin Cosmet Investig Dent* 2016;8:35–50.
- 24.** Locker D, Poulton R, Thomson WM. Psychological disorders and dental anxiety in a young adult population. *Community Dent Oral Epidemiol* 2001;29:456–463.
- 25.** Lenk M, Berth H, Joraschky P, Petrowski K, Weidner K, Hannig C. Fear of dental treatment: an underrecognized symptom in people with impaired mental health. *Dtsch Arztebl Int* 2013;110:517–522.
- 26.** Sartory G, Heinen R, Wannemüller A, Lohrmann T, Jöhren P. Die modulierte Schreckreaktion bei Zahnbehandlungsphobie. *Zeitschr klin Psychol Psychiat* 2009;38:213–222.
- 27.** World Health Organization. The ICD-10 classification of mental and behavioural disorders: Clinical descriptions and diagnostic guidelines. Geneva: World Health Organization, 2013.
- 28.** American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, 5th edition. Washington, DC: American Psychiatric Association, 2013.
- 29.** Graham FK, Clifton RK. Heart rate change as a component of the orienting response. *Psychol Bull* 1966;65:305–320.
- 30.** Graham FK, Putnam LE, Leavitt LA. Lead-stimulation effects of human cardiac orienting and blink reflexes. *J Exp Psychol Hum Percept Perform* 1975;104:175–182.
- 31.** De Jongh A, Bongaarts G, Vermeule I, Visser K, De Vos P, Makkes P. Blood-injury-injection phobia and dental phobia. *Behav Res Ther* 1998;36:971–982.
- 32.** van Houtem CM, Aartman IH, Boomsma DI, Ligthart L, Visscher CM, de Jongh A. Is dental phobia a blood-injection-injury phobia? *Depress Anxiety* 2014;31:1026–1034.
- 33.** Poulton R, Thomson WM, Brown RH, Silva PA. Dental fear with and without blood-injection fear: implications for dental health and clinical practice. *Behav Res Ther* 1998;36:591–597.
- 34.** Öst LG, Sterner U, Lindahl IL. Psychological responses to blood phobics. *Behav Res Ther* 1984;22:109–117.
- 35.** Marks I. Blood-injury phobia: a review. *Am J Psychiatry* 1988;145:1207–1213.
- 36.** Wannemueller A, Adolph D, Joehren HP, Blackwell SE, Margraf J. Psychophysiological reactivity of currently dental phobic-, remitted dental phobic- and never-dental phobic individuals during exposure to dental-related and other affect-inducing materials. *Behav Res Ther* 2017;90:76–86.
- 37.** Corah NL. Development of a dental anxiety scale. *J Dent Res* 1969;48:596–602.
- 38.** Humphries GM, Clarke HM, Freeman R. Does completing a dental anxiety questionnaire increase anxiety? A randomised controlled trial with adults in general dental practice. *Br Dent J* 2006;201:33–35.
- 39.** S3-Leitlinie (Langversion) Zahnbehandlungsangst beim Erwachsenen, AWMF-Registernummer: 083-020. Available at: [https://www.awmf.org/uploads/tx\\_szleitlinien/083-020I\\_S3\\_Zahnbehandlungsangst-beim-Erwachsenen\\_2019-11.pdf](https://www.awmf.org/uploads/tx_szleitlinien/083-020I_S3_Zahnbehandlungsangst-beim-Erwachsenen_2019-11.pdf). Accessed 1 April 2020.
- 40.** Spielberger CD. Anxiety: current trends in theory and research. Vol I. New York: Academic Press, 1972.
- 41.** Appukuttan D, Vinayagavel M, Tadepalli A. Utility and validity of a single-item visual analog scale for measuring dental anxiety in clinical practice. *J Oral Sci* 2014;56:151–156.
- 42.** Bandelow B, Zohar J, Hollander E, Kasper S, Möller HJ. WFSBP Task Force on Treatment Guidelines for Anxiety, Obsessive-Compulsive and Post-Traumatic Stress Disorders. *World J Biol Psychiatry* 2008;9:248–312.
- 43.** Höglund M, Bågesund M, Shahnava S, Wårdh I. Evaluation of the ability of dental clinicians to rate dental anxiety. *Eur J Oral Sci* 2019;127:455–461.
- 44.** Wannemüller A, Jöhren HP, Borhstädt A, et al. Large group exposure: a feasibility study of exposure combined with diaphragmatic breathing in highly fearful individuals. *Front Psychol* 2017;7:2007.
- 45.** Naumova EA, Faber S, Lindner P, et al. Parallel study about the effects of psychotherapy on patients with dental phobia determined by anxiety scores and saliva secretion and composition. *BMC Oral Health* 2016;17:32.
- 46.** Talo Yildirim T, Dundar S, Bozoglan A, et al. Is there a relation between dental anxiety, fear and general psychological status? *Peer J* 2017;5: e2978.
- 47.** Almoznino G, Zini A, Sharav Y, Yanko R, Lvovsky A, Aframian DJ. Overlap between dental anxiety, gagging and blood-injection-injury related fears: A spectrum of one multidimensional phenomenon. *Physiol Behav* 2016;165: 231–238.
- 48.** Locker D, Liddell A. Stability of Dental Anxiety Scale scores: a longitudinal study of older adults. *Community Dent Oral Epidemiol* 1995;23:259–261.
- 49.** Moore R, Brødsgaard I, Birn H. Manifestations, acquisition and diagnostic categories of dental fear in a self-referred population. *Behav Res Ther* 1991;29:51–60.
- 50.** Johansson P, Berggren U. Assessment of dental fear – a comparison of 2 psychometric instruments. *Acta Odontol Scand* 1992;50:43–49.
- 51.** Tönnies S, Mehrstedt M, Eisentraut I. Die Dental Anxiety Scale (DAS) und das Dental Fear Survey (DFS)- zwei Messinstrumente zur Erfassung der Zahnbehandlungsängsten. *Zeitschr Med Psychol* 2002;11:63–72.
- 52.** Humphris GM, Morrison T, Lindsay SJ. The Modified Dental Anxiety Scale: validation and United Kingdom norms. *Community Dent Health* 1995;12:143–150.
- 53.** 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;19:347–351.
- 54.** De Jongh A, Muris P, Schoenmakers N, Terhorst G. Negative cognitions of dental phobics: Reliability and validity of the dental cognitions questionnaire. *Behav Res Ther* 1995;33:507–515.
- 55.** Sartory G, Heinen R, Pundt I, Jöhren P. Predictors of behavioural avoidance in dental phobia: the role of gender, dysfunctional cognitions and the need for control. *Anx Stress Coping* 2006;19:279–291.
- 56.** Neverlien PO. Assessment of a single-item dental anxiety question. *Acta Odontol Scand* 1990;48:365–369.
- 57.** Luyk NH, Beck FM, Weaver JM. A visual analogue scale in the assessment of dental anxiety. *Anesth Prog* 1988;35:121–123.
- 58.** Schuurs AH, Duivenvoorden HJ, Thoden van Velzen SK, Verhage F, Makkes PC, Eijman MA. Dimensionality of dental anxiety measurements. *Community Dent Oral Epidemiol* 1985;13:152–155.
- 59.** Humphris GM, Freeman R, Campbell J, Tutti H, D’Souza V. Further evidence for the reliability and validity of the modified dental anxiety scale. *Int Dent J* 2000;50:367–370.
- 60.** Humphris GM, Hull P. Do dental anxiety questionnaires raise anxiety in dentally anxious adult patients? A two-wave panel study. *Prim Dent Care* 2007;14:7–11.
- 61.** Pekkan G, Kilicoglu A, Hatipoglu H. Relationship between dental anxiety, general anxiety level and depression in patients attending a university hospital dental clinic in Turkey. *Community Dent Health* 2011;28:149–153.
- 62.** Viinikangas A, Lahti S, Yuan S, Pietilä I, Freeman R, Humphris G. Evaluating a single dental anxiety question in Finnish adults. *Acta Odontol Scand* 2007;65:236–240.
- 63.** Milgrom P, Weinstein P, Kleinknecht R, Getz T. Treating fearful dental patients: a clinical handbook. Reston: Reston Publishing, 1985.
- 64.** Kanegane K, Penha SS, Munhoz CD, Rocha RG. Dental anxiety and salivary cortisol levels before urgent dental care. *J Oral Sci* 2009;51:515–520.
- 65.** Armfield JM, Mohan H, Luzzi L, Chrisopoulos S. Dental anxiety screening practices and self-reported training needs among Australian dentists. *Aust Dent J* 2014;59:464–472.
- 66.** Wardle J. Fear of dentistry. *Br J Med Psychol* 1982;55:119–126.
- 67.** Kleinknecht RA, Klepac RK, Alexander DA. Origins and characteristics of fear of dentistry. *J Am Dent Assoc* 1973;86:842–848.
- 68.** Berggren U, Carlsson SG, Hägglin C, Hakeberg M, Samsonowitz V. Assessment of patients with direct conditioned and indirect cognitive reported origin of dental fear. *Eur J Oral Sci* 1997;105:213–220.
- 69.** Abrahamsson KH, Berggren U, Hakeberg M, Carlsson SG. The importance of dental beliefs for the outcome of dental-fear treatment. *Eur J Oral Sci* 2003;111:99–105.
- 70.** Abrahamsson KH, Öhrn K, Hakeberg M. Dental beliefs: factor structure of the revised dental beliefs survey in a group of regular dental patients. *Eur J Oral Sci* 2009;117:720–727.

71. Stouthard ME, Mellenbergh GJ, Hoogstraten J. Assessment of dental anxiety: a facet approach. *Anx Stress Coping* 1993;6:89–105.
72. Stouthard ME, Hoogstraten J, Mellenbergh GJ. A study on the convergent and discriminant validity of the Dental Anxiety Inventory. *Behav Res Ther* 1995;33:589–595.
73. Aartman IHA. Reliability and validity of the short version of the Dental Anxiety Inventory. *Community Dent Oral Epidemiol* 1998; 26:350–354.
74. Jöhren P. Validierung eines Fragebogens zur Erkennung von Zahnbehandlungsangst. *ZWR – Dt Zahnärztebl* 1999;108:104–114.
75. Jöhren P, Enkling N, Heinen R, Sartory G. Klinischer Erfolg einer Verhaltenstherapeutischen Kurzintervention zur Behandlung von Zahnbehandlungsphobie. *Dtsch Zahnärztl Zeitschr* 2009;64:377–382.
76. Jöhren P, Sartory G. Zahnbehandlungsangst und Zahnbehandlungsphobie, Hannover: Schlütersche, 2002.
77. Barthelmes M. Die visuelle Analogskala als Screening Instrument zur initialen Diagnostik der Zahnbehandlungsangst: eine Validierungsstudie [Thesos]. Bern: Universität Bern, 2008.
78. Armfield JM. Development and psychometric evaluation of the Index of Dental Anxiety and Fear (IDAF-4C). *Psychol Assess* 2010; 22:279–287.
79. Tönnes S, Mehrstedt M, Fritzsche A. Psychometric assessment of the German version of the Index of Dental Anxiety and Fear (IDAF-4C+) - a new instrument for measuring dental anxiety. *Psychother Psychosom Med Psychol* 2014;64:141–149.
80. Facco E, Zanette G, Favero L, et al. Toward the validation of visual analogue scale for anxiety. *Anesth Prog* 2011;58:8–13.
81. Newton JT, Buck DJ. Anxiety and pain measures in dentistry: a guide to their quality and application. *J Am Dent Assoc* 2000;131:1449–1457.
82. Laux L, Hock M, Bergner-Köther R, Hodapp V, Renner KH. *State-Trait-Angst-Depressions-Inventar (STADI)*. Göttingen: Hogrefe, 2013.
83. Gale EH. Fears of the dental situation. *J Dent Res* 1972;51:964–966.
84. Heaton LJ, Carlson CR, Smith TA, Baer RA, De Leeuw R. Predicting anxiety during dental treatment using patients' self-reports: Less is more. *J Am Dent Assoc* 2007;138:188–195.
85. Caprara HJ, Eleazer PD, Barfield RD, Chavers S. Objective measurement of patient's dental anxiety by galvanic skin reaction. *J Endod* 2003;29:493–496.
86. Benjamins C, Schuurs AH, Hoogstraten J. Skin conductance, Marlowe-Crowne defensiveness, and dental anxiety. *Percept Mot Skills* 1994;79:611–622.
87. Dailey YM, Humphris GM, Lennon MA. The use of dental anxiety questionnaires: a survey of a group of UK dental practitioners. *Br Dent J* 2001;190:450–453.
88. Höfert, HW, Jöhren HP. Zahnbehandlungsangst erkennen und behandeln. Diagnostik, Therapie, Praxismanagement. Balingen: Spitta, 2010.
89. Ingersoll BD. *Psychologische Aspekte der Zahnheilkunde*. Berlin: Quintessenz, 1987.
90. Margraf-Stiksrud J. Der ängstliche Patient. In: *Zahnmedizin Update*. Stuttgart: Thieme, 2013.
91. Aitken RC. Measurement of feelings using visual analogue scales. *Proc R Soc Med* 1969;62:989–993.
92. McCormack HM, Horne DJ, Sheather S. Clinical applications of visual analogue scales: a critical review. *Psychol Med* 1988;18:1007–1019.
93. Svensson E. Construction of a single global scale for multi-item assessments of the same variable. *Stat Med* 2001;20:3831–3846.
94. Hasson D, Arnetz BB. Validation and findings comparing VAS vs. likert scales for psychosocial measurements. *Int Electron J Health Educ* 2005;8:178–192.
95. Schuurs AHB, Hoogstraten J. Appraisal of dental anxiety and fear questionnaires: a review. *Community Dent Oral Epidemiol* 1993;21:329–339.
96. Slovin, M. Managing the anxious and phobic dental Patient. *NY State Dent J* 1997;63: 36–40.
97. Elfstrom ML, Lundgren J, Berggren U. Methodological assessment of behavioural problem dimensions in adults with dental fear. *Community Dent Oral Epidemiol* 2007;35:186–194.
98. Franklin JC, Moretti NA, Blumenthal TD. Impact to stimulus signal-to noise ratio on pre-pulse inhibition. *Psychophysiology* 2007;44: 339–342.
99. Wannemüller A, Sartory G, Elsesser K, Lohrmann T, Jöhren HP. Modality of fear cues affects acoustic startle potentiation but not heart-rate response in patients with dental phobia. *Front Psychol* 2015;6:170.
100. Ost LG, Sterner U, Fellenius J. Applied tension, applied relaxation, and the combination in the treatment of blood phobia. *Behav Res Ther* 1989;27:109–121.



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