

Anxiety Related to Nonsurgical Root Canal Treatment: A Systematic Review



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Abstract

Introduction: Anxiety is an emotion characterized by feelings of tension, worried thoughts, and physical changes. Dental anxiety has been associated with pain, fear, care avoidance, and more invasive treatments including nonsurgical root canal treatment (NSRCT). The very words *root canal* are deeply embedded in societal consciousness. Better understanding of dental anxiety may prevent treatment avoidance. The purpose of this study was to conduct a systematic review of NSRCT-associated anxiety. **Methods:** Inclusion/exclusion criteria defined MEDLINE, Cochrane Library, psychINFO, manual, and citation searches. Title lists and abstracts were read to determine utility; data were extracted, summarized, and compiled into an evidence table, and meta-analyses were performed. **Results:** Defined searching produced 835 titles; 36 articles were included, mostly representing modern populations from countries with very high human development indices. Major sources of heterogeneity included differing study aims, outcome measures, clinical settings, locations, operators, sample selection, and sample size. Meta-analysis of 18 articles including 1989 subjects gave a pretreatment anxiety rating of 39 (standard deviation, 9) on a normalized 100-point scale. Meta-analysis of 4 articles including 232 subjects gave a post-treatment anxiety rating of 27 (standard deviation, 5) on a normalized 100-point scale, representing a 30% reduction. A L'Abbe plot of 5 studies also showed that anxiety decreased after NSRCT. Limited data indicated that gender, age, and prior NSRCT experience influenced NSRCT-associated anxiety. NSRCT-associated anxiety was ranked high among dental treatments, often close to oral surgery. **Conclusions:** NSRCT-associated anxiety was generally moderate. Anxiety decreased after NSRCT. Limited evidence suggested that anxiety is influenced by patient and treatment factors. (*J Endod* 2016;42:1726–1736)

Key Words

Anxiety, dental fear, dental phobia, meta-analysis, review, root canal therapy, systematic

Anxiety is an emotion characterized by feelings of tension, worried thoughts, and physical changes such as increased blood pressure (1). Anxiety is a normal reaction to stress and can be beneficial (2, 3). It has been defined as “The apprehensive anticipation of future danger or misfortune accompanied by a feeling of worry, distress, and/or somatic symptoms of tension” (4). Anxiety can help us to prepare and pay attention or alert us to danger. Anxiety differs from fear in that it refers to anticipation of a future concern, whereas fear occurs in response to a specific immediate threat. However, dental anxiety and dental fear are highly correlated (5, 6).

Anxiety is multifactorial and is influenced by a patient's life experiences; information acquired directly or indirectly, true or false; their intrinsic vulnerability; and by their dentist (7–14). Anxiety pathways include the cognitive, parental, informative, verbal, and vicarious (15). External factors and contextual experiences over many years can contribute to anxiety (8, 9, 12, 16, 17). In addition, the entire lived environment, including social interactions, and media can influence feelings of anxiety (14). For example, anxiety can be learned from parents, peers, colleagues, and friends. Negative or unpleasant experiences can increase anxiety (16). The most common pathways associated with endodontic anxiety are cognitive conditioning and parental, but different pathways appear to be adopted by different ethnic groups (15, 18).

Anxiety can lead to recurring intrusive thoughts and concerns or cause avoidance of certain situations out of worry. This can lead to impacts on job performance, school-work, personal relationships, and health behaviors. Anxiety affects many dental patients (19). Dental anxiety has long been recognized, studied, and measured (20, 21). It has been correlated with increased probability of dental treatment avoidance (22, 23). It also makes the treatment process more difficult, disrupts scheduling, and causes discomfort to caregivers (24). Dental experience can decrease anxiety. Conversely, continued avoidance can increase anxiety, creating a vicious cycle (25–27). Dental anxiety may have pervasive consequences; individuals manifesting severe dental anxiety may be more vulnerable to some psychological disorders (8, 28, 29).

Significance

The importance of patient-based, psychosocial, and psychological factors is growing rapidly in various healthcare arenas. Better understanding of dental anxiety may prevent avoidance of root canal treatment, suffering, and morbidity and will assist dentists in managing anxious patients.

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Alternatively, a highly anxious person may simply manifest more dental anxiety (11). In any case, a reduction in dental anxiety can improve both oral health and quality of life (23, 30, 31).

Dental anxiety has been associated with pain and is more common with intrusive treatments such as extractions, fillings, and nonsurgical root canal treatment (NSRCT) (32–36). In addition, a higher level of anxiety may increase pain intensity; the context of the treatment is very important (37).

The very words *root canal* appear to be deeply embedded in societal consciousness; they are a commonly used and most unfortunate idiom for something menacing or to be dreaded. Terms such as *root canal economics* and *root canal politics* have entered popular usage in ways that demonstrate the negative connotations associated with NSRCT. A recent State of the Union address equated the Great Recession with root canal treatment as something to be disliked. Scientific articles have reported patients as saying “I would rather have a baby than a root canal” (38, 39). Anticipation of a negative experience can increase anxiety (3). Improved understanding of NSRCT-associated anxiety could improve patient management, decrease anxiety, increase treatment acceptance, decrease treatment avoidance, and increase treatment completion.

Anxiety is associated with dental treatment, specifically with NSRCT; this has profound implications for patients and dentists. Hence, the purpose of this study was to conduct a systematic review of NSRCT-associated anxiety.

Materials and Methods

A systematic review was developed following established procedures including PRISMA guidelines (40). Methodology included formulating review questions, constructing a search strategy, defining inclusion and exclusion criteria, locating studies, selecting studies, assessing study quality, extracting data, and interpretation.

During the design phase after pilot search strategies were being developed and tested by using sentinel articles, an iterative process was used to identify the following review questions:

1. What is the pretreatment anxiety level for patients who are due to receive NSRCT?
2. Does level of NSRCT-associated anxiety change after treatment?
3. Is NSRCT-associated anxiety influenced by patient and treatment factors?

Search Methodology

Electronic searches were performed in MEDLINE, Cochrane Library, and psychINFO databases. The search strategies are described in Figure 1A and B. A separate search of psychINFO was included because it has only a moderate overlap with MEDLINE, and it uses a different thesaurus for indexing (Fig. 1B). The results from the designed search strategies were supplemented by manual searches and citation mining. Two investigators screened the titles and abstracts of all articles

A	<pre>(("Root Canal Therapy/psychology"[MeSH] OR "Manifest Anxiety Scale"[Mesh] OR "anxiety scale"[text word] OR "DAS"[text word] OR CDAS[text word] OR "Anxiety"[Mesh] OR "Fear"[Mesh] OR anxiet*[text word] OR fear*[text word])) AND (("Root Canal Therapy"[Mesh] OR "Root Canal Preparation"[Mesh] OR "Endodontics"[Mesh] OR "Dental Pulp Diseases"[Mesh] OR "Periapical Diseases"[Mesh] OR "root canal*" [text word] OR endodont*[text word] OR "dental pulp"[text word] OR "pulp stone*" [text word] OR "pulpal dysplasia"[text word] OR "coronal dentin"[text word] OR "pulp necrosis"[text word] OR "pulp necroses"[text word] OR "pulp gangrene*" [text word] OR "pulp mummification*" [text word] OR "pulp autolyses"[text word] OR "pulp autolysis"[text word] OR "secondary dentin*" [text word] OR "periapical disease*" [text word] OR "periapical periodontitides"[text word] OR "periapical periodontitis"[text word] OR "Dentoalveolar Abscess*" [text word] OR "Alveolar Abscess"[text word] OR "periapical abscess*" [text word] OR "dental granuloma*" [text word] OR "periapical granuloma*" [text word] OR "radicular cyst*" [text word] OR "periapical cyst"[text word] OR "Dental Pulp Disease*" [text word] OR "pulp calcification"[text word] OR "denticle*" [text word] OR "pulp exposure*" [text word] OR "pulpitis"[text word] OR "pulpless tooth"[text word] OR "pulpless teeth"[text word])) AND English[lang]</pre>
B	<pre>((("root canal*" OR endodontic* OR "dental pulp" OR "pulp stone*" OR "pulpal dysplasia" OR "coronal dentin" OR "pulp necrosis" OR "pulp necroses" OR "pulp gangrene*" OR "pulp mummification*" OR "pulp autolyses" OR "pulp autolysis" OR "secondary dentin*" OR "periapical disease*" OR "periapical periodontitides" OR "periapical periodontitis" OR "Dentoalveolar Abscess*" OR "Alveolar Abscess" OR "periapical abscess*" OR "dental granuloma*" OR "periapical granuloma*" OR "radicular cyst*" OR "periapical cyst" OR "Dental Pulp Disease*" OR "pulp calcification" OR "denticle*" OR "pulp exposure*" OR "pulpitis" OR "pulpless tooth" OR "pulpless teeth") OR (SU.EXACT("Dental Surgery") OR SU.EXACT("Dental Treatment"))) AND ((SU.EXACT("Taylor Manifest Anxiety Scale") OR SU.EXACT.EXPLODE("Anxiety") OR SU.EXACT.EXPLODE("Fear")) OR "anxiety scale" OR DAS OR CDAS OR anxiet* OR fear*)</pre>

Figure 1. Search strategies for root canal treatment–associated anxiety. Box I lists the PubMed search strategy; this was replicated in the Cochrane Library. Box II lists the PsycINFO search strategy; the limiting term was “English.”

TABLE 1. Summary of Data on Anxiety Associated with NSRCT

Author	Year	Field of study	Study design	No. of patients/ country	Description	Measurement methods	Relevant findings
Morse et al (42)	1981	Stress, relaxation, and saliva in NSRCT	Observational	34/USA	NSRCT in specialty private practice	Anxiety scale, salivary analyses	Anxiety decreased post-treatment. Salivary metrics improved post-treatment. Hypnosis and meditation appeared to reduce anxiety.
Morse et al (43)	1981	Stress and anxiety associated with NSRCT	Follow-up, prospective,	29/USA	NSRCT in dental school	Anxiety scale, salivary analyses	Anxiety decreased post-treatment. Salivary metrics improved post-treatment. Hypnosis and nitrous oxide-oxygen were more effective than local anesthesia alone.
Dworkin et al (44)	1983	Nitrous oxide analgesia with pulpal electrical stimuli	Observational	28/USA	Young female patients	AST, PTh, PTo, SI, SA, STA	Nitrous oxide decreased levels of absolute sensation, pain threshold, and anxiety, and it increased pain tolerance
Morse et al (45)	1983	Stress, meditation, and saliva in NSRCT	Observational, survey	10/USA	NSRCT in dental school	Questionnaire, saliva	Anxiety decreased from pretreatment to-post treatment
LeClaire et al (39)	1988	NSRCT fear	Survey	82/USA	NSRCT in dental school specialty clinic	Questionnaire	Patients disliked, from most: injection, files, percussion, x-ray, rubber dam. Anxious patients were more affected by hearsay, felt more pain, had more emergencies, and missed appointments. 96% would choose NSRCT again; 4% were unsure.
Wong et al (46)	1991	NSRCT and oral surgery anxiety	Retrospective, survey	213/USA	American patients military clinics	Questionnaire	Hearsay ranked extraction and NSRCT equally; however, actual experience ranked extraction $\times 3$ worse than NSRCT. Anxiety scores did not differ among extraction

Morse (47)	1993	Brain wave synchronizer and NSRCT anxiety	Observational, controlled	30/USA	NSRCT in specialty private practice	Questionnaire, skin resistance, pulse, patient movement	and NSRCT, gender, or age. Negative hearsay increased anxiety for NSRCT, but prior bad experience did not. Anxiety decreased post-treatment. Brain wave synchronizer, verbal calming, and music decreased anxiety. Anxiety, from most: injection, rubber dam, drilling, x-ray, finish, instrumentation, obturation.
Morse (48)	1994	Brain wave synchronizer and NSRCT	Observational, controlled	30/USA	NSRCT in specialty private practice	Questionnaire, skin resistance, pulse	Anxiety, from most: injection, drilling. Music and brain wave synchronizer reduced anxiety
Morse (49)	1994	Brain wave synchronizer and NSRCT	Observational, controlled	36/USA	NSRCT in specialty private practice	Subjective responses, patient movement, saliva	Music and brain wave synchronizer reduced anxiety
Miller et al (50)	1995	Physiological stress of dental procedures	Prospective	50/USA	Dental school	Salivary cortisol assay	Cortisol levels decreased through NSRCT, the lowest ranked of 4 treatments including extraction.
Eli et al (51)	1997	Fear and anxiety associated with type of dental treatment	Prospective comparative	92/Israel	Public dental clinic	STAI, DAS, VAS, AVAS, STh, PTh, Pen	Extraction followed by NSRCT produced the most anxiety. Anxiety correlated with expected pain but not with experienced pain.
Ehrich et al (52)	1997	Benzodiazepines and anxious patients	Randomized, double-blind, controlled	79/USA	NSRCT in Navy clinic high anxiety patients	VAS, DSST	Patient anxiety decreased steadily from pretreatment to intraoperative. More anxiety in female and less educated patients; prior NSRCT experience and preoperative pain did not influence anxiety.
Peretz et al (53)	1998	Dental anxiety patients undergoing NSRCT	Retrospective	98/Israel	NSRCT in specialty practice	DAS	Gender, age, and treatment type influenced anxiety. NSRCT did not
Stabholz et al (54)	1999	Dental anxiety before dental treatments	Questionnaire	30/Israel	NSRCT in dental school	DAS	

(continued)

TABLE 1. (continued)

Author	Year	Field of study	Study design	No. of patients/ country	Description	Measurement methods	Relevant findings
Watkins et al (55)	2002	Anticipated and experienced pain and NSRCT	Questionnaire	333/USA	NSRCT in dental school	STAI, VAS	increase the odds of high anxiety, unlike extraction and scaling. Patients anticipated more unpleasantness than they experienced; unpleasantness related to gender, anticipated and experienced pain, and decreased with age.
Gedney et al (33)	2003	Memory of pain	Prospective, longitudinal	167/USA	NSRCT in dental school	STAI, VAS, phone interview	Pre-existing affective state contributed to the sensory and affective dimensions of pain recollection.
Klages et al (56)	2004	Anxiety and pain sensitivity and expected and experienced pain	Observational	97/Germany	NSRCT or extraction in clinics	DAS, PSI, PES, questionnaire	Patients expected more pain than they experienced; anxiety increased expected and experienced pain. Female patients were more anxious. Pain and distress did not differ between NSRCT and extraction.
Udoye et al (57)	2005	Pretreatment anxiety	Clinical study	40/Nigeria	Dental school	DAS	Pretreatment NSRCT anxiety was higher than for extraction and all other treatments. Anxiety was influenced by age and gender.
Frisk and Hakeberg (58)	2006	Socioeconomics and apical disease	Cross-sectional	844/Sweden	Random population sample	Questionnaire, x-rays, DAS	Anxiety and socioeconomics did not influence periapical health, unlike the presence of caries or NSRCT.
Johnson et al (59)	2006	NSRCT shared decision-making	Randomized, controlled	32/USA	NSRCT in dental school	Questionnaire, Likert scale	Routine informed consent did not differ from shared decision-making on pretreatment anxiety.

Van Wijk and Hoogstraten (6)	2006	Fear of NSRCT pain	Questionnaire	437/Netherlands	Psychology students	FDP, S-DAI	Anxiety strongly correlated with fear; information decreased fear; fear increased interest in sedation; female patients had more fear and anxiety.
Akhavan et al (60)	2007	Anxiety in endodontic patients	Cross-sectional	150/Iran	NSRCT in dental school	DBS, DFS	Younger, female, and less educated patients were more anxious. Anxiety was unaffected by age at first dental encounter, complaint, number of encounters, or unfavorable experiences.
Ridell et al (61)	2007	NSRCT associated factors	Retrospective cohort	105/Sweden	NSRCT in 10- to 19-year-olds	Chart review	Risk factors for NSRCT included DMFT, missed appointments, and dental anxiety
Agdal et al (62)	2008	Oral health and treatment need	Observational, follow-up	40/Norway	DSM-IV dental phobics in dental school	DAS, DFS, BAT	Patients with more NSRCT need had lesser decreases in anxiety and in negative thoughts after cognitive behavioral therapy.
Collado et al (63)	2008	Dental anxiety and patients' expected difficulty	Observational	116/France	Newcomers to dental school	DAS, DPD-VAS	Anxiety correlated with patient-expected difficulty. NSRCT ranked moderately among all treatments. Female patients were more anxious; age had no effect.
Lai et al (64)	2008	Music and anxiety	Randomized, controlled	44/Taiwan	NSRCT in dental school	STAI, physiological measures	Music reduced anxiety; anxiety decreased post-treatment.
Lindemann et al (65)	2008	Benzodiazepine and pain	Observational, controlled	58/USA	Emergency NSRCT in dental school	DAS and VAS for pain	Pretreatment anxiety was moderate.
Georgelin-Grugel et al (66)	2009	NSRCT vs SRCT induced stress	Observational	60/France	NSRCT or SRCT in dental school	BP, HR, VAS	Experienced stress depended on anticipated anxiety, but not on treatment type, duration, age, or sex.
Singh et al (67)	2012	NSRCT and perceived control	Observational, controlled	60/India	NSRCT in anxious dental school patients	MDAS	Anxiety was decreased by a perceived control communication

(continued)

TABLE 1. (continued)

Author	Year	Field of study	Study design	No. of patients/ country	Description	Measurement methods	Relevant findings
Carter et al (15)	2014	Pathways of fear and anxiety in NSRCT	Survey, observational	594/Australia	NSRCT in dental school	Questionnaire	system; anxiety decreased post-treatment. Cognitive conditioning and parental pathways were primary causes of fear and anxiety. Female patients were more influenced by indirect conditioning.
Prathima et al (35)	2014	Anxiety with different treatments	Cross-sectional	225/India	NSRCT and other treatment	MDAS	Anxiety associated with extraction, NSRCT, and gum surgery did not differ.
Huh et al (10)	2015	Patient demand for sedation	Observational	100/USA	NSRCT consult in dental school	Questionnaire	NSRCT patients were concerned about anxiety itself, but less than about pain or injection. Younger patients were more anxious. Prior NSRCT reduced anxiety. Anxiety and cost influenced demand for sedation.
Ali et al (68)	2015	Dental anxiety before treatment	Cross-sectional	101/Pakistan	NSRCT in dental students	DAS	Injection/needle, followed by NSRCT and extraction produced the most anxiety. Female patients were more anxious.
Santana et al (69)	2015	Heart rate and NSRCT	Cross-sectional	50/Brazil	NSRCT of necrotic molars	HR	HR variability was decreased during NSRCT. The parasympathetic component of cardiac modulation was increased at injection.
Wali et al (70)	2016	Anxiety before and after NSRCT	Cross-sectional	200/Pakistan	NSRCT in dental school	DAS, questionnaire	Female patients had more anxiety before and after NSRCT. Half the patients reported fear and

Di Nasso et al (71)	2016	Influence of music on NSRCT anxiety	Randomized, controlled	100/Italy	NSRCT	DAS, SBP, DBP, HR	Music administered to subjects significantly decreased SBP, DBP, and HR during NSRCT.	pain with NSRCT. Percussion and radiography were disliked.
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AST, absolute sensation threshold; BAT, behavioral avoidance test; BP, blood pressure; DAS, dental anxiety scale; DBS, Dental Beliefs Survey; DBP, diastolic blood pressure; DFMT, decayed filled missed teeth; DES, Dental Fear Survey; DPD-VAS, Dental Procedure Difficulty Visual Analogue Scale; DSM-IV, Diagnostic and Statistical Manual [of Mental Disorders], Fourth Edition; DSST, digital symbol substitution test; FDP, fear of dental pain; HR, heart rate; MDAS, Modified Dental Anxiety Scale; PEn, pain endurance; PES, Pain Experience Scale; PSI, Pain Sensitivity Index; PTh, pain threshold; PTo, pain tolerance; SA, stimulus aversiveness; SBP, systolic blood pressure; SI, stimulus intensity; S-DM, Short version of the Dental Anxiety Inventory; SRCT, surgical root canal therapy; STA, Spielberger State Anxiety; STAI, State-Trait Anxiety Inventory Scale; STh, sensation threshold; VAS, Visual Analogue Scale.

identified in the electronic and manual searches. Articles that did not meet the inclusion criteria were excluded. All remaining articles were full-text reviewed in the second stage of the process.

Inclusion and Exclusion Criteria

Inclusion criteria required quantitative or qualitative data on anxiety associated with NSRCT in adults. Inclusion criteria for article review were articles published in English from January 1960 through July 2016. Literature that failed to meet the inclusion criteria or that had an inadequate quality rating was excluded.

Study Quality

Study quality, methodology, design, and data analysis were assessed by using the Wong Scale–Revised (41). Studies were assessed by reviewer's responses to 9 questions; a score of 1 (inappropriate), 2 (mediocre), or 3 (appropriate) was assigned to each question. The “What,” “Who,” and “How” of each study received 3 questions apiece. Bias was principally addressed by the “How” questions. Out of a comprehensive total score of 9–27, a score under 18 indicated that the methodology, design, and analysis of the study failed to support the reliability of the authors' conclusions, necessitating exclusion.

Data Collection and Analysis

An iterative process was used to determine what data could be extracted. For each included article, data were extracted independently by 2 investigators, and any discrepancies were adjudicated by a third investigator, summarized, and compiled into a table of evidence. Quantitative and qualitative data variables are listed in Table 1.

Where possible, pretreatment and post-treatment anxiety data from like studies were analyzed by meta-analysis. Data generated from different anxiety measurement methods, including 3-, 5-, 7-, 10-, and 80-point scales and 100-point visual analogue scales, were normalized or converted by multipliers to 100-point scales, eg, data from a 3-point scale (0, 1, 2) were multiplied by 50, data from a 4-point scale (0, 1, 2, 3) by 33.3, etc. Summary measures, descriptive statistics, weighted means, and standard deviations (SDs) were calculated. This approach was taken because most anxiety measures are considered to be internally consistent, reliable, and valid; agreement and correlation among different scales have been reported; and self-reported measures are considered to be accurate (34, 72).

A L'Abbe plot was used to depict the effect of NSRCT on anxiety from studies that reported both pretreatment and post-treatment anxiety. L'Abbe plots are very useful in assessing changes that are due to treatment, especially among heterogeneous studies when pretreatment values may vary widely. Pretreatment data serve as a baseline measure to which analogous post-treatment data can be validly compared. Points plotted to the upper left of the diagonal plot line denote an increase in anxiety after treatment, whereas points plotted to the lower right of the diagonal line denote a decrease in anxiety after treatment.

Results

Description of the Existing Literature

Initial electronic, manual, and citation searches identified 788, 30, and 17 titles, respectively, giving a total of 835 titles. Of the 788 titles identified electronically, 231 were identified in MEDLINE, 53 titles were identified in the Cochrane Library, and 504 additional titles were identified in the separate PsychINFO search (Fig. 1). After title screening, 571 abstracts were reviewed, and full texts for 130 articles were obtained. After full-text review and citation mining, 36 articles containing data on anxiety associated with NSRCT were identified (Table 1).

Of the 36 included articles, 27 were initially identified by electronic search, 8 by manual search, and 1 by citation mining. Systematic review yielded a return rate of 3.4% for the titles initially identified by defined electronic searching.

Major sources of heterogeneity included differing study aims, outcome measures, differences in clinical setting, study geographic location, differences in operator type, and variations in patient selection or sample size (Table 1).

The included studies were all published after 1980. The mean and median years of publication were 2002 and 2006, respectively.

The overall mean study quality rating of the 36 included studies was 21 (SD, 2) on the 27-point Wong Scale–Revised (41). Because all studies had quality ratings of 18 or above, none were excluded for reasons of quality.

The Human Development Index (HDI) is a composite statistic of life expectancy, education, and income per capita indicators, published by the United Nations, that ranks countries into 4 tiers of human development, ranging from low to very high. Almost all studies described in this article, 29 of 36, were performed in countries with very high HDIs, 2, 2, and 3, respectively, in countries with high, medium, and low HDIs.

Meta-analyses

Meta-analyzable data on pretreatment anxiety were identified in 18 articles. Meta-analysis of these 18 articles including 1989 subjects gave a pretreatment anxiety rating of 39 (SD, 9) on a normalized 100-point scale.

Meta-analyzable data on post-treatment anxiety were identified in 4 articles. Meta-analysis of these 4 articles including 232 subjects gave a post-treatment anxiety rating of 27 (SD, 5) on a normalized 100-point scale, representing a 30% reduction.

The L’Abbe plot showed that anxiety decreased after NSRCT in each of the 5 included studies (Fig. 2). One article with both pretreatment and post-treatment anxiety data was not included in the preceding meta-analyses because it only included anxious patients, a biased sample; however, it could be included in the L’Abbe plot, which indicates change independently of absolute values.

In addition, 10 articles that used self-reported or physiological measures of anxiety indicated that anxiety decreased after treatment (Table 1) (42, 43, 45, 47, 50, 52, 64, 67, 69, 71).

Patient and Treatment Factors

The hypothesis that anxiety is influenced by patient and treatment factors was supported by limited evidence (Table 1). Three studies reported injection as being the most anxiety-producing element of NSRCT (39, 47, 48). Female gender was associated with increased anxiety in 11 studies (6, 15, 53–57, 60, 63, 68, 70) but not in 3 others (10, 46, 66). Seven studies related increased age to decreased anxiety (18, 35, 53–55, 57, 60), but 5 found no age influence (10, 46, 56, 63, 66). Two studies related lower educational level to increased anxiety (53, 60). NSRCT was variably ranked as producing more, equal, and less anxiety than extraction (35, 50, 51, 54, 56, 57, 63). Various treatment interventions were reported to reduce anxiety; these included hypnosis, meditation, nitrous oxide, brain wave synchronizer, verbal calming, music, cognitive behavioral therapy, and a perceived control communication system (15, 42–44, 47–49, 62, 64, 67, 71).

Discussion

NSRCT-associated anxiety level was moderate before treatment and was diminished after treatment (Fig. 2). Although NSRCT-associated anxiety was moderate, it appeared to be roughly equivalent to that associated with tooth extraction, a much more physically invasive

procedure (Table 1), a result in confluence with the concept that anxiety is more an emotional than a reasoned response. Prior known context may be more important than perception of the experienced event (37).

People may project or generalize their unpleasant situation to everything surrounding that particular situation, for example, associating pain of pulpal origin with the treatment that actually relieved that pain. Again, the context may be more important than the actual event (37).

Trait anxiety is characteristic of an individual, a constituent personality attribute, a general baseline of their stress, nervousness, related to their personality and genetics (1). Trait anxiety may include general nonspecific worry about future events. Hence, trait anxiety necessitates a broad general approach, for example, using medication or psychological treatments. People with higher levels of trait anxiety may be more easily stressed and respond more strongly than others to state anxiety situations such as NSRCT (11).

State anxiety is a temporary heightened emotion in response to a particular situation (2). Hence, state anxiety can be managed by using techniques such as hypnosis, meditation, nitrous oxide, verbal calming, cognitive behavioral therapy, or focusing reason on the particular causal situation. Thus, state anxiety may be simply decreased by treatment completion, even without learning. More frequent dental visits may lessen anxiety because the experience becomes more familiar and more comfortable to the patient (7). It is important that dentists and all health care professionals present NSRCT in a positive non-threatening manner so that state anxiety can be minimized. This action goes beyond anxiety itself because increased anxiety is associated with increased pain (13, 33, 39, 51, 56).

As for all systematic reviews, this study was constrained by the extant literature. A wide variety of outcome variables were used (Table 1); sample sizes were often small. Self-reported data were common, but this is routine practice for the study of anxiety. Overall study

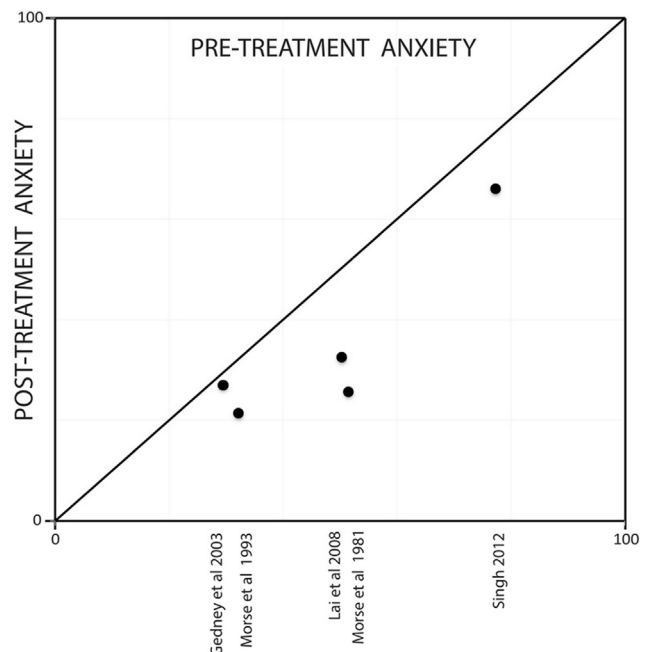


Figure 2. L’Abbe plot of effect of NSRCT on anxiety. All 5 included studies fell to lower right of the diagonal line, indicating that anxiety decreased after treatment.

quality was only moderate, and levels of evidence were generally low. In this current study, the meta-analysis of pretreatment anxiety included 18 studies; 15 of these studies included data on state anxiety exclusively, 1 mostly contained state anxiety, and 2 contained both state and trait data. Corah's Dental Anxiety Scale, focusing on state anxiety, was the most prevalent instrument; it was used in 6 studies. Valid comparisons could be made between pretreatment and post-treatment anxiety levels because the same measures were used within these 4 studies, as described within the L'Abbe plot. Several articles that could not be subjected to meta-analysis used physiological measures as surrogates for anxiety such as galvanic skin resistance, pulse, blood pressure, saliva consistency, cortisol levels, and patient movement (42, 43, 45, 47–50, 69, 71). Because of the nature and limitations of the extant data, further analyses are inappropriate and lack utility.

The consequences of undue NSRCT anxiety can be devastating. Anxiety is known to be associated with general dental treatment avoidance, often creating a self-perpetuating vicious cycle (22, 23, 25, 27). A history of previously missed dental appointments is associated with increased need for future NSRCT (61). However, other factors such as cost may also play a large role in treatment avoidance (57). Negative experiences may be over-reported, but pleasant and positive experiences may be under-reported. This may create bias about unexperienced situations. However, familiarity or experience with NSRCT tends to decrease the anxiety.

With respect to anxiety, provision of dental pretreatment information tends to benefit internally oriented personalities, those with an internal locus of control, who may be more active in attempting to manipulate their environment; consultation may help these patients (17). Externally oriented personalities, those who perceive their reinforcement as being determined by factors outside of their personal control, may not benefit from information; a sense that the doctor is in charge may help these patients cope with anxiety (17).

Uncertainty decreases our ability to prepare for the future, thus contributing to the anxiety (3). Reducing uncertainty through providing accurate and predictive information may reduce anxiety (3). Alternatively, patients can be encouraged to be more tolerant of uncertainty and to focus on the present and not on what might come (3). This strategy incorporates the concept of mindfulness into cognitive behavioral therapy, which helps those suffering from anxiety to understand that uncertainty about the future does not need to rule their lives (3). Experience of NSRCT likely decreases anxiety by informing the patient through experience and decreasing feelings of uncertainty.

NSRCT is not the only dental procedure to enter common verbiage as a metaphor for something to be disliked or difficult; the phrase *like pulling teeth* is very widely used and long predates the introduction of NSRCT. Future efforts must be made to educate the public on the conduct of NSRCT and dental care in general, as well as on its value in decreasing pain and in saving teeth. Dentists and caregivers must be trained in recognizing and addressing anxiety. Patients may manifest anxiety in different ways: verbally, crying, hyperventilating, fainting, clenching their fists, silence, or loquaciousness (39). Patient attitudes to their dentists are extremely important (7, 13).

Through compassion, effective pain management, provision of information, and coping skills the clinician may negate the effects of hearsay, prevent unpleasant experiences, and reduce anxiety (46).

Conclusion

This systematic review revealed that anxiety associated with NSRCT was generally moderate; anxiety decreased after NSRCT. Limited evidence suggested that anxiety is influenced by patient and treatment factors.

Acknowledgments

The authors deny any conflicts of interest related to this study.

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